Installation Manual

basic field practices for installation of elevators and escalators . . .

NATIONAL ELEVATOR MANUFACTURING INDUSTRY, INC.

(INCORPORATED UNDER THE LAWS OF THE STATE OF NEW YORK)

INSTALLATION MANUAL

Basic Field Practices

FOR INSTALLATION OF ELEVATOR AND ESCALATOR EQUIPMENT

NATIONAL ELEVATOR MANUFACTURING INDUSTRY, INC.

KERMIT KRAUS, Author
Freeport, New York

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PREFACE

Some 16 years have elapsed since the original N.E.M.I. Erection Manual was published. General acceptance of the original book was good and through the cooperation of the International Union of Elevator Constructors and the National Elevator Manufacturing Industry, the manual was used as a reference book text for the elevator constructors mechanics' rating examinations.

When printed copies of the book were no longer available in mid 1960, the N.E.M.I. Board of Directors decided to review the book and bring it up to date to include information of new materials, and methods. These changes have been quite considerable in number and reflect the general technical advances achieved by the building trades as well as specific changes in the elevator industry.

A committee was formed to engage a technical writer and to supervise the work of producing the new edition. This committee held its first meeting in New York in late January, 1961, and arranged for the author of the original book to immediately begin work on the new edition.

The original book was designed to assist in overcoming a shortage of trained elevator mechanics that existed at the end of World War II. This need for men was recognized by both the Union and Management which cooperated very closely during a period of several years in establishing training classes and providing the N.E.M.I. Manual on Electricity, the N.E.M.I. Manual on Drafting and the N.E.M.I. Erection Manual, as well as visual aids and supplementary material and literature, such as the "Pilot Course" which ran in a number of issues of "The Elevator Constructor" during 1946 and 1947.

The situation today is one in which the industry faces a continuing expansion, but in addition has requirement for men with high technical ability due to the increasing complexity of elevator control and scheduling devices, as well as the introduction of the new materials and methods referred to in our opening comments.

The second edition of the manual has been somewhat changed in form from the original. Four new chapters have been added in order to cover safety procedures more effectively and to outline information on escalators, plunger elevators and the general structure of the elevator industry. In addition to this all of the remaining original chapters have been edited and in general expanded. Despite this, the original intent of the manual, which was to provide an introductory text for new and inexperienced men, still remains as the prime reason for the existence of this book.

The N.E.M.I. Board of Directors wishes to express its thanks and appreciation to those who have participated in the preparation of the second edition of this field manual, and to the International Union of Elevator Constructors for their backing and support in this undertaking.

In particular, we wish to thank Mr. K. Kraus the author and the "Re-Write Committee." This latter group served on a voluntary basis and devoted a considerable amount of time in reviewing and analyzing the text drafts and the book format. It included Messrs. N. Dick — Montgomery Elevator Company; A. L. Lockwood and G. E. Yeakley — Westinghouse Electric Corporation, Elevator Division; W. H. Miller — Haughton Elevator Company; W. O. Nance — Dover Corporation, Elevator Division; M. Wesley — Seaberg Elevator Company and F. W. Kraus of the Otis Elevator Company, who served as chairman and general coordinating editor. Mr. W. I. Wells acted as ex-officio member representing the N.E.M.I. Board of Directors. The N.E.M.I. Labor Committee under Mr. D. D. Tofanelli, exercised general control of the work.

We believe that the author and the committee have turned out a creditable book and deserve the thanks of Union and Management.

The member companies of the National Elevator Manufacturing Industry, Inc., and its Board of Directors hope that the field men will find this book as acceptable and useful as the original appears to have been.

C. A. Schmidt

Clarence A. Schmidt
Chairman of the Board of N.E.M.I.
1 January 1962

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FOREWORD

The writing of the original N.E.M.I. Erection Manual was in the nature of a "crash" program.

The book was written in 1946 in conjunction with the author's work in expanding the N.E.M.I. field education group activities throughout the country, development of visual aids, writing the "Pilot Course" and introducing it in The Elevator Constructor magazine, guiding the authors of the manuals on Electricity and on Drafting, as well as some lecturing and field contact work on the education program itself.

Writing was begun in February 1946, and completed in June. The book was in the hands of N.E.M.I. and Union members in September of the same year.

Accomplishment of this was due in large part to the cooperation of an excellent technical publication staff. This group under the direction of Mr. F. A. Kuehl, who was Chairman of the N.E.M.I. Labor Committee, worked long hours to prepare text and art work for publication. As the deadline approached, extra help was employed and mass editing, proofreading and layouts were resorted to in order to get the book "on the road."

Quite naturally, we later found some errors in text, arrangement, photo and sketch references as a result of the pressure of work and inexperience of some of the personnel. However, the field need for information was real and the errors generally could be reconciled, therefore, the book was released.

The continuing demand for the manual some sixteen years after the first printing, appears to justify the early release of the book. However, for all these years the author and Mr. H. E. Browne, the original editor, have been bemoaning the fact that the more obvious errors and omissions could not be corrected.

The N.E.M.I. Manual Re-write Committee removed further cause for recrimination when they arranged for the author to undertake the work of bringing the book up to date for a second edition. The resulting volume, now named the N.E.M.I. Installation Manual, follows herewith. Although it is channeled in the same pattern of "Basic Practices" of elevator installation that was established for the N.E.M.I. Erection Manual, we have added four chapters. In addition, the scope of information was widened to provide background data on the subject matter of each chapter. Articles relating to hydraulic elevators and escalators have been included in the four new chapters. Every effort has been made to retain the elementary approach to our work that was found acceptable in the earlier book.

During the re-writing of this manual, Mr. D. D. Tofanelli, present Chairman of the N.E.M.I. National Labor Committee, arranged for the same technical staff to again perform in their usual commendable manner, the job of preparing the text for

publication. Mr. H. E. Browne has once more labored many hours as editor, art consultant and photographer. Messrs. M. R. Davis and A. J. Demny did the art and drafting layouts and details. Mrs. M. A. Molloy typed and retyped from the writer's indecipherable script and equally poor typing.

Grateful acknowledgement is made to the many other persons and organizations whose cooperation has provided suggestions that influenced this text. In particular, the N.E.M.I. Installation Manual Re-write Committee (named by Chairman of the Board of Directors, Mr. Clarence A. Schmidt, in the "Preface") did a most helpful job of reviewing all drafts and offering suggestions for revision. However, special thanks is due to the Committee Chairman, Mr. F. W. Kraus, who devoted much personal time to analyzing and coordination. Mr. C. R. Thompson of the Dover Corporation made some excellent suggestions on the draft of chapter 14. Members of the General Construction Manager's Staff of the Otis Elevator Company also provided numerous recommendations such as those included in Mr. L. C. Claypool's review of the chapter on escalators.

Our sincere thanks are given to the American Society of Mechanical Engineers and the National Fire Protection Association for permission to refer to and quote from their authoritative books, the "American Standard Safety Code for Elevators, Escalators and Dumbwaiters" (A17 1-1960) and the "National Electric Code" (1959 ED).

We also appreciate the cooperation and suggestions of the N.E.M.I. Commissioner, Mr. W. I. Wells and his staff.

It is hoped that the new format will be as acceptable to the men of the I.U.E.C. and the N.E.M.I. members as was the first manual and, also, that the book will be of material assistance to constructors.

By: Kermit Kraus

Kermit Kraus (Author)
Freeport, New York
1 January 1962

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NEMI INSTALLATION MANUAL

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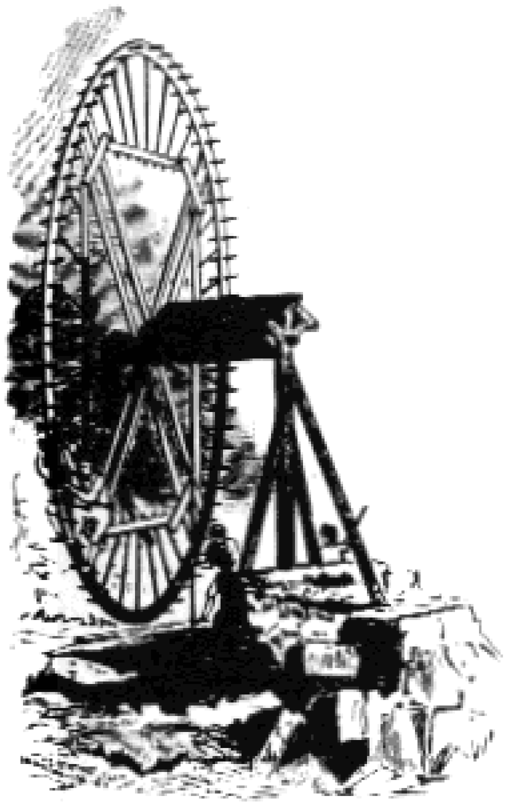
CHAPTER 1

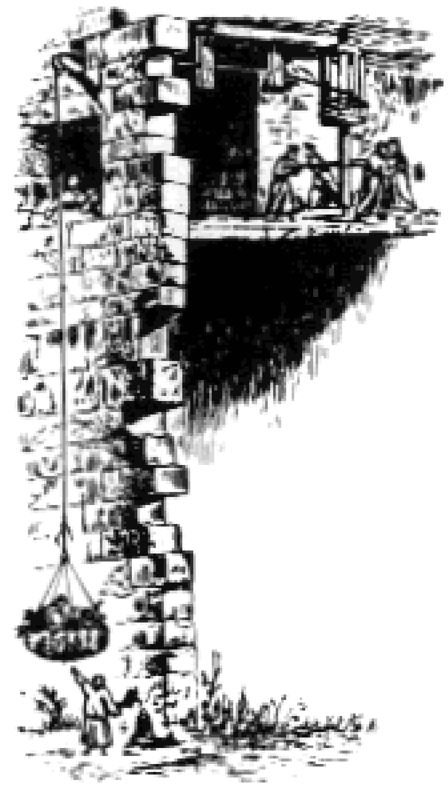
CHAPTER I
Section -a1



INTRODUCTION

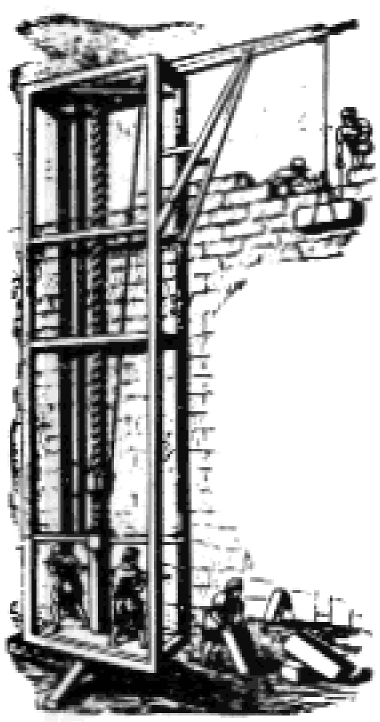
History of Vertical Transportation

1. The Encyclopedia Britannica notes that an elevator or lift is a hoisting and lowering mechanism equipped with a car or platform which moves in guides in a substantially vertical direction. The article continues with several pages of interesting background information, beginning with comments on elevators used in the palaces of the Roman emperors.



2. During a recent visit to Rome the author spent some time viewing the jumbled ruins of the Coliseum arena and the palace of the ancient emperors of the Roman Empire. There is little easily seen evidence of the counterweighted, hand powered elevators that reputedly lifted the famed animals to the arena level. Neither were the twelve hoistways of the elevators of the Caesor's palace visible. However, records indicate that such elevators did in fact exist.

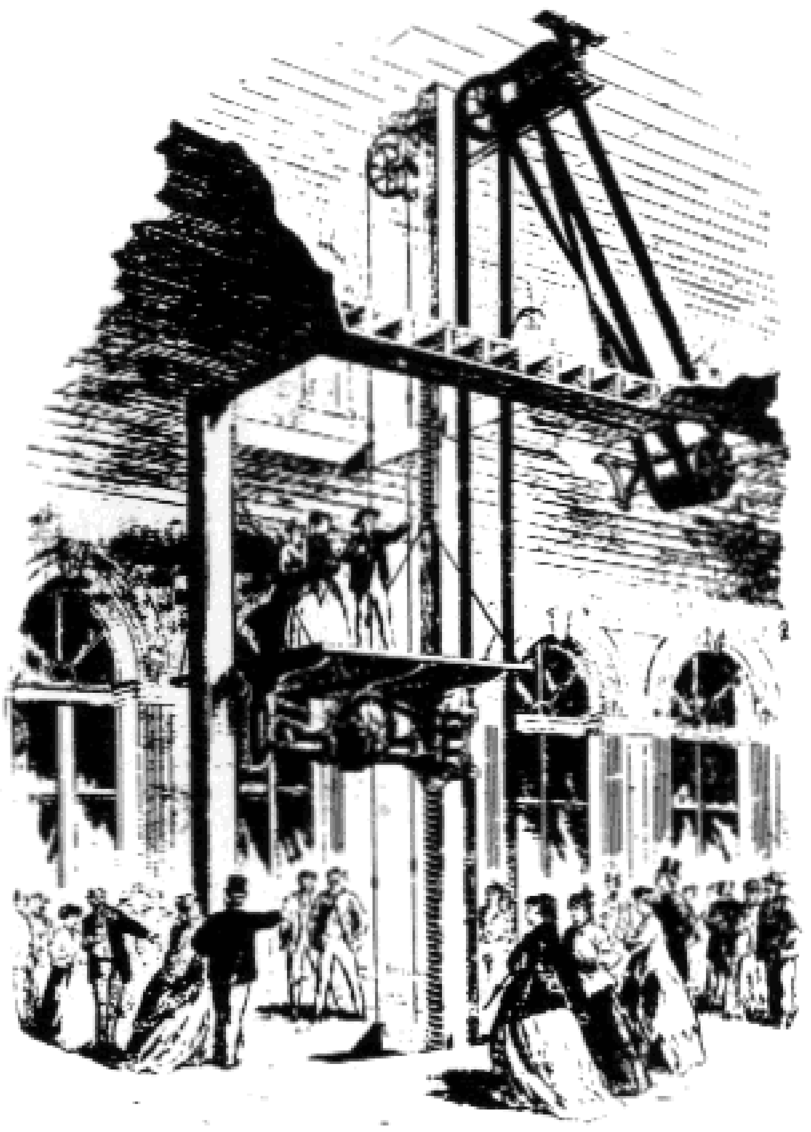
3. The Britannica also notes that Vitruvius, a Roman architect, wrote in 26 B.C. about several devices used for raising weights as early as 236 B.C. We believe that historically, definite types of lifting equipment have been traced to the year 336 B.C., when Archimedes was said to have invented an elevator for hoisting materials. It is logical to assume that if we trace time further, we might observe primitive man making use of hoists and pulleys as indicated by old prints. Construction on the Pyramids, the Great Wall of China, the Parthenon; and other great ancient structures included practices that were further examples of man's application of hoisting methods.



4. Woodcuts indicate that early elevators were driven by harnessed animal power and by wheels on which men provided the force, similar to the way squirrels operate squirrel cages.

5. The history of Vertical Transportation parallels the new development of civilization. As nations grow economically, materially, and intellectually, there is a closely allied growth in the field of vertical transportation and the design and construction of monumental types of structures. It will be seen throughout history that the most powerful nations

have made the most progressive steps in the development of building design, construction and of lifting equipment. We read that Louis XIV and Napoleon I were familiar with Velayer's "flying chair," an elevator composed of a chair that employed the use of a counterweight; that Maria Theresa of Austria employed the use of an elevator to visit the grave of her husband. Use of steam power was first made practical in the British Isles. There is evidence that this new form of driving power was soon applied to crude forms of freight elevators in England. However, these "lifts" were not safe in general so regular use of elevators for passenger service was not inaugurated until 1852 when the elevator safety device was made practical in the United States. This development was dramatized in the Crystal Palace exhibition, where top-hatted E. G. Otis, the inventor, repeatedly rode a safety equipped platform to a free-fall safety operation. This demonstration was made in 1853. In effect, this event dates the modern elevator industry as being almost one hundred and ten years of age. There have been many major improvements and refinements made to elevators in the ensuing years.



Early Belt Driven Elevator

6. Development of a practical wire rope by John Roebling had a strong effect on the progress of elevator design and operation. The continuing improvement in wire rope design and construction offers further opportunity for machine and sheave redesign to this day. In similar ways the greater knowledge of drawing copper, handling it in factory and field, insulating it with better grades of natural rubber, synthetic rubber and thermoplastics permit elevator design engineers to expand their ideas to adapt new electrical materials and techniques to our field or work.

7. In its beginning the elevator industry was one where a few individuals set up workshops to fabricate elevators piecemeal. Today there are hundreds of highly organized elevator companies in all parts of the world. Europe, South Africa, Latin America, Australia, New Zealand and Japan all manufacture modern elevator equipment. Many of their firms are aggressively engaged in a battle for export markets in competition with the numerous companies in the United States and Canada.

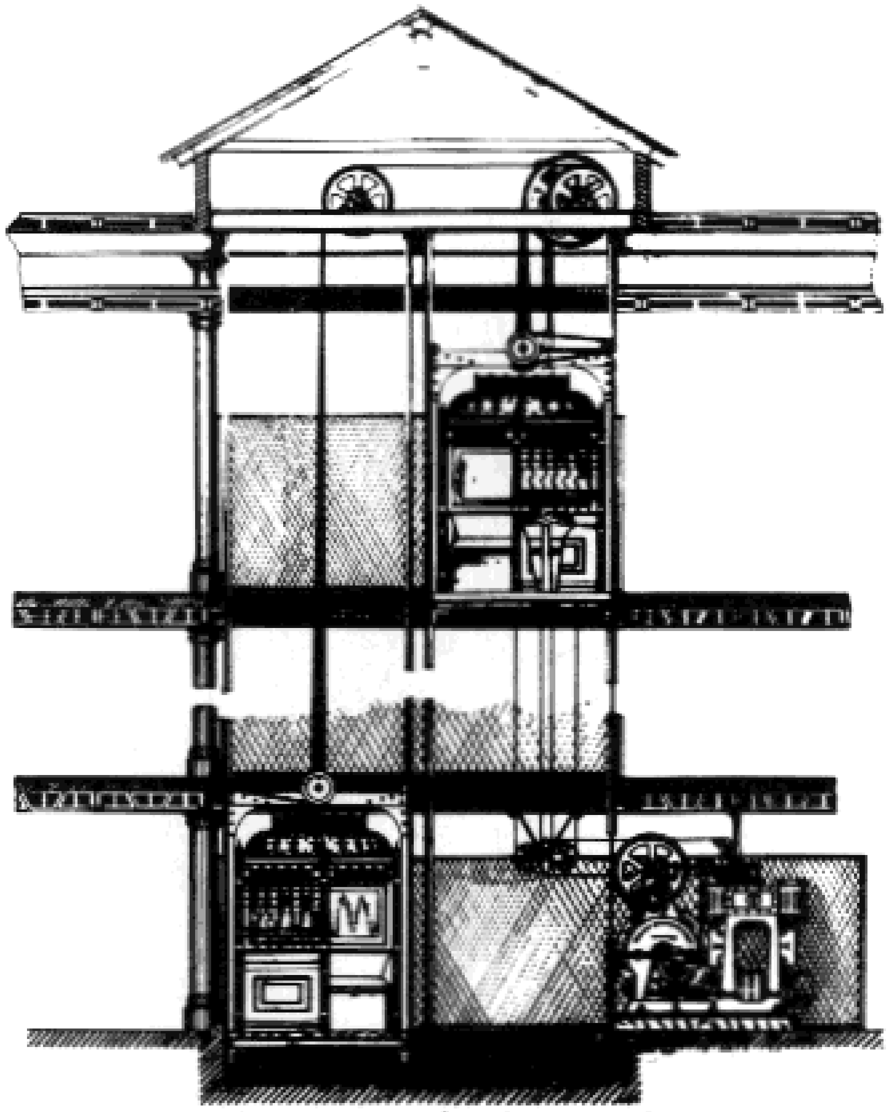
8. At present, elevator engineering is a highly specialized industry combining applications of newest developments in the electrical, chemical and mechanical fields. A look at the skyline of any large city will easily show the absolute dependence placed on vertical transportation by the public. With availability of better elevators, man has built outstanding examples of architectural beauty; structures that otherwise would remain at their 1850 heights. What the rate growth and the culmination of design of vertical transportation will be, is unknown. History has shown us that the progress of skyscraper design and functional construction is largely dependent on the developments and refinements to machines and control devices in the elevator industry. An interesting side light is that the world famous St. Peters in Rome is at present installing new elevators to serve its observation roof.

9. The first modern developments in elevatoring were made primarily during the 1850's, although history does record a "lift" or hoist built in England by Frost and Strutt in 1853. This elevator, known as the "Teagle," was provided with two hoist ropes extending from the car around a hoisting sheave and thence to two counterweights, one for each rope.

10. In view of later developments, the main feature of the "Teagle" was that movement was transmitted to the car by traction between the hoist ropes and sheaves instead of direct pull by a drum. About 1850 the application of steam as a prime mover was introduced in the United States by Mr. Otis Tufts, a Bostonian. Commercial elevators were first introduced about 1850, when Henry Waterman of New York and George H. Fox and Company of Boston developed a two floor steam elevator. The forerunner of modern elevator practice, however, was the introduction of the steam driven elevator with a safety to prevent the car from falling in case the hoist rope parted.

11. An early commercial passenger elevator installation employing cars equipped with the safety previously described, was made by Elisha G. Otis in 1857 in the New York store of Haughwout and Company.

12. An interesting elevator of this period was the "Vertical Screw Railway." Although this type of machine was actually developed about 1850, it was not installed in any prominent building until 1859. At this time, one was installed in the Fifth Avenue Hotel and another in the Continental Hotel, both in New York City. The high cost and other factors made this type impractical. From 1859 until about 1869, Mr. Tufts was engaged in the elevator business under the firm name of "Otis Tufts and Company." He developed a few inventions for elevators.

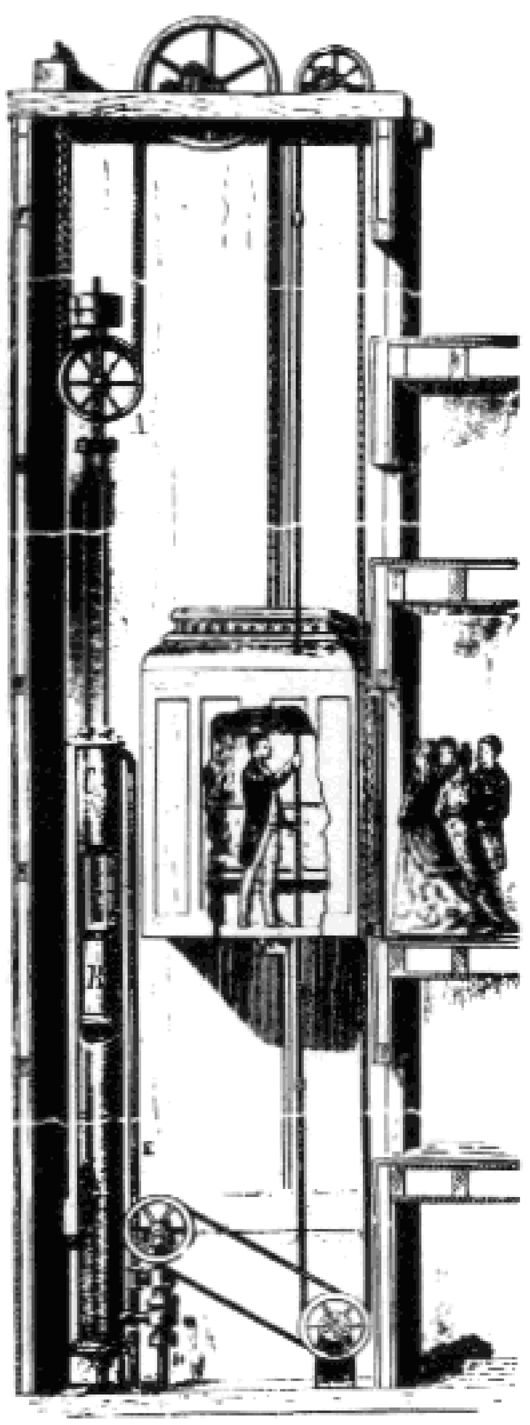


Two Cars Driven by One Machine

13. In 1859 Elisha Otis, who was not related to Otis Tufts, introduced an elevator having an independent, reversible steam engine connected to the winding drum by belt and gear, using chains to compensate for the unbalanced weight of the hoisting rope. The increased efficiency resulting from these improvements initiated the actual beginning of the commercial utilization of elevators.

14. Elisha Otis experimented with compensation because early usage of elevators demonstrated that, despite the use of counterweights, some other form of weight equalization was required. Loops of chains were suspended from the bottom of the car to the bottom of the counterweight. Among other devices used for counterbalancing the cars on early elevators was a counterweight rope drum mounted above the car rope drum. Thus, instead of having only one hoist drum a second one for the counterweight was mounted directly above that for the car, and was driven from the car hoist drum by spur gears which were ring gears on the drum ends. An example of this type of elevator machine was running in Cooper Union Institute, New York, until a few years ago.

15. The year 1861 saw an improvement in roped elevators, consisting of the use of multiple ropes rather than only one or two. Each rope was capable of sustaining the full weight of the car, or about 4,000 pounds, on the early installations. The use of multiple ropes was satisfactory and is still common practice.



Old Hand-Rope Controlled Plunger (Note Cylinder Located in Hoistway)

16. In France, Leon Edoux installed a hydraulic elevator, in the year 1867, at the Universal Exhibition in Paris. The Edoux elevator was practical for its day and maintained popularity in Europe up until late in the nineteenth century. Today most elevators in Europe, and in fact, around the world, are "traction" drive.

17. About 1870, hydraulic elevators became popular in this country as well. There were two general types of these machines. Names of these old types vary locally but they can be called the roped cylinder type and the plunger type. Many of each are still in use. The cylinder type consists of a large cylinder with a piston actuated by water pressure and connected to a rigging closely resembling a multiple rope fall. This fall actually lifts and lowers the car. The plunger type consists of a long cylinder sunk into the ground in which a plunger or hollow piston operates. This piston is connected to the bottom of the car. Ropes lead from the top of the car to the overhead sheaves and down to a counterweight. When water is forced into the cylinder, it raises the plunger and lifts the car.

18. It is interesting to note that the public soon got the notion that such cars were the safest, as they were supported on a rigid column. As a matter of fact, many hydraulic elevators with counterweights are no safer than any other. For example, if for any reason the plunger should become loose from the car, the counterweight could pull the car and a limited load at a tremendous speed in the up direction and the car could strike the top of the hoistway. Because of this possibility, the inside of the plunger was often equipped with a set of ropes, which connected the bottom of the car to the bottom of the plunger. In the event a plunger breaks loose from its platen (or connection plate) it would still be fastened to the car on this type of elevator. Such cars can operate at 600 and 700 feet per minute, but are very expensive. Elaborate pumping equipment is required with both types since pressures of 1,000 pounds per square inch and higher are necessary. Also, for the plunger type, a hole must be drilled below the pit floor as deep as the rise is high. Imagine the cost of sinking a hole 300 feet deep by 12 inches in diameter in New York City, where bed rock starts on the surface!

19. Aside from the high initial cost and excessive maintenance expenses, two other objectionable features of hydraulic elevators arise from the passenger's viewpoint. First, there is a considerable difference in up and down speeds, especially under the extremes of load conditions. Because of this the service rendered is the slowest when the loads are the heaviest. Second, such cars often give most unpleasant bouncing sensations on starting and stopping, if air pockets exist in the cylinder. These objectionable characteristics, plus the high installation and maintenance costs, led to research and thus to new developments in the elevator industry.

20. The development of the elevator in Europe during the latter half of the nineteenth century paralleled our own. Mr. F. Chanut, however, in his article published in the French magazine "Architecture" stated that the "price of water for power became prohibitive in Europe during this period, necessitating improvements on hydraulic elevators, and culminating in the original development of the electric elevator."

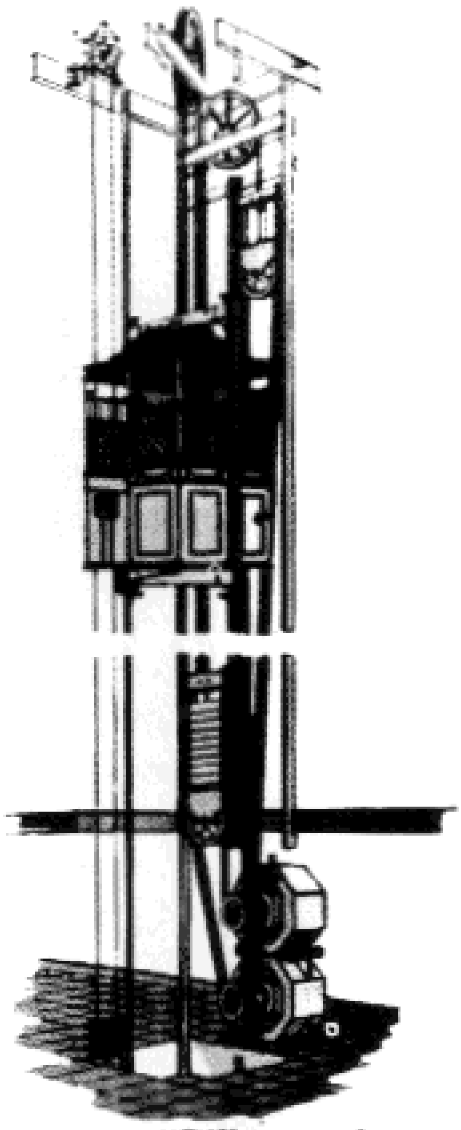
21. In 1867 the Crane Elevator Company, then the Northwestern Manufacturing Company, began building hoisting engines and passenger elevators. They, therefore, may be considered pioneers in the field. Their ten types of machines were the result of the inventions of their superintendent, Mr. Doolittle and their engineer, George H. Reynolds.

22. One of the most important developments of the 1870's was the introduction of the overspeed safety and governor in 1878 by Charles R. Otis. This safety device was designed to automatically cause the car safety to grip the wooden guides, if the elevator attained pre-determined speeds, thereby stopping and holding the car in case of overspeed due to any cause.

23. This contribution introduced the use of a safety that applied itself to the guide rails gradually instead of the almost instantaneous gripping of the broken-rope type. Present day safeties fall broadly into three general classifications. They are the broken-rope safety, the roll safety and the gradual safety. The first two are instantaneous types but different in concept, depending on rope breakage and overspeed respectively to set up the safety operation. Both are generally restricted to 125 feet per minute car speeds in the United States of America and Canada. Codes in other areas permit their use with higher car-speeds. The influence of development of reliable safeties on passenger psychology is easily appreciated.

24. As mentioned previously, electric elevators had their origin on the European continent. In 1880, Werner Siemens constructed an electric elevator in Germany that carried an electric motor and rotating pinions underneath the car platform. The pinions engaged with racks secured to the guide posts, causing the car to climb up and down the hoistway. The first electric elevator known to have been built in America was installed somewhat later (in 1887) by William Baxter Jr., in Baltimore.

25. In America, the commercial use of electric elevators began in 1899 with the installation of two electric elevators by Otis Brothers and Company, in the Demarest Building, New York. The machines were essentially the same as those of the steam operated type, the only difference being that the steam engine was replaced by a direct-current shunt motor. Several years elapsed before alternating-current motors were developed to the extent where they could be applied to elevator machines. Electric machines offered great possibilities, but the gear problem at that time would not permit car speeds much higher than 400 feet per minute. Worms with multiple threads (as many as seven) were used, but wear on gears increased very rapidly as the car speeds went up. A very disagreeable vibration was imparted to the car at fast speeds. For high rises, consequently, the hydraulic machines were preferable and maintained their superiority for some years. At least one prominent company, Haughton Elevator Company, has overcome this difficulty and has had geared elevators operating at 700 F.P.M. However, this duty is no longer being sold, but they do offer geared machines at 500 F.P.M. The Montgomery Elevator Company also has in the past installed 500 F.P.M. geared elevators in Moline, Illinois; Burlington, Iowa and other mid-west cities. Most companies limit geared machine speeds to 400 F.P.M. today.



Fraser "Differential" Drive Equipment

26. Early attempts were made, however, to improve the electric elevator for use in high buildings. The Sprague-Pratt screw elevator in 1894 used the multiplying sheaves and roping of the hydraulic elevator, but moved the cross-head by a screw driven with an electric motor. The Frazer Elevator, employing electric motors and a differential bottom rope drive, brought further improvement to the field.

27. A great change came about in 1903 when the "gearless traction" type of elevators with 2:1 and 1:1 roping were introduced. These gearless machines are used on high-speed elevators today and consist of very slow-speed, direct current, shunt or compound motors with driving sheaves mounted on the armature shafts. Instead of the ropes winding on a drum they travel over these sheaves and around secondary sheaves, each rope making a double wrap on the driver. For 1:1 roping, one end of each rope is fastened to the car and the other to the counterweight. On 2:1, the ropes pass over the sheaves on the car and the counterweight and are dead-ended on hitchplates usually set in the overhead work. The friction of the ropes on the driving sheave, called "traction," furnishes the driving force of the car; this is much the same as the traction between the rails and the wheels of a locomotive. Gearless traction elevators are now operating at speeds as high as 1600 F.P.M.

28. The Montgomery Elevator Company advises that their engineer, Mr. J. F. Green, developed the first electric geared traction elevator in their shop. They note that the first commercial installation was made in Des Moines, Iowa, in the face of much adverse sales criticism from competition. Otis Elevator Company records indicate that their first electric geared traction installation was made in the State and Denning Building, Chicago, Illinois, in the year of 1912.

29. The advantages of the traction machine can be listed as: (a) a given machine can be used for almost any rise, as compared with drums which must have capacity for enough rope to accommodate the rise; (b) when either the car or counterweight becomes landed, the ropes lose their traction, leaving the sheave to spin without moving the car. This constitutes an important safety feature. With the advent of the traction machine, therefore, the days of the hydraulic cars appeared to be numbered. In the past few years, however, the plunger electric elevators have again become quite popular for certain applications. Machines, controllers and especially pumps have improved to a point where their use has motivated installation of the plunger types where hoistway structures are not suitable for traction of drum elevators. Limited overhead conditions also have some influence on owner acceptance, though "self-supporting" underslung traction elevators tend to reduce the impact of this factor.

30. Most plunger electric units today are "closed circuit" installations, where the fluid passes from a storage tank to the piston or pistons and return. On the up direction a pump forces the fluid from the tank to the cylinder, lifting the car. To descend, a valve is electrically opened and the fluid is forced back into the storage tank by the weight of the elevator and load. Many units use oil rather than water as the actuating fluid.

31. Probably the greater number of plunger electric elevators installed today are for limited rise freight use but several companies have been quite successful in utilizing the type for specialized passenger service. All are direct plunger types.

32. Thus far we have reviewed generally the four motivating forces in elevator development; belt, steam, hydraulic and electric. With the exception of the small over-all percentage of modern plunger elevators, present day developments become the story of the refinement of electrical phases of vertical transportation. With this in mind, a short summary can be made of the development of motor control and methods of operation.

33. Electric motor control may be divided into two general overlapping periods: 1899-1922; 1922-present day. These dates, of course, are by no means definitive, but are merely presented as a guide to eras of development.

34. **1890-1922**. During this period, elevators were controlled primarily by "**resistance controls.**" At first the hoisting motor was supplied with power from a direct current source of supply. Rotation direction was regulated by switching the connections to the armature of the motor; acceleration and retardation were controlled by cutting out and reinserting resistance in steps in circuit with the armature. The motion or momentum was stopped by a brake. About 1900, with the introduction of A.C. motors, the field of this control was further widened. An additional method of control, the application of the Ward Leonard system, was introduced and installed in the nineties by Otis Elevator Company, but, since it was only used in a few buildings, it may be placed in the modern period.

35. Modern. A more intensive application of the Ward Leonard system to elevators known as **Unit Multi-Voltage or Variable Voltage Control**, was installed in the early twenties. The system is applicable to either A.C. or D.C. power supply as the elevator generator may be driven by either A.C. or D.C. motors fed from the power supply of the building. Westinghouse Electric Corporation, Elevator Division, and other companies have also made many advancements in this line.

36. Although the various methods of operation have been developed in progressive steps it is impossible to say that any one or two are used exclusively. Each contract, whether for freight or passenger use, requires certain features in its elevator service. Therefore, a particular method of operation, that is, one considered more advantageous to some need of the installation, might be used. The development of the various methods will be discussed in their approximate sequence or origin.

37. Hand-Rope Control. This system of control was used with early type machines and if used today it would probably be on freight elevators. The car is controlled in one of two ways; by a hand rope running through the car, or by a hand rope attached to a lever within the car. In either case the rope runs over sheaves in overhead and pit, then to a ''shipper'' wheel on the controller. This wheel revolves in the direction the hand rope is moved. It turns a shaft which opens and closes the direction switches by means of cams.

38. Car-Switch Control. Developed near the turn of the century, this control provides a more flexible operation of the elevator at the hands of the attendant by means of a self-centering, lever-operated switch. This switch energizes electromagnetic switches on the controller which supply power to the motor in the chosen direction. Connections between the car and machine room are made through flexible traveling conductor wires called ''traveling cables.'' This system is also becoming obsolete in Europe, U.S.A. and Canada. It is still popular to some extent in Asia and Latin America.

39. Single Automatic Push-Button Control. Control of the car is by the passenger rather than by an attendant. By means of a push button at any landing, the passenger calls the car to him. Having entered the car, he indicates the level desired by pressing a marked car button. Single, automatic push-button was brought into use about 1892. There are a number of variations of push-button control. Although its use in U.S.A. and Canada is pretty well restricted to low rise, non-intensive service installations, push-button units are very popular, even for office buildings and apartments of ten or more landings in price conscious sections of Europe and Asia. Japan, the Philippines and Hong Kong are exceptions since their office buildings often use the very highest quality of equipment.

40. Collective Control. This type of operation permits any number of landing buttons to register calls concurrently. This has a great advantage over single automatic push-button control, where only one passenger or group of passengers can be served at a time. A passenger entering the collective elevator at the 1st landing might register his stopping point as ''6.'' Other passengers might send or call the car by pushing their landing buttons in the car or in the halls. The elevator will automatically stop at these intermediate stations, answering in sequence all calls in one direction. It will, after its last call, answer all calls in the opposite direction.

41. The original installation of this model was made at St. Luke's Hospital, Chicago, Illinois in 1925. Variations of the system include ''down only collective'' and ''skip stop.'' Installations in low cost housing frequently use this latter system or combine it with push-button types of control.

42. Signal Control. This was developed in the early twenties and was first installed in the New York Standard Oil Building in 1924. Signal control systems were a very popular type of elevator control for 25 years. Thousands of units still operate on this control throughout the world. Stopping of cars is automatic. The passenger indicates by pressing a landing button his intention to travel in the up or down direction. The elevator automatically halts at his landing. He enters and tells the operator the stop he wishes to make. By means of push buttons within the car, the attendant registers this stop. After being started manually, the elevator will automatically slow down and level at the selected floor. After each stop, the operator closes the door and starts the car by a single movement of a starting handle, lever or button. When the car is again in motion, the starting handle is released and the car continues to the next landing indicated on the attendant's board or on the landing relay panel as demanded by waiting hall passengers. Having made all up calls, the car automatically reverses to the down direction, is started, and makes all the down stops called for by the car and landing push-buttons. A rather elaborate systems of signals is usually a part of such an installation, if more than three cars are in a bank.

43. Operatorless ''Electronic'' Types of Control. A standard dictionary describes the word ''electronics'' as, ''That branch of physics which treats of the emission, behavior and effects of electrons....'' Electrons, in turn, are, ''regarded as the ultimate particles from which all atoms are built up.'' (Quoted out'of context.) Broadly speaking, therefore, all modern elevators are ''electronically controlled.'' However, in the terminology of the elevator industry the term electronic is rather loosely used and applies to the increasing trend toward employment of electrolitic condensors, rectifiers, electronic tubes and even transistors as control mediums.

44. Refinement of the signal control systems as used by a number of companies has been one of the several reasons for the development of the so called ''operatorless'' elevators. Terminology and circuitry vary widely between companies but all systems tend toward scheduled automation of elevatoring to a degree that would not be possible with manual controls. The American Standard Safety Code defines this general class of operation as ''Group Automatic'' control. (This terminology appears in the 1960 edition of the Code.) Tube and condensor timing devices have aided in providing the degree of reliability necessary to permit operatorless elevators to run up to speeds of 1,600 feet per minute with safety in heavily populated, high-rise buildings. This reliability was not possible with old style mechanical dashpot timing. Intricate scheduling devices that are, in effect, electronic computers or ''brains'' make the new systems practical by dictating not only the time of dispatch, the starting and stopping of individual elevators, but also the sequence and even the frequency of the starts. Some even automatically pick out required scheduling programs varying from heavy traffic patterns with all units in use to ''holiday'' programs with only one car in service. Load weighing features assure that loaded cars will by-pass (but not re-set) unwanted hall calls. Electric eyes and other sensitive devices reduce possibility of automatic doors striking passengers. Various types of intercommunication systems can be arranged to provide any service from simple ''car to starter'' talk-back to a complex recorded message system. This latter informs passengers at appropriate times if the car is overloaded, if they are blocking the doors and other pre-determined messages.

45. Some real estate operators now consider the elevator starter to be more of a public relations man than one who directly affects traffic flow. Since the new systems are automatically based on traffic patterns and not subject to distractions, they are more consistent than most human starters could be.

46. The starter's panel in the main lobby is used on these intallations, as well as on signal control. However, its automatic operation tends to diminish the need for it and it is conceivable that except for position-indicator lights and intercommunication system functions the starter's panel may become superfluous in the foreseeable future.

47. Designs of appliances and fixtures developed in the period from 1946 to 1961 have followed the modern trend. New metal alloys and some plastics have been introduced. The ''touch button,'' a plastic and metal hall and car push-button replacement, is an interesting innovation of the Otis Elevator Company. It is centered on the use of a triode tube in a glass envelope as the means to establish calls.

48. Westinghouse and other firms employ car and hall buttons that signal the registering of desired stops by illuminating the buttons themselves, once they have been pressed. Foreign competitors also provide this type of call button.

49. While the elevator manufacturers were developing newer drive and control mechanisms they also were conscious of the need for greater safety imposed by higher speeds and operation by passengers.

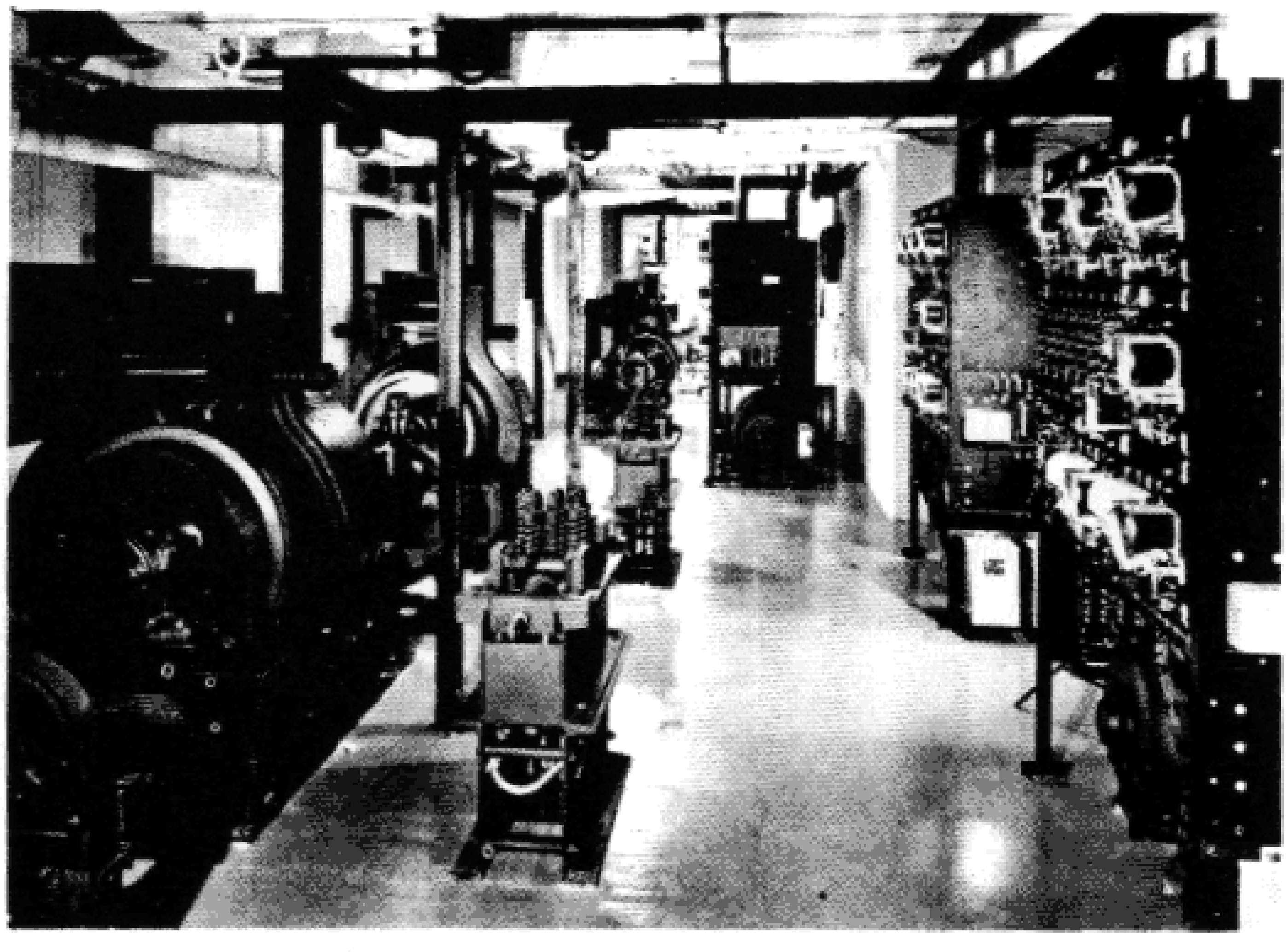
50. Early elevators were simple platforms. On these the passengers were given little protection. Through the years the well designed car enclosures and entrances used today have evolved. First the sides and tops were added to car platforms, then entrance gates, both on cars and at landings, were included. Operating safety was further increased by addition of gate contacts, safety operated switches, final limits, hoistway stopping switches and alarm devices. Car and hoistway doors were added, they were powered by pneumatic engines and electric engines. Telephone and public address systems were added.

Japan's Famed Politeness is Displayed by Girl Elevator Starter

51. While design and material improvements were being introduced into elevator installations, various cities, states and countries legislated elevator codes into existence. Today the majority of progressive areas do have such codes. Their general intent is to protect the public from unsafe conditions. One of the best guides for code committees is the "American Standard Safety Code for Elevators" published by the American Society of Mechanical Engineers. Many state and municipal codes in the United States use this book as a basic outline. Mexico, and possibly other countries also use it for the same purpose.

52. Some European countries regard safety in elevators in a different light than do the Western Hemisphere countries, and others. For example, self-service passenger elevators in Europe are permitted to operate without car gates. At the other extreme, until recently Australia insisted on "drop" safety tests (without hoist ropes) on all completed elevators. They still require a double set of contacts on all hoistway doors.

53. The elevator code authorities in all areas try to the best of their abilities to insure safe conditions for passengers. As a result of engineering advances, appreciation of responsibility on part of labor and management as well as cooperation



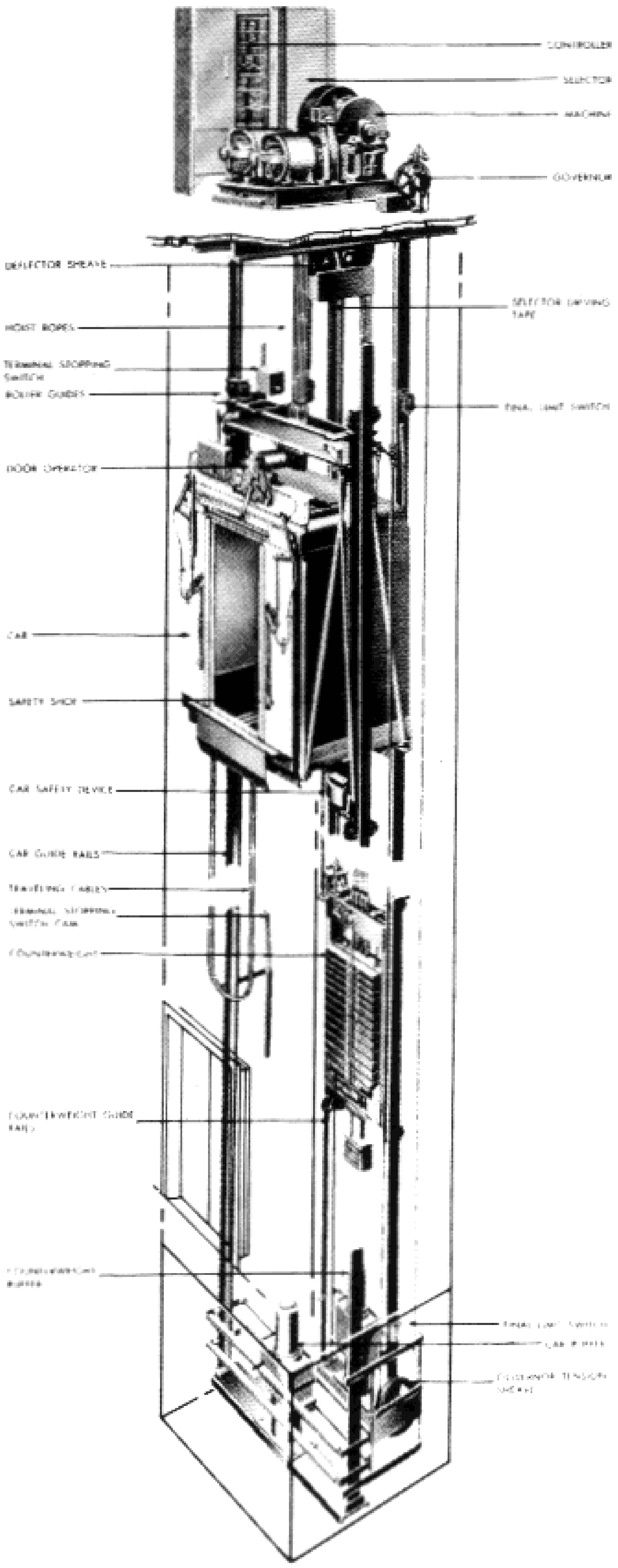
Modern Montgomery Gearless Machine Room

between code and other governing authorities and the industry, today's elevator is the safest form of public transportation. The elevator carries more passengers per day than any other individual system in most of the world's major cities.

54. In reviewing elevator history, we have reached the present day with its new and varied methods of control and operation. As the elevator of 1950 is outmoded today, so the elevator of today will undoubtedly be obsolete in the future. Barriers to construction of ancient buildings, compelled the inventions of the past. The stumbling blocks of today will likewise induce the developments of the next century. We have noted the eras of the pulleys and hoist, the plunger and cylinder, the drum and sheave; the days of the so called "gaslight era," the mirrored cars, the cushioned seats, the marbled halls. Some of these still exist today, especially in foreign countries, where the traditional opposes the modern.

55. The elevator industry has moved a long step forward in the few years since the first edition of this book was written.

56. The history of elevators has more than a mere story value. By the past, we may judge the future. There is a real object lesson in it; namely, that in the elevator industry, as in all engineering and construction fields, review of the past indicates that there has been and will be a constant progress towards better, more refined equipment. This suggests that, as individual elevator men, we must move forward. As the industry progresses,



Modern Otis "UMV" Geared Elevator Equipment

we must maintain pace with it and the trend is very definitely toward control refinement. This inevitably brings electrical complexity and the need for greater application, training and education on the part of the individual, whether he is a field, factory or office man.

57. Escalators (or moving stairs) are also a form of vertical transportation. Mention of these devices has been omitted from this article because the subject is covered separately in chapter 15, of this manual.

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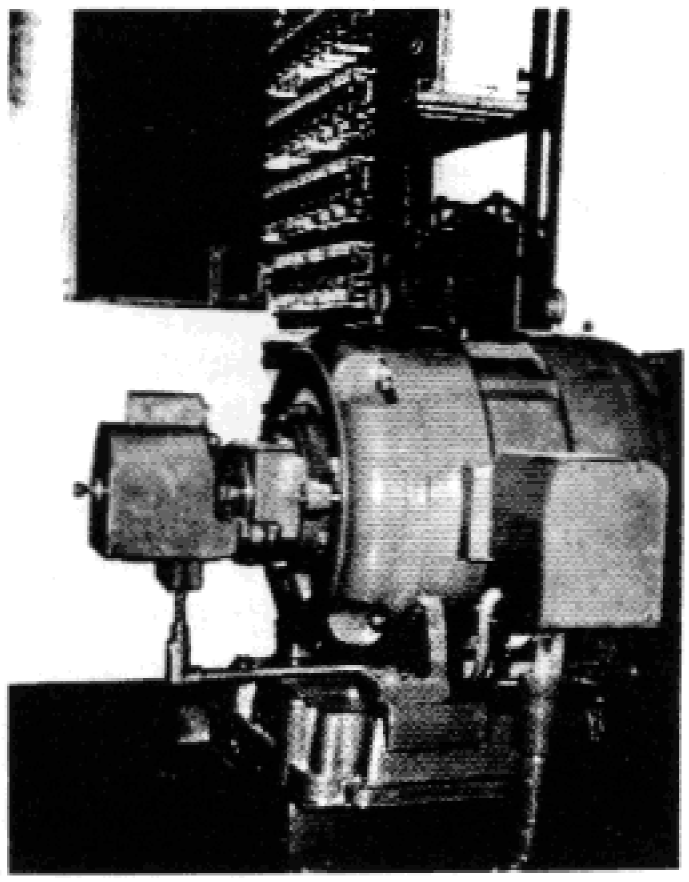
CHAPTER 1
Section -a2

INTRODUCTION

Elevator Installation — General Outline, One Elevator

1. The N.E.M.I. Installation Manual is not designed to set a single standard of construction practices. The author is fully aware that many "short cut" methods are in daily practice. Construction procedure is highly controversial and it is only desired that this book serve as an introduction to the elevator business. Because of this, in introduction, we will outline the general procedure followed in the erection of an elevator in a single hoistway. We will also assume that the operation occurs in a small city, where the mechanic reports to his employer's office at 8:00 A.M. on a "starting date." The mechanic is ordered to install an elevator in a steel frame building. The elevator will be equipped with slide guides and a wedge-clamp safety.

2. As a rule his superintendent gives him a large envelope containing the final layouts, the rail bracket layout, a set of straight and hoistway wiring diagrams, and a conduit layout. The envelope should also include detail drawings, wiring material lists, door and operator drawings, as well as any special details on the contract, appliance drawings, special equipment drawings, and time tickets and envelopes. Shipping notices or a material list, or a copy of the contract data should be enclosed also. Some companies give the final acceptance sheet to the mechanic at this time.



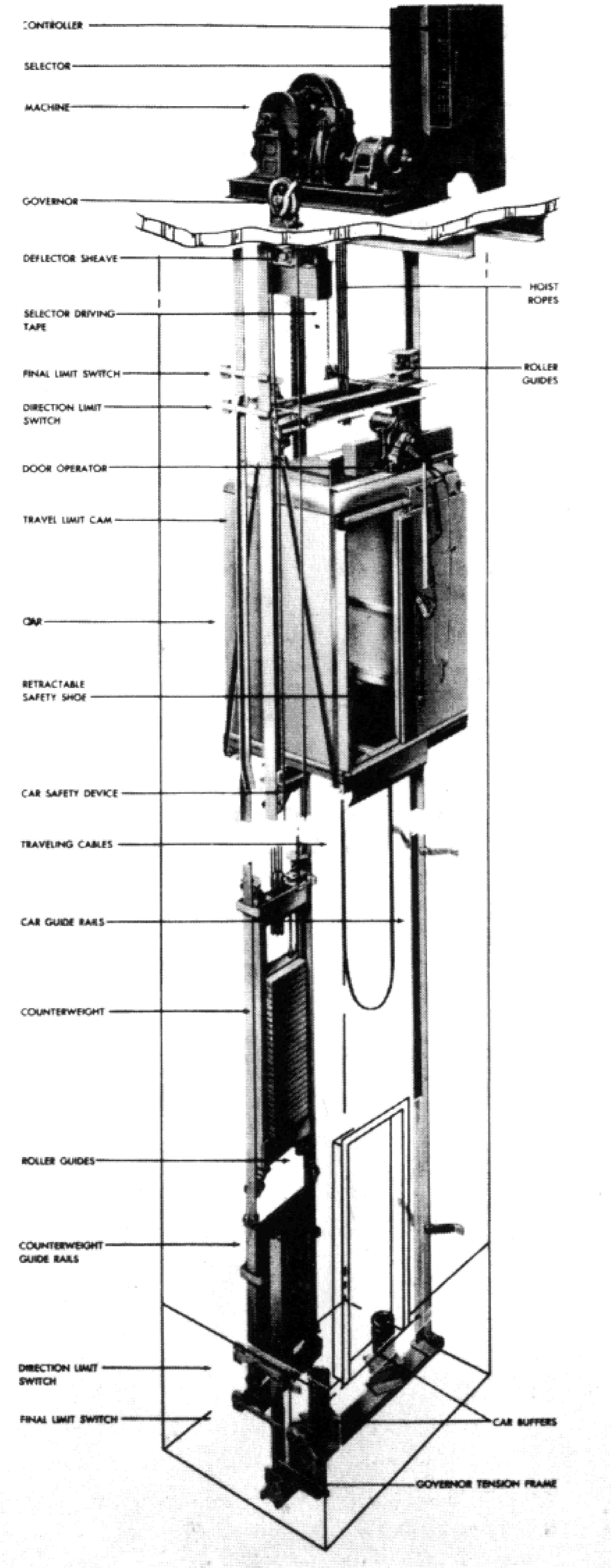
Haughton Geared Machine Motor With Speed Regulating Governor

3. The final layout should be examined closely as a starting point to be sure that enough information is available to begin the job. The layout should show the size and location of the elevator hoistway in the building, size and location of machine, rail types and entrances as well as

other pertinent data. Any discrepancies in the layout should be discussed with the field superintendent.

4. If the drawings are in order, the mechanic should then check his tool kit. He should have a hand tool-box which would include hammers, center punches, hack-saw, wrenches of different types, screw drivers of various sizes, slip-joint and cutting pliers, a level, a plumb-bob, and a square. The heavier or special tools, such as electric drills, welders, pipe cutters, stocks and dies (if required), files, chisels, chain hoists, slings, planks, rollers, and accessories such as test phones and meters would be supplied to the mechanic by the company employing him. When tools and materials are in order, the mechanic should make out a stock order for sundries, such as rags, cotton waste, *22 gauge annealed iron or piano wire (for plumbing the guide locations), and other sundries considered necessary at that time. At least one helper would be assigned to the mechanic. If the machine is sizeable, more assistance might be required.

5. The mechanic's first duty on arrival at the field location is to obtain permission from the building construction superintendent to store materials. A space where the materials can be stored safely and semi-permanently should be obtained. If not well located, the materials have to be moved frequently to permit the building carpenters, plasterers, electricians or others to perform their work. Materials for the elevator should be stored near the hoistway. This is especially true of the heavier or more bulky materials such as rails, machine, controllers, carframe, counterweight and entrances.



Composite of Modern Alternating Current Installation

The first materials required will be rails and brackets. For this reason, they should certainly be stored adjacent to the hoistway.

6. After the material is safely stored and before actual erection is started, check the layout with the builder's plans. If satisfactory, the mechanic should take plumb wire and hand tools to the top of the hoistway. (This is an outline, so no details of plumbing or other methods will be given. These points will be taken up in a separate series of sheets included in this manual.) When the guide lines or plumb lines have been dropped, the mechanic can determine the exact location of the holes for the bolts supporting the guide-rail brackets. He will assign helpers to the work of drilling these holes. (Holes can be punched in steel, if hydraulic tools are available.) Brackets can be welded by licensed men in many areas. On concrete or brick structures inserts or self-drilling achors are frequently installed for guide-rail bracket bolts. (See Chapter 5 for details.) While this work is in progress, the mechanic should check all building conditions relating to the elevator installation. In a steel frame building, the distance between the plumb lines of the guide rails and the front beams should be checked at each floor. The hoistway can be "squared" by checking the diagonally opposite corners. Any projections into the hoistway that do not appear on the final layout should be brought to the attention of the building construction superintendent immediately. Any necessary alterations are to be made by the building contractor and not by the elevator constructor, unless so authorized by the elevator field superintendent.

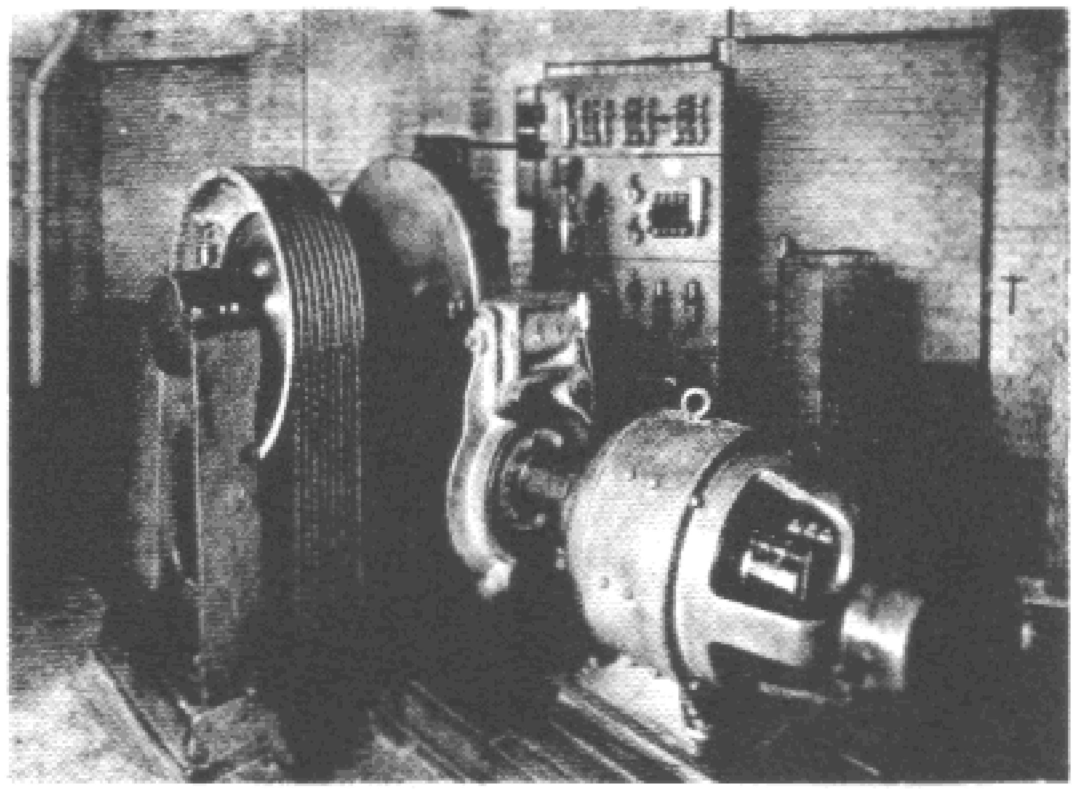
7. Assume that the truck with material arrives on the job site, while the work of drilling for guide-rail bracket bolts is in progress. The mechanic and helpers will unload the truck. In unloading, it should be borne in mind that hand trucks, dollies, chain hoists, pullers, rope falls, pry dollies, hydraulic jacks, rollers and crowbars can relieve the men of 90% of the work of "buggy-lugging." Use of good tools when handling shipments can also avoid unnecessary damage to materials. The mechanic should carefully check delivery receipts against the material received, and see that there is no damaged equipment. In the event of damage or short shipment of material, these facts should be reported to the office by telephone. Also, before being signed, the delivery receipt should be marked up to indicate such damage or shortage.

8. When the material has been stored in the best possible location and the bracket bolt holes are all prepared, the work of installing the brackets may proceed. Care should be exercised to see that they are square with each other and plumb. After the guide-rail brackets are installed, the next step is to install the guide rails and align them. The pit work follows the guides.

9. The chain hoist or hoisting tackle can be hung, preferably in the machine room over the hoistway. (No men should be in the hoistway or pit while this is being done.) With hoisting equipment in place, the machine, controller, selector, signal equipment (if any), and machine beams can be hoisted into the machine room. The hoistway should again be clear of men. The machine beams, then the machine, are the last two items to be hoisted. Machine beams and the machine template (if used) can then be set in place. Align them carefully with guide rail locations. Run all necessary machine room conduit. Where the machine is set on a frame or directly on the beams, the machine can now be installed. If a machine room slab of concrete

over the beam is indicated, the building contractor can install forms and pour the concrete as soon as the machine beams are in place and the conduit is installed. Be sure to put wood blocks or other forms in all rope, tape or wire drive hole positions. (Another common and very practical system is to block up the machine on steel to the height of the concrete floor. The elevator constructor then proceeds to complete the installation at least to the point of all conduit work, ropes and selector tapes. The contractor then pours the concrete floor slabs.) During this time, the helper can be distributing door sills and entrance frames to the various floors in front of the elevator hoistway. This, of course, only if the doors are to be installed by the elevator constructor.

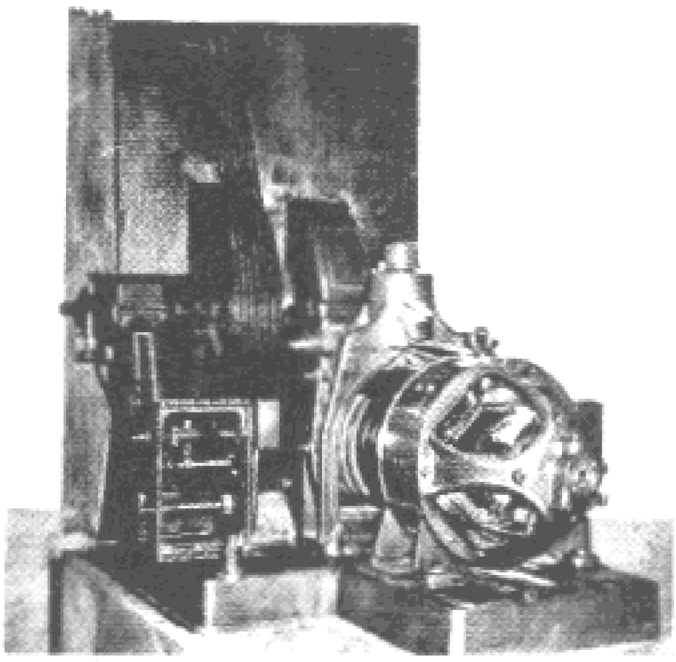
10. To set the hoistway entrance door sills, it is necessary to first determine the exact height of the sills above the rough floor at each floor. The building construction superintendent should always be asked to confirm these locations. A template should be used in the installation of sills. For inexperienced mechanics, this should be supplied by his company and should be carefully made. With it, the entrance door sills may be set at each floor and their exact alignment with the guide rails assured. Note that the builder is not to fill in the front of the hoistway with hollow tile or any other material until the door sills, headers, hall-button boxes, and position-indicator boxes are set in place. This will eliminate the possibility of unnecessary work in chopping and will facilitate work on the entrances. When conditions demand, the sills, frames and headers as well as the entrance could be set in place if the mechanic is held up while the machine room slab sets. (Usually the builder will not permit any weight to be placed on the machine room slab until it has set for some days.) It is sometimes necessary to leave one entrance frame and header out until the elevator cab is installed.



Leitelt Installation with Floor Controller

11. After the entrances are in place, begin the installation of the carframe and counterweight. The car can be assembled at the top of the hoistway in this case. (The carframe is mounted on bolts which are placed in holes drilled through the face of the car guide rails. These bolts support the car safety jaws.) (See Chapter 8 for details of installation of cars with roller guides.) The entire carframe can be assembled, the platform put in place, and the car conduit installed for wiring. Door operators (of some manufacturers) should be installed at this time, before the car cab is on the platform. (Other makes of operators are installed after the cab is complete.) Alternatively, the carframe and platform can be assembled at the bottom landing. If this latter procedure is followed, the governor and governor rope tension frame are installed immediately after the carframe. The governor is then roped

and the car is hoisted to the top for roping. (The governor is set on steel channels, if necessary, such as on jobs where the machine room floor is not poured.) The counterweight is then assembled on wood blocks in the pit. About one-half the "sub" or filler weights are installed in the frame at this time, unless a "sash-type" weight is used. If a sash-type counterweight is used, extra weight must be placed on the car platform to compensate for lack of the car enclosure weight.



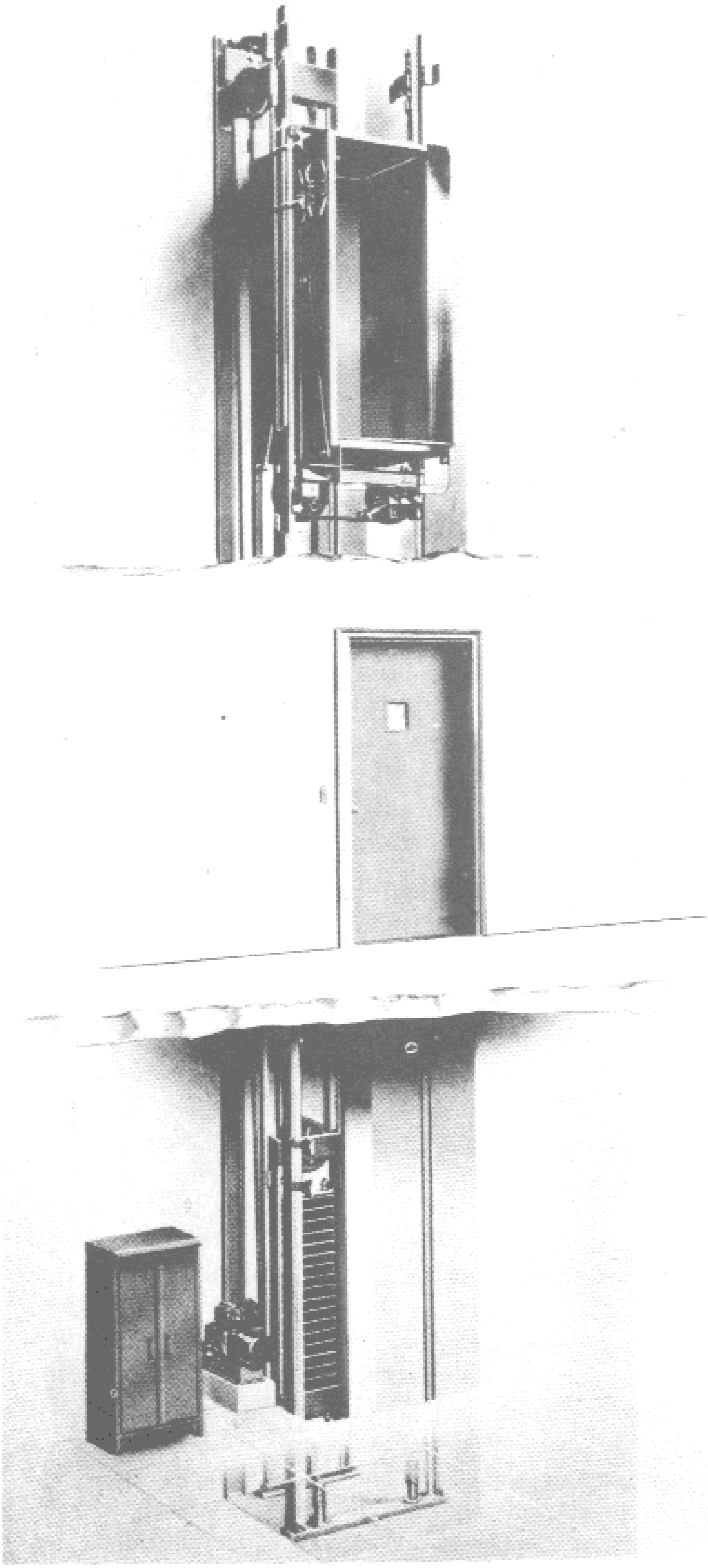
Basement Installation of Westinghouse Geared Machine

12. When the entrance and carframes are in place, and assuming the machine room slab is not ready to support the machine, the hoistway conduit may be run. It is important to set the hall boxes and conduits in place before the building contractor fills in the wall. If this cannot be done, have the bricklayer put in wood blocks or leave openings at the points where the button boxes and position indicator boxes will be installed later.

13. If the layout shows the machine setting on the concrete slab, the machine can be rolled into place on wood or pipe rollers. However, when sound isolation is specified, it should be placed under the machine and the drive sheave carefully aligned in relation to the guide-rail centers. The safety governor can then be set in place (if not done earlier as noted above).

14. Next, install the hoist and governor ropes, taking all precautions to keep the ropes free of kinks. Also, it is important to "turn-in" ropes properly. Detailed instructions concerning these items will be found in Chapter 9 of this book.

15. When the ropes are installed and electric power is available at the controller, the construction mechanic should call for an adjustor to check the alignment of the machine shafts, if his company has a routine of using adjustors for this work, otherwise he performs the alignment check under supervision of the "super." (Some motors are mounted directly on the worm shafts and motor rotating elements do not require this alignment.) If needed, this check should be made before the machine is turned over by power. If necessary to wait for the arrival of the adjustor, the mechanic can clean and lubricate the brake cores and pins, and pull in the motor wires. He can assemble the brake and motor on the bedplate temporarily, and also connect the motor wires. When these parts are assembled and the car conduit has been run, the mechanic can remove the bolts from under the car safety-shoes and move the car by operating controller switches by hand or with the motor crank. Moving the car throughout the hoistway, he can file the guide-rail joints from the top of the car crosshead. This is a convenient method of doing this work. Car shoes should be protected so steel filings do not enter the gibs. When rails are filed, they should be checked with a 36" steel straightedge and a final alignment made. As a general rule, while one man is doing this filing, a second man can be working in the


Composite of Personal Service Elevator

machine room on the wiring and connecting of the controller wires. On small installations, the length of wires between the controller and the hoistway junction box (if used) is generally measured and the wires cut and pulled in as one group. Where only two men do the work on the job, this would be done before filing the rails, so that one man could connect the wires, while the other was in the hoistway. The traveling cable should be dropped from the junction box at the earliest possible moment. Loop the free end and carry it back up the hoistway so a natural loop is formed. The bottom of the loop should be held above the pit floor. Secure the cable end to itself to hold the loop and permit the cable to assume its normal hanging position. The man working on the wiring in the machine room could also move the elevator car manually, whenever it becomes desirable for the other man to work at different positions in the hoistway. Field telephones can be connected for communication, if the building conditions require it.

16. Later, the installation of hoistway door hangers and doors may be started, except for the one entrance, if it has been left open for the installation of the elevator car enclosure. After the doors are in proper alignment install the door closers or locks.

17. Generally, it is easier to do all possible work such as installation of floor switches (or limits) and wiring at this time. It is far more convenient to work from the car platform, than scaffolds or planks out in the hoistway. Therefore, even though the car is ready for the installation of its enclosure, do all possible work before installing the cab. When it is felt that all hoistway work has been completed to the greatest possible extent, make a rough cleaning of the hoistway, beginning at the top and continuing to the bottom. Remove all loose pieces of concrete and dirt. Thoroughly clean the elevator safety shoes. Place the car at the entrance, where the door frame has been left out in order to install the car enclosure. Remember that the car enclosure is the part of the elevator that the customer sees. It often has a fine finish. Handle it with due care. Entrance jambs and car door panels must be plumb and square.

18. When the car enclosure is completely installed and the final door entrance finished, the car operating panel, position indicator, car lights and appliances may be installed and wired. At the same time, remember to add more filler weights to the frame to compensate for the extra weight placed on the car.

19. When installing conduit and wiring the elevator, remember that all wires should be in conduit or flexible tubing. Also, no one piece of flexible tubing should be more than 36" long. All rigid, thinwall and flexible conduit must be securely fastened. All entrances to appliance boxes or car operating panel boxes must have bushings or approved fittings to protect the wires from being chaffed or cut. Methods of ringing out and checking wiring will be discussed at length in Chapter 10 of this book under the heading "Construction Wiring."

20. Long before this amount of work has been completed, the mechanic, adjustor, or "super" will have aligned the machine and motor. He will have checked the direction of the elevator motor rotation, and checked it for proper dynamic center. Since all the machine room and hoistway wiring has been completed, it is time to run the elevator at low speed from the car panel. Set the car at the terminal landings in accordance with your limit switch diagram, which is based on local and national code requirements. Adjust the two final limits. (If there is a stopping switch, adjust that also in accordance with the standard stopping distances.) Check limit operation by moving the car slowly from the controller until the limit cam opens the limit contact. Measure the distance from car sill to floor. Try to run the car from the car operating panel. If it should not run, move the car off the limit by closing the up or down switches on the controller manually. Test the elevator for general operation at intermediate floor stops with the car operating device. Put the doors into operation. If the general results seem fair, call for an adjuster to come on the job to make an adjustment and inspection of the entire installation, if your company practice utilizes men in this category. While awaiting his arrival, make a preliminary check of the guide-rail bolts and alignment, and retest the operation of the car. Clean up any small items of work which may have been noted on a check list during the installation of the equipment. Do not paint the elevator hoistway or machine until after your final inspection and adjustment have been made, and the check list of work completely cleaned up. Test the operation of any appliances such as hall-position indicators, gongs, alarm bells or telephones. Be sure that all toe guards are installed, that all knock-out box or junction-box covers are in place, and unused conduit holes are covered by blanks or similar fittings. When and if the adjustor arrives on the jobsite, cooperate with him during his inspection. After he completes the inspection, he will probably leave a rough, unofficial copy of the inspection report on the job. Clean up all this work also, as required by this report.

21. When the inspection work has been completely cleaned up to the satisfaction of the superintendent, approach the owner or building manager and request him to accept the elevator. If he is satisfied with its operation, have him sign an acceptance slip. This slip is to be turned over to your elevator construction superintendent, and the elevator will be considered as completed.

22. In summary of the foregoing we may, therefore, suggest the following as a recommended method of procedure for the installation of an elevator with slide guides in a single hoistway.

(1) Study final layout and detail drawings
(2) Allocate material storage space — unload and store materials
(3) Field check the hoistway drop-lines (check location of lines with building construction superintendent)
(4) Install brackets and rails — align guides
(5) Hoist machine room equipment
(6) Install machine beams and machine room equipment; pipe the machine room
(7) Set door sills (verify exact location of height of sills with building construction superintendent)
(8) Set door entrances (leave one out until car cab is set)
(9) Set door struts and headers
(10) Install counterweight, carframe and platform
(11) Pipe the hoistway and hall appliances
(12) Hang traveling cables
(13) Align the machine, controller and other machine room parts, if not done earlier
(14) Pull machine room wires and ringout or otherwise test them for identification
(15) Rope the car and governor
(16) Connect machine room wiring
(17) File and align guide-rail joints
(18) Install door hangers and panels (by this time the car can usually be operated from the controller manually)
(19) Install door locks
(20) Complete the hoistway work (limits, cams, etc.)
(21) Clean down the hoistway
(22) Pipe and wire the car and connect traveling cables
(23) Install car enclosure and appliances
(24) Check car control operation and set limits, stopping switch, and floor switches
(25) Call for first inspection (if company practice requires this)
(26) Clean up inspection report work
(27) Final inspection and clean up
(28) Painting — hoistway and machine room
(29) Call for code authority inspection, if required
(30) Obtain final acceptance
(31) Return unused materials to shop

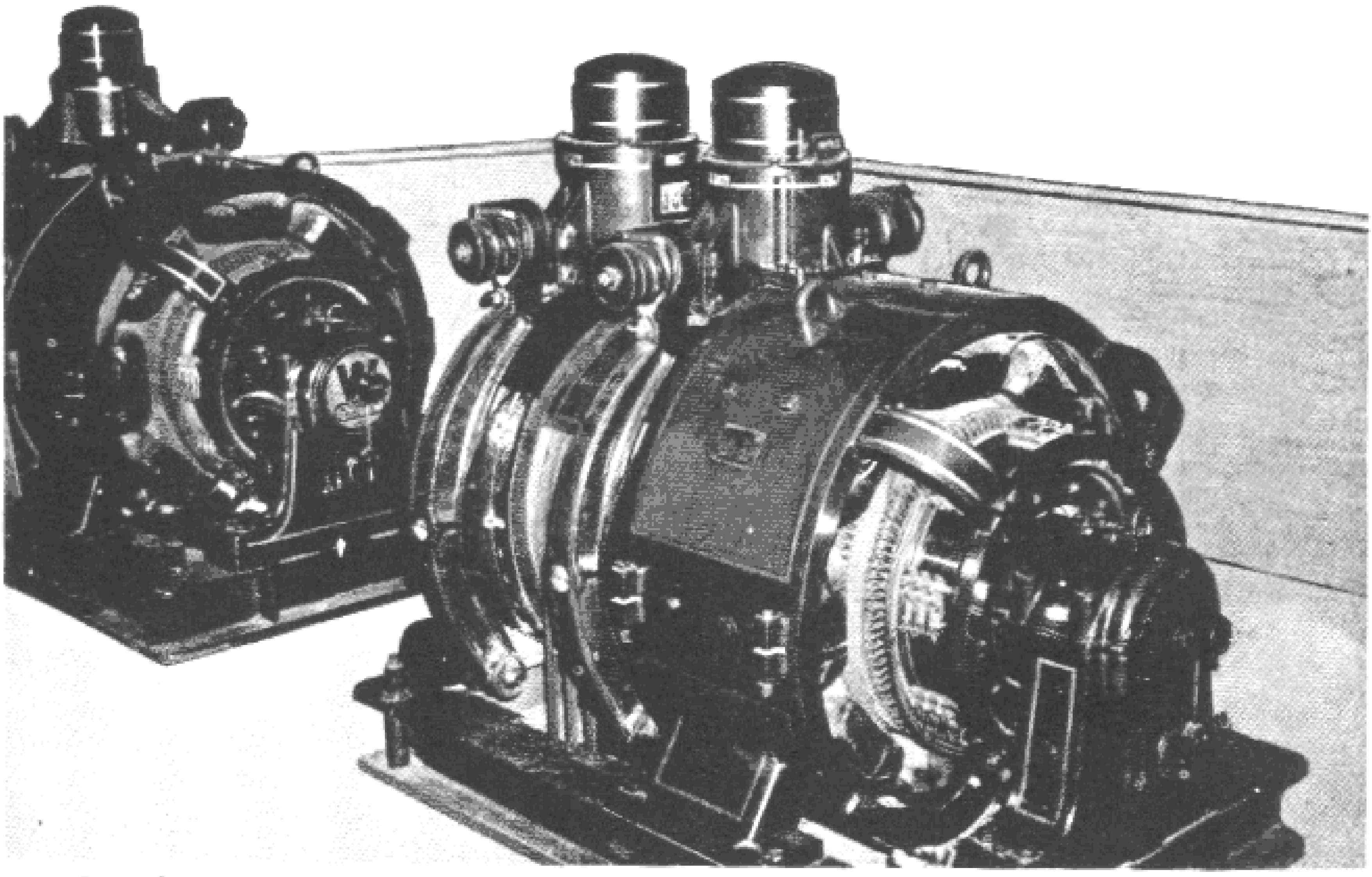
It is stressed that the foregoing represents one very basic and practical method of installing a single, low-rise elevator in steel framed hoistways. Modern methods improve on this old "standard." Several methods will be outlined further on in this book and will include description of the use of a moving skip hoist (or "false car") and power hoisting equipment.

CHAPTER 1
Section -a3

INTRODUCTION

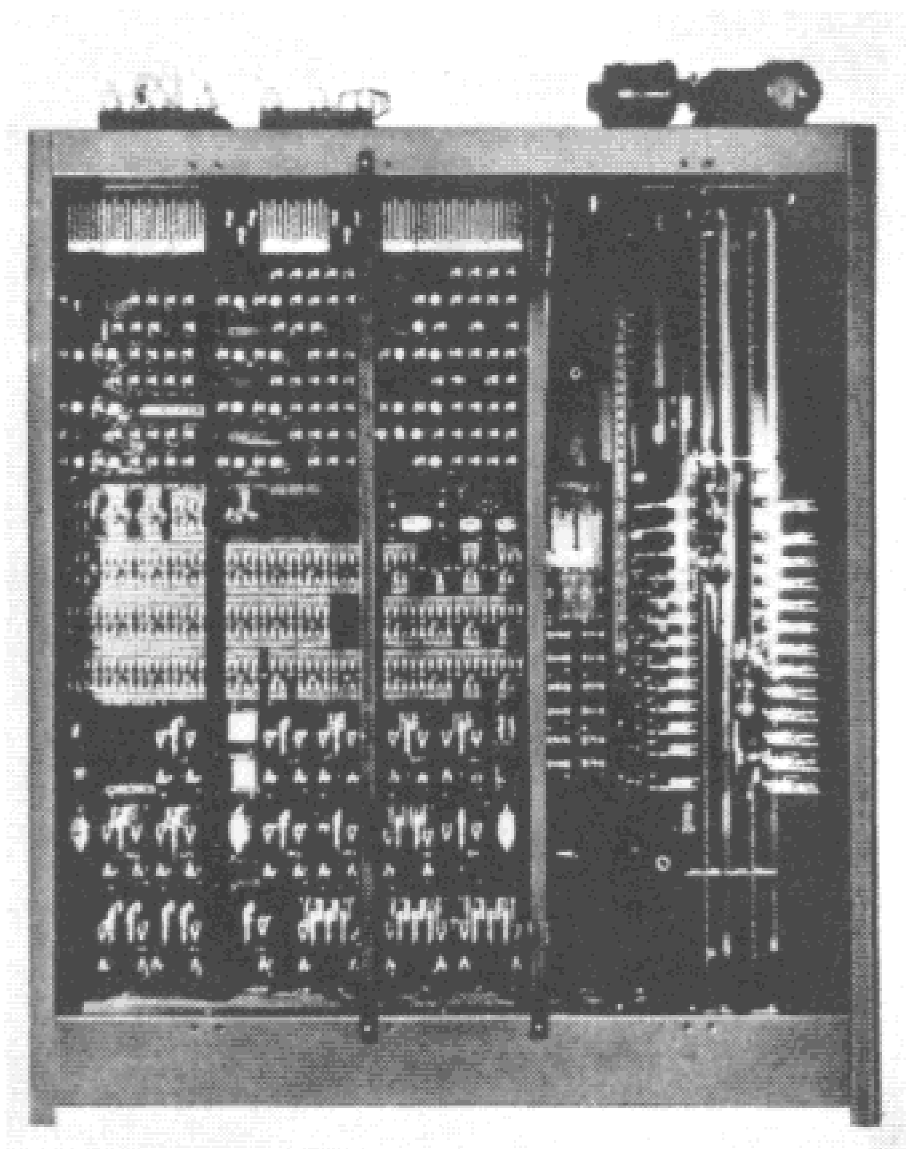
Elevator Installation — General Outline, Elevators in a "Bank"

1. When a mechanic has once installed a single elevator in an isolated hoistway, he should have a good idea of the general sequence of construction. Despite this, he must guard against several possible serious errors, when he installs a bank of elevators, that is two or more cars in line.



Part of a Bank of Westinghouse Gearless Machines (Note Extra Brake on "Safe Lift" Machine)

2. Let us say that the mechanic has been ordered to install a bank of three gearless elevators in a steel frame building. All necessary drawings, instructions, and papers have been given to him. His tool kits are in order. Tarpaulins, a power hoist, a workbench, and several large tool boxes probably would be sent to the job-site on a contract of this size. Storage and locker space have been obtained adjacent to the hoistways. The majority of the material has arrived and is safely stored. The machines, floor controllers, and controllers have been covered to protect them from dirt, water, or other damage.

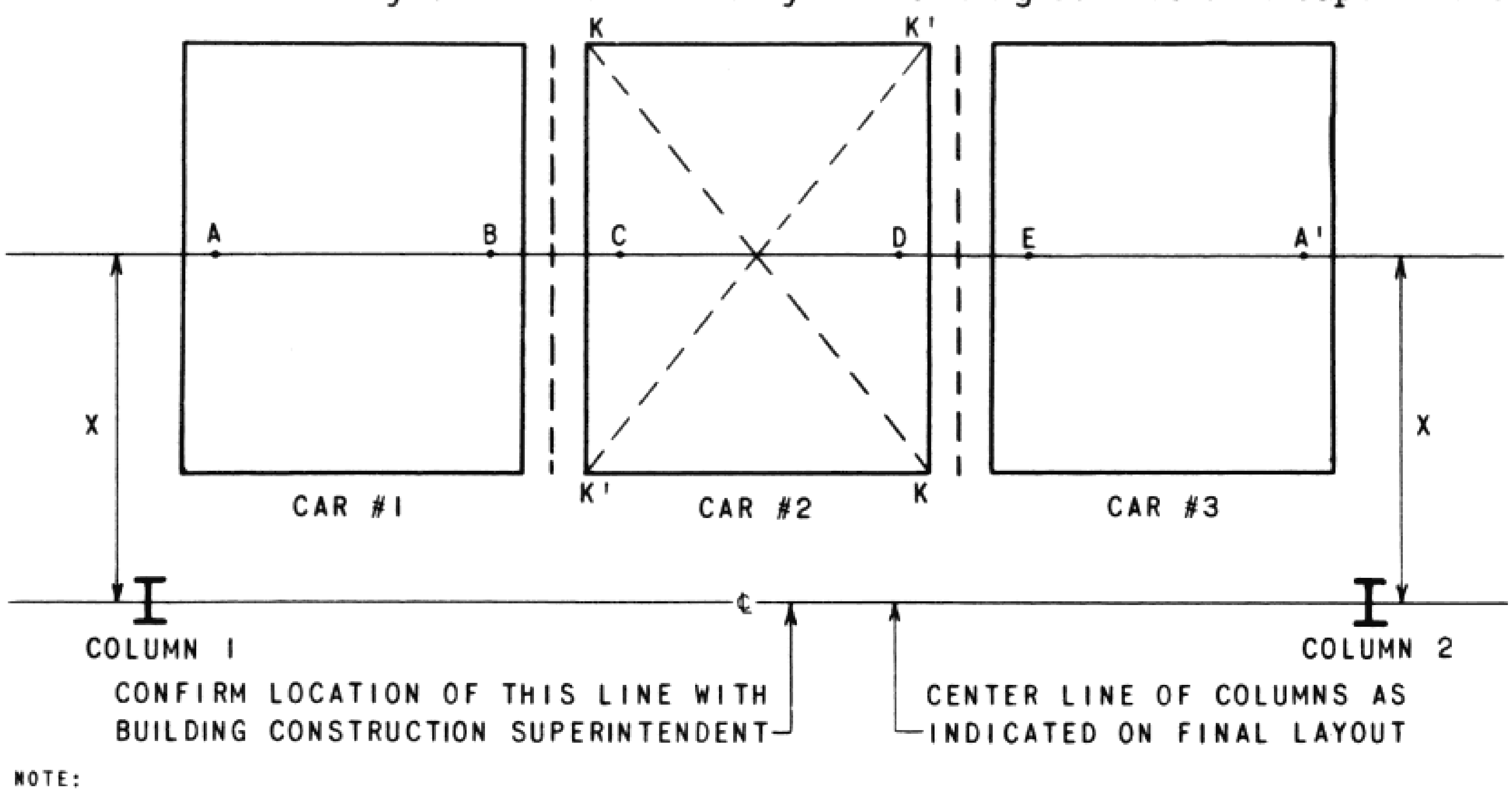


Modern Westinghouse Type SD Selector

3. Shanties are usually supplied by elevator contractors on this type of installation. A drawing table should be constructed of plywood or other lumber in one corner of the shanty.

4. A helper or apprentice should be given the job of keeping the shanty in order, handling all material and heavy tool storage, and inventories. Packing lists should be filed and checked off as material is used. A rough inventory should be constantly kept of material and sundries on hand. (It should be kept current to the work.) Such a file will enable a foreman-mechanic to anticipate the need for materials and avoid delays due to lack of them.

5. As far as the actual work goes, it is obvious that the principle of installing each of a group of elevators is the same as that of installing the equipment for one unit in an isolated hoistway. There are, however, several important factors that must be carefully considered and handled. Most important of these is the true alignment of the rails and also the fronts or entrances at each floor. When installing a single unit, starting lines are obtained from the layout and confirmed by the building contractor's superintendent.



NOTE:

a. DROP PLUMB LINES AT A AND A', EACH TO BE X DISTANCE FROM THE ESTABLISHED CENTER LINES OF THE BUILDING COLUMN.

b. CHECK ALL HOISTWAYS FOR SQUARE WITH STEEL TAPE AS AT LINES K-K AND K'-K'.

c. EXTEND HORIZONTAL WORKING LINES BETWEEN A AND A' AT TOP AND BOTTOM OF HOISTWAY.

d. USING THE WORKING LINES FOR LOCATION, DROP LINES FOR GUIDE RAIL CENTERS AT POINTS B, C, D, E, AS INDICATED BY THE FINAL LAYOUT.

e. OTHER WORKING LINES CAN BE ESTABLISHED FROM THE CENTER OF THE MAIN GUIDES FOR EACH CAR.

f. ON STRUCTURES WITH "PANEL" CONSTRUCTION, WORKING LINES ARE GENERALLY INDEXED FROM THE CENTER LINE OF THE CORRIDORS. CONFIRM THESE POINTS WITH BUILDING CONTRACTOR'S SUPERINTENDENT.

Sketch #1

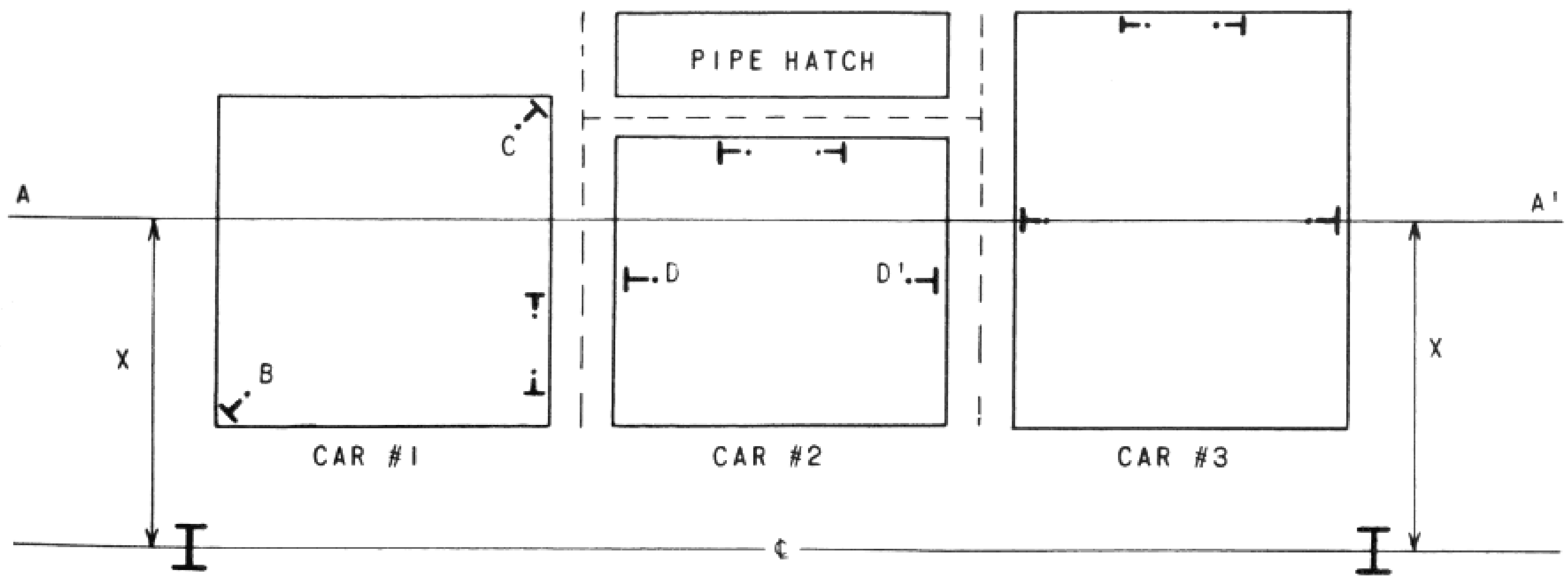
It is then merely necessary to keep all rails and entrances aligned with each other and the front wall. Obviously, a bank of elevators immediately brings into being the necessity of correctly aligning the entrances, rails and machinery of each elevator with those of the others in the bank also.

6. One method of assuring this alignment if all the elevators are identical, or opposite hand, is to drop plumb lines for each of the outer rails of the two end elevators in the bank. In our example of three elevators, this would mean the lines for the outer rails of cars #1 and #3. These first lines would be located (as in a one-car installation) from the centers of pairs of building columns, or in modern "panel" construction, from the corridor center line. Confirm these reference points with the building superintendent. (Refer to sketch 1.)

7. After these locations are obtained and carefully checked at the top and bottom of the hoistways, horizontal cross lines would be extended between them. These horizontal or "working" lines would establish the center lines of the guide rails for all cars, and plumb lines could be dropped separately for each rail. Each hoistway should be cross-checked for square with a steel tape as at lines K-K and K'-K' on car #2 of sketch #1.

8. Installation would then continue as outlined for a one car job except that intermittent checks should be made at various floors to see that the work does not go out of alignment. Generally the chain hoist or other tackle is rigged in the center hoistway (or highest rise hoistway if other than the center one). All material is then taken up in that hoistway and rolled to its proper place. This saves re-rigging time and also leaves all but one hoistway clear for other work to proceed safely.

9. The general procedure would not vary, even if the elevators in the bank are not identical. A horizontal working line would have to be established from the building columns. From this working line all guide-rail centers could be easily established. Sketch #2 illustrates this clearly.



NOTE:

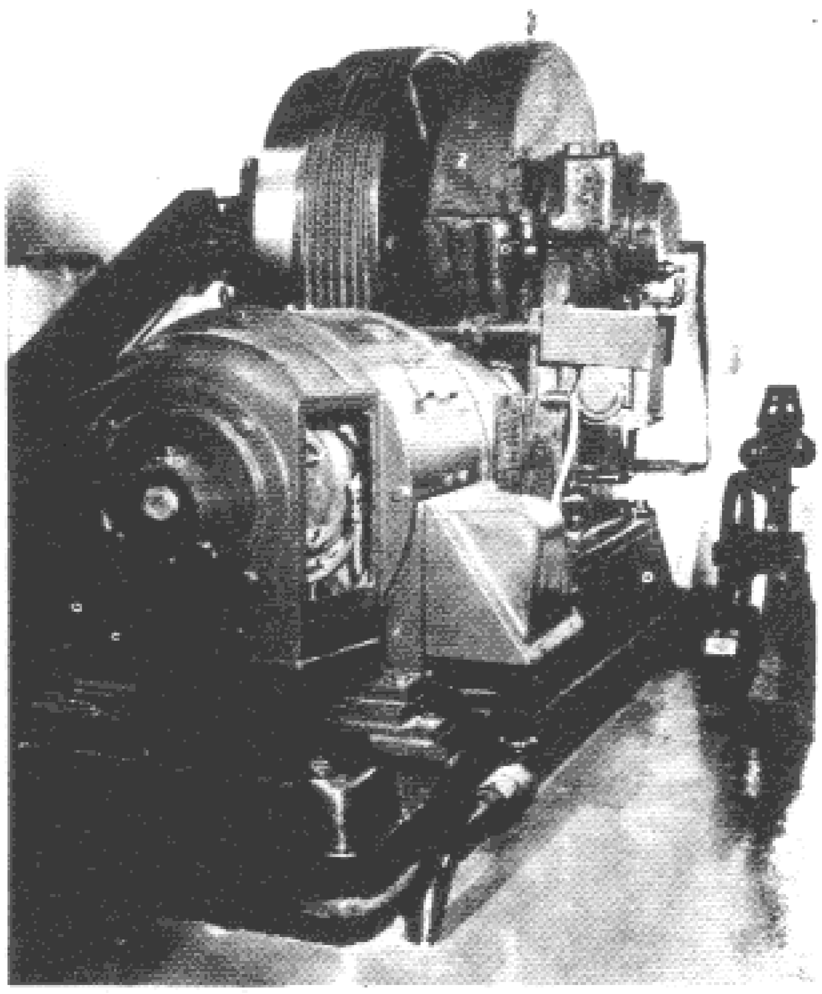
a. USING CENTER LINE OF CAR #3 AS A BASE LINE, A-A' CAN BE ESTABLISHED AS A WORKING LINE.

b. POINTS B, C, D, D' AND ALL OTHER PLUMB AND WORKING LINES CAN BE LOCATED FROM A-A'.

c. ON STRUCTURES WITH "PANEL CONSTRUCTION, WORKING LINES ARE GENERALLY INDEXED FROM THE CENTER LINE OF THE CORRIDORS. CONFIRM THESE POINTS WITH BUILDING CONTRACTOR'S SUPERINTENDENT.

Sketch #2

10. After the plumb lines are established as in sketch *1 or *2, the mechanic can proceed with the work in a manner similar to that suggested in Chapter 1-a2. Some work, however, is common to all elevators in a bank, such as push-button risers, which may be single or multi-buttoned at each floor. Three elevators, for example, would probably have two hall-button units at each floor and two risers. Present day practice often employs machine room and hoistway wiring troughs instead of conduit (see "Construction Wiring," chapter 10).

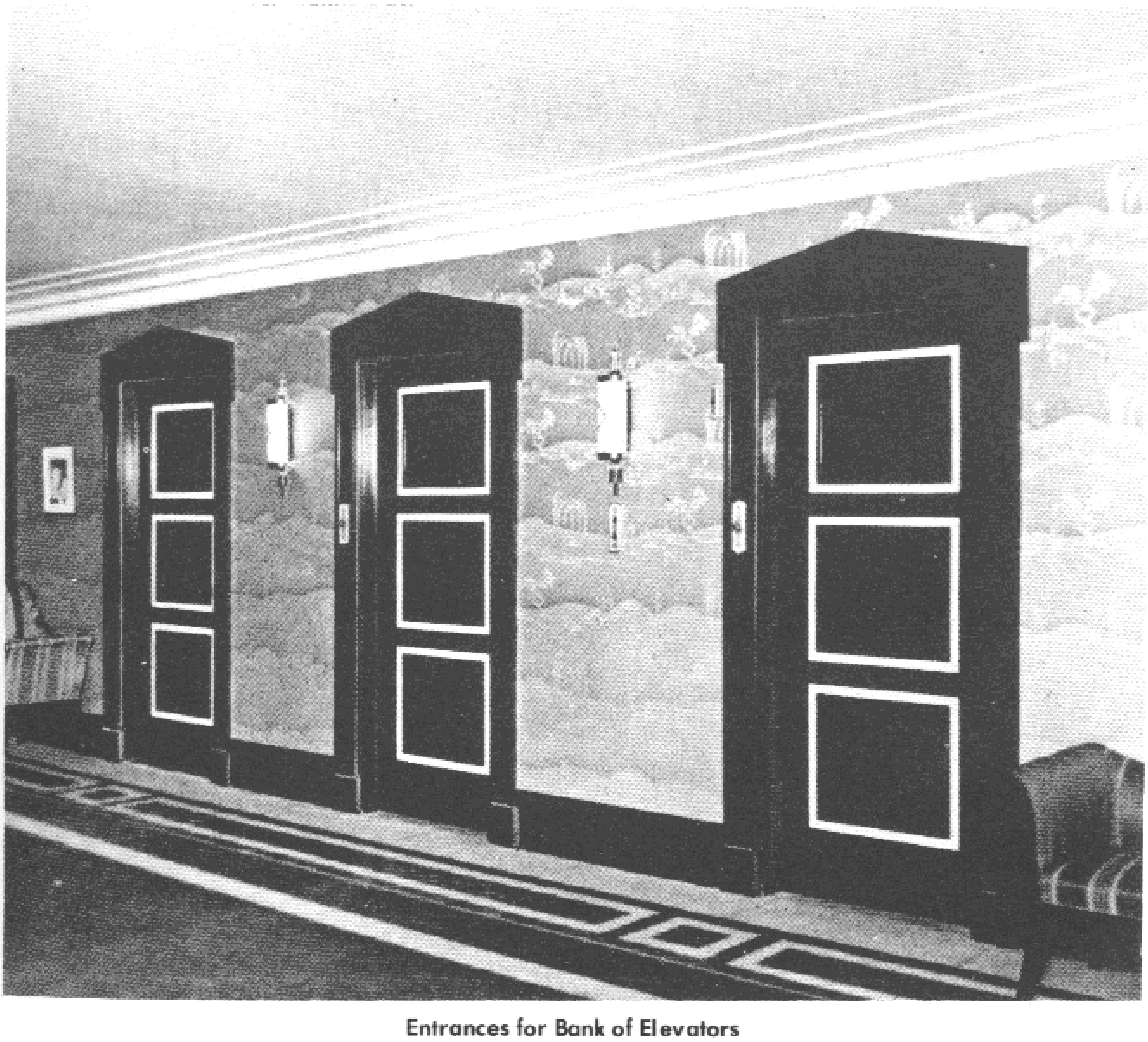


Haughton Geared Machine and Governor

11. Existing field conditions always impose variations that prevent any set routine of construction from being established for all jobs. Regardless of this fact, new men must have some basic idea of the progressive steps to be taken in erecting an elevator. We suggest, therefore, the following as a routine that could be followed:

(1) Store and protect material and equipment on jobsite.
(2) Obtain locker and/or work bench space.
(3) Plumb the hoistway and inspect working conditions.
(4) Place working lines.
(5) Install guide-rail brackets.
(6) Stack guide rails and install pit work.
(7) Hoist equipment to machine room and secondary level.
(8) Set machine and other overhead beams.
(9) Install all machine room conduit, then have carpenters set up forms for pouring machine room and secondary slabs. (Be sure to get blocks in place for rope holes, etc., unless machine blocking frames permit roping, wiring and tapes to be installed before floor is poured.)
(10) Set sills.
(11) Assemble carframe, platform and counterweight frames and where design permits, the door operator.
(12) Set door bucks and headers, and check them against other cars.
(13) Install hoistway conduit, including hall button and other appliance boxes.
(14) Run the car conduit.
(15) Hang traveling cables from the hoistway junction box, to permit them to stretch.
(16) Set the machine and auxiliary sheaves (and governor, if not yet set), motor generator set, floor controller, controller and relay panel.
(17) Install car and safety governor ropes.
(18) Pull machine room wiring, ring it out and hook up.
(19) File and align guide rails (lubricate them if required).
(20) Install door hangers.
(21) Install door panels.

(22) Install door locks.
(23) Install hoistway equipment such as stopping switch and limit cams, etc.
(24) Complete hoistway wiring.
(25) Install car enclosure, switches and appliances and wire the car. Install door operator, if not done previously.
(26) Try the elevator at slow speed on up and down directions. Set final limits as per charts or diagrams for car speed.
(27) Adjust hoistway switch contacts, temporarily.
(28) Test operation of all hoistway and pit switches, then try car at high speed.
(29) Try doors in operation.
(30) Where required, call for an inspection and adjustment. Clean up Inspection Report work. Second inspection.
(31) Painting.
(32) Call for code authority inspection, if required.
(33) Final acceptance.
(34) Return unused material to shop.



Entrances for Bank of Elevators

CONTENTS

CHAPTER 2

CHAPTER 2
Section -a1

S A F E T Y

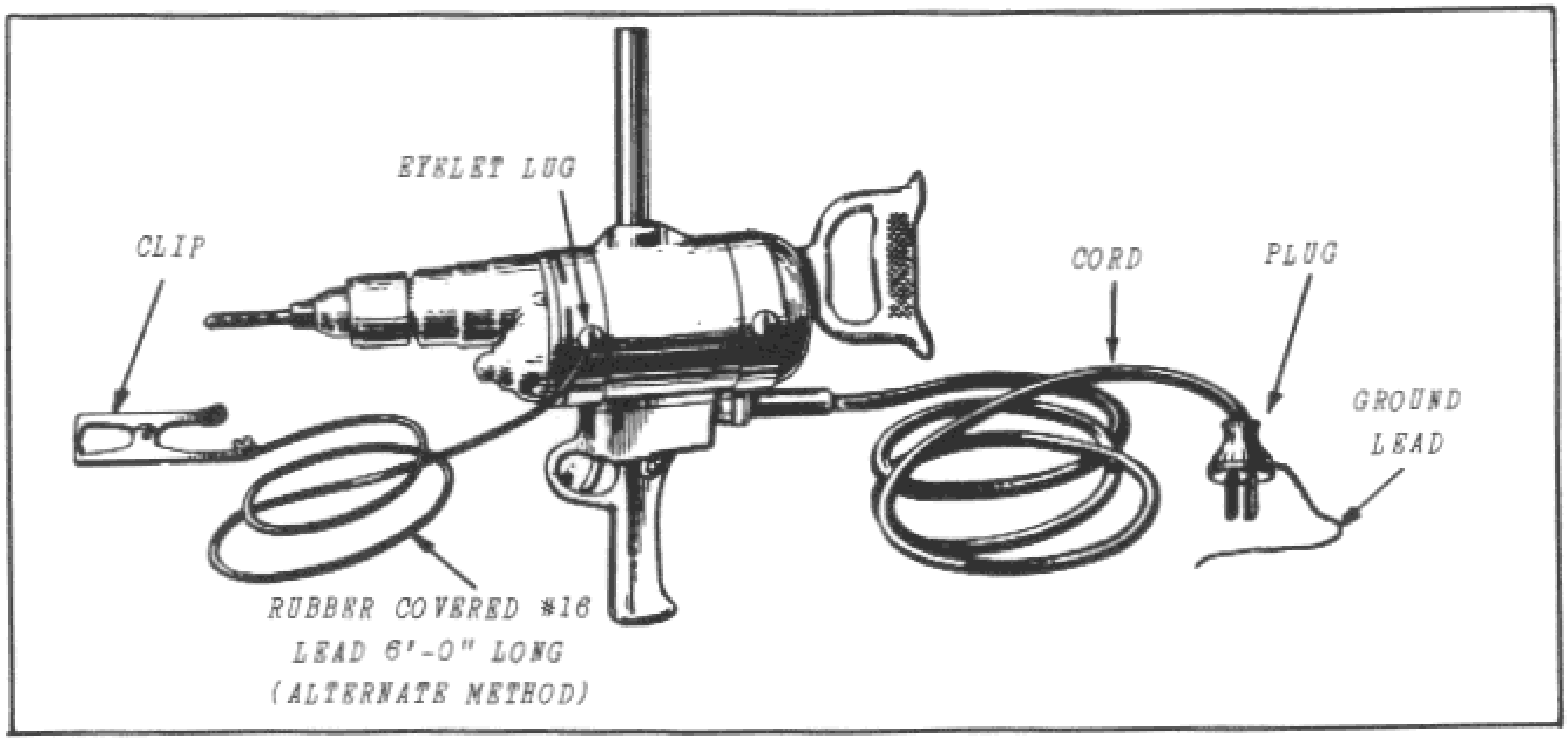
General

1. When the original N.E.M.I. Erection Manual was written about fifteen years ago, only one sheet was devoted to safety items. In reviewing the original text it was agreed that the subject should be expanded. This was not because the elevator industry has become more hazardous. Actually we now stress safe practices and use more safety equipment than ever before. The object of this chapter is to make new men aware of the importance of safe practices and safety equipment. The old story of "one hand for the company and one hand for yourself" is still based on sound reasoning. The need for appreciation of the potentials for accidents must be in our minds as we do elevator work. That "first step" down the hoistway will always be a big one!

2. We believe that some of the general safety rules spelled out in the first edition of the manual are worth repeating. They are: "As speed and height of elevators have increased, alertness on the part of the man has become more important. The old axiom of, "a hand for the company and a hand for me" does not cover the bill. Comparatively few fatal accidents occur among men engaged in the elevator trade, but numerous "minor" injuries do.

Minor accidents don't seem minor to the fellows to whom they happen.

They cause inconvenience to both the men and the company.



Methods for Grounding Electric Tools

It is recommended that full advantage be taken of all safety measures. All jobs should have a first-aid kit in the locker or tool shed. Many companies issue these automatically at the start of a job. (In some states this is required by law.) All electric tools should have ground leads on their housing and those leads should be used. Safety helmets are recommended, as are safety shoes.

Whenever heavy material is handled, keep toes and fingers clear.

No "hoist" should be made until the hoistway is clear of all men except those doing that work.

Use only sound timber, blocks and rope. It takes more time to get a new machine than it does to get a new timber or steel sling.

Never leave heavy equipment hanging on a chain block overnight. Place timbers and blocks under it to take the strain off.

Never let anyone "ride the ball" or ride with a load of material on a hoist.

Wear goggles and gloves when burning. Do not have greasy overalls that a spark may set afire. Keep a bucket of water handy to put out any fire that may accidently start.

Don't wear overalls that are too long and may trip you, especially while working steel or from planks.

When working around moving machinery, do not have your shirt or jumper hanging loose, where it may be caught.

Be careful in handling electricity, especially in damp weather or wet locations.

Be sure that the supply switch is open when you work on the motor, exciter or generator. A sign "Do Not Close" should be hung on supply switches at such times.

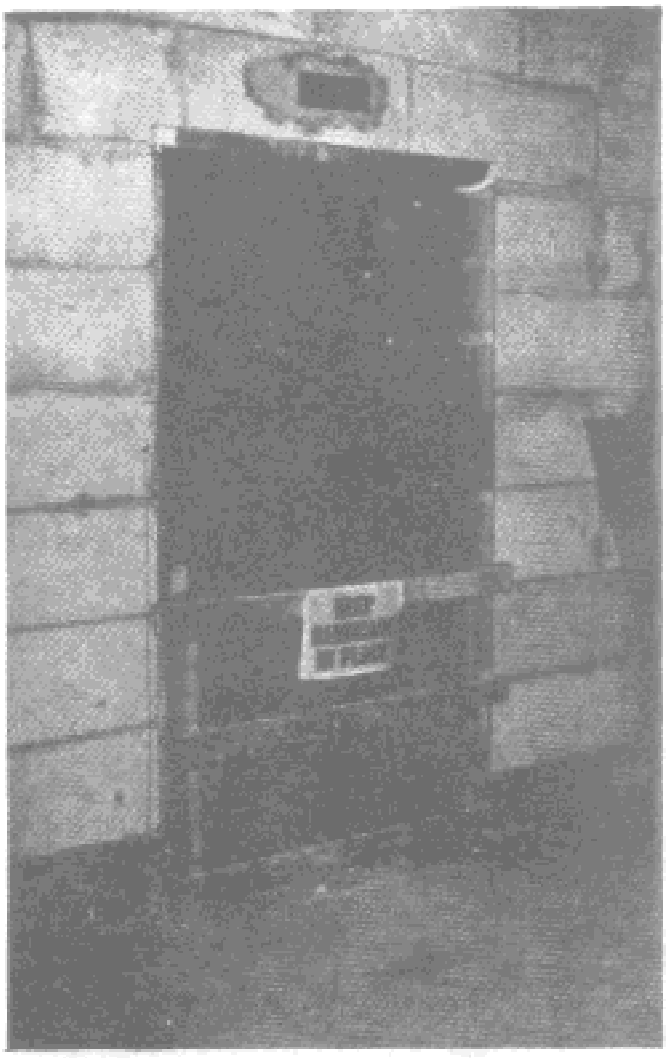
Never work from weak planks or scaffolds. Don't ride the car top or work in the pit unless you are sure your operator is competent and careful. If, when working on the car top there is too much noise in the hoistway to talk to the operator, open the emergency hatch and give signals.

Do not slide down the cables.

"A hand for me and a hand for the boss" is not enough, if a man does not keep his mind on what he is doing.

3. In other sections of this chapter we will review clothing, equipment and tools as they relate to safety.

4. An essential part of any good field work is to establish a routine of good housekeeping. A clean, well arranged job is safer than a sloppy one. Be sure also to



Good Housekeeping Promotes Safety

protect the areas where our men work. Be particularly careful when working near any moving equipment or in hazardous areas such as gasoline cracking plants, garages, steel mills and mines.

5. Most jobs are equipped with first-aid kits. This is very good practice. However, the kits are of little value if men do not know how to use them. It is recommended that men attend courses in first aid such as those given by the Red Cross, U.S. Coast Guard Auxiliary or similar recognized organizations.

6. Compensation laws of many states and regulations of most companies require that accidents to employees, or third parties, be reported promptly and in detail. Standard forms for reporting accidents are usually available through insurance companies, state authorities or the employers. The reports should be accurate and as concise as reasonably possible to enable others to accurately analyze the cause and effect. Reports are normally submitted to the employer through the elevator superintendent.

7. The N.E.M.I. has prepared and distributed to member companies a convenient pamphlet on safety. A copy is packaged with this book. We ask you "pass it around the job."

CHAPTER 2
Section -b1

S A F E T Y

Clothing and Equipment

1. Almost any item of clothing or any piece of equipment used on an elevator installation has some relation to personal safety. A loose shoe sole, an overall with cuffs or a carelessly laid out rope are all tripping hazards. It is obvious, therefore, that reasonable thought should be given to types of clothing and equipment that is used in our work.

2. Overalls or dungarees should fit snugly and should not have cuffs. Tool pockets should be in good condition, especially when working in a hoistway. Overalls should

be clean and free of grease. This is very important when burning, arc welding or working near any open flames.

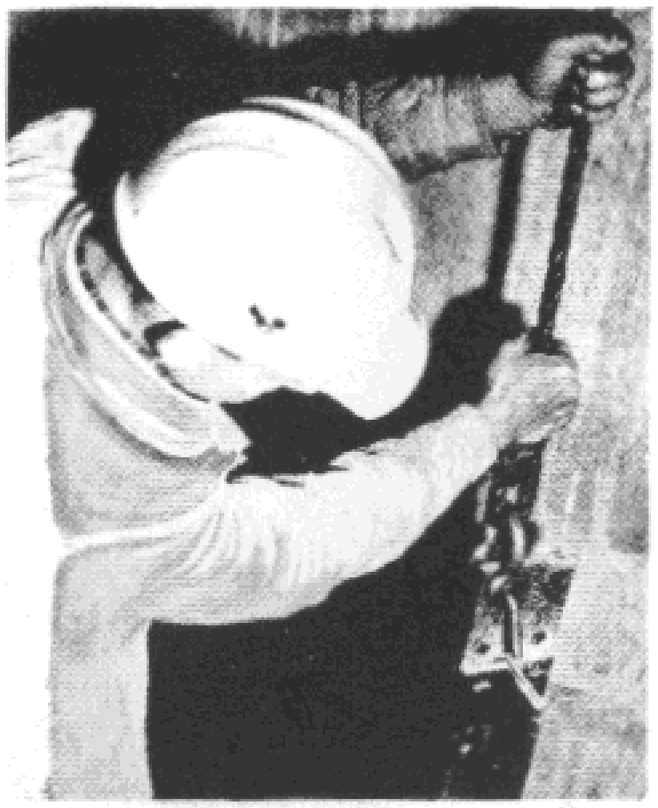
3. Safety shoes are recommended for our work. They are manufactured in a number of styles but their main feature is that they include toe protection in the form of a steel box built into the shoe. These toe caps can withstand blows of several hundred pounds. Shoe stores in most cities now carry safety shoes. Mail order houses also sell several styles of these shoes. Some elevator firms carry shoes in stock and sell them to the men at cost. Variations include shoes with spring steel inner sole though this is not as popular as it was at one time. Other shoes have insulation for cold weather and some have special "non-skid" soles.

Safety Shoes with Steel Toe Cap

4. Most elevator companies now supply their field men with safety hats, commonly called, "hard hats." There are quite an improvement over an old "derby" filled with cotton waste! Although safety helmets made of aluminum alloys or steel were once used in our industry, the present practice is generally to use hats made of plastic or agricultural by-products. Some hats have wire mesh impregnated with a bonding material. These hats are strong and reasonably light but have the great advantage of not conducting electricity. The metal hats can be dangerous in confined areas where "live" electric terminal studs are exposed. Safety hat accessories include chin straps and also, for cold weather, liners, hoods and face protectors.

5. Most large construction sites are "hard hat jobs." General contractors usually have a stock of safety hats at the site entrance and insist that every visitor wear one. Sub-contractors are obliged to provide their workmen with hats. Elevator companies are generally sub-contractors or have individual contracts with the owners. Regardless of this they are subject to site regulations. Insurance companies often demand use of the hats. It is our recommendation that they be worn generally on all construction and modernization sites but especially for all hoistway, pit and other work in exposed areas. Hat styles are designed for specific work. The full brim hat is intended for general work and is widely used. However, men welding often prefer the safety hat with a "cap" or half brim only. This style is more convenient for use with the welder's helmet and the brim is worn to the back when used during welding. Another model is available with a welder's helmet hinged to the hat crown. It is called a "combination" safety helmet and welding helmet. Other special purpose helmets are also available.

6. Protection of eyes is extremely important. It is generally conceded that injuries from dust, flying particles, splashes of liquids, and other harmful rays, such as



Hard Hats Should Always Be Worn in Hoistway

This Plastic Eyeshield Has High Resistance to Pitting and Lenses are Replaceable

welding or other electrical arcs are among the most common causes of accidents in the building trades. There are three broad forms of protection from such injuries: safety glasses, goggles such as welders or burners, and masks (or shields). The difference between glasses and goggles are sometimes not too well defined but in general we can say that safety glasses are types that are clear or lightly tinted lenses of a shatter resistant material. They are often in conventionally shaped frames with temple pieces that hook over the ears. The lenses can be clear glass for eye protection only or can be ground to suit an individual eye prescription. Depending on usage, they may or may not have side shields. All N.E.M.I. manufacturers supply the clear safety glasses to field men as required.

Several types of goggles are used in elevator work. One is a simple plastic or clear glass type that protects the eyes and has a shielding arrangement that fits closely to the face. Usually these goggles are held to the face by an elastic band. They fit over normal prescription glasses (if this is required) and are used when chopping concrete and for similar work.

A second type of goggle is the "burners" or "welders" glasses. These are colored glass in close fitting frames and offer maximum protection from harmful infrared and ultraviolet rays that are encountered in welding and burning. Generally the dark glass is covered by a high impact resistant clear cover-glass as protection for the comparatively expensive colored discs. The "frames" are held against the face by an elastic band, as a general rule.

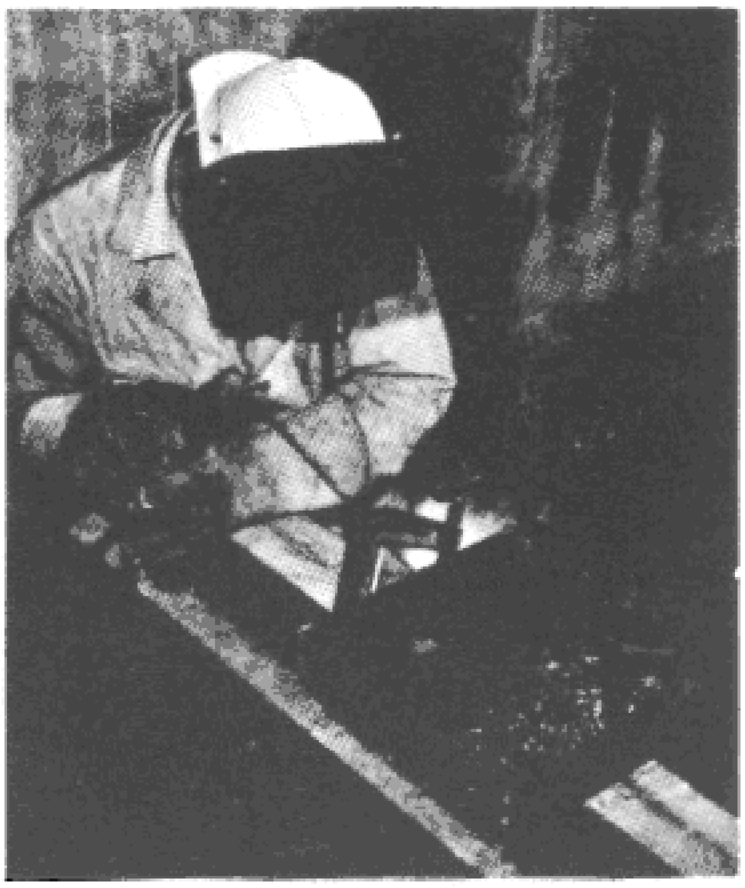
Mine Safety Appliance recommends a filter shade #10 for arc welding up to 250 amperes and #8 for heavy acetylene cutting and welding. Welders masks or helmets, eye and head shields are designed to give maximum protection to the wearer. The helmets themselves are generally made of fiber or fiber glass. The glass inserts are shade #10 filter glass, like welder's goggles. They also are protected by a clear glass cover-plate and the steel frame for the glass is insulated. Some models have an inner protection of safety glass.

Welder's helmets can be used with separate cap type safety helmets but are more easily used with the "combination" safety and welder's helmet. On these the welder's helmet or mask is hinged onto the safety helmet. It can be moved clear of the face easily between welds. N.E.M.I. companies supply welders and burners goggles or helmets to field men as required.

There are other types of masks or shields used on our work occasionally. These may be required when cleaning hoistways, working with solvents or similar jobs and they are supplied by the company.

7. Wear glasses or goggles when handling blow torches or molten metals such as babbitt. Also, when working adjacent to welders, be sure to wear goggles with side shields and Calobar lens and any other necessary protective devices.

8. Gloves and gauntlets should be worn at appropriate time. Whenever welding or burning be sure to use approved types of gauntlets, i.e., leather or asbestos on arc or gas welding respectively. Do not wear gauntlets when handling molten babbitt or the other fluid metals. Use gloves that are tight at the wrist so the metal cannot splash into the glove. Gloves will protect the hands when chopping concrete, or handling steel, lumber or other rough materials. They are dangerous near moving rope sheaves and similar parts.



A Mechanic Well Equipped for Welding

9. Dust masks and other types of respirators are required under certain circumstances. The most commonly used types are those with mechanical filters and range from simple aluminum frames held to the face by elastic and fitted with gauze filters to rather elaborate units with patented filters. Chemical respirators are not required for most of our work. However, when respirators are needed, the elevator companies usually supply them.

10. The wisdom in using the respirators under certain circumstances are obvious. No one wants to inhale grinding stone particles, heavy dust or noxious fumes such as those from some agents used for cleaning.

11. Carbon tetrachloride has been used as a cleaning agent as well as a fire extinguishing chemical for many years. It is effective but extremely noxious in restricted or poorly ventilated areas. One of the worst features of it is that inhalation of "carbon-tet" can affect red corpuscles of the blood and since the effects are cumulative, increasingly serious harm can come from constant usage of the chemical. We do not recommend its use but, if no other cleaner is available, be sure to wear masks and rubber gloves when handling the liquid.

12. Incidentally, the U.S. Coast Guard has ruled that fire extinguishers employing CCL4 (carbon-tet) as the fire quenching agent may not be approved even for use on motor boats after December 31st, 1961.

13. When burning or welding it is wise to use welders aprons and sleeves. These can be of leather, asbestos or other flame resistant materials. They protect you and your clothes from burns and damage.

14. Safety harness type belts are sometimes worn by elevator men. These devices combine supports around shoulders and back as well as around the waist. Some are made of leather, others of strong cotton webbing. Lines or lanyards are snapped to these belts to afford protection for especially risky jobs, such as releasing a counterweight safety in a blind hoistway.

15. The general rule applying to clothing and equipment in the building trades is to consider the work you are about to do and equip yourself properly. Remember also, you have a responsibility to the men working with you as well as to yourself.

CHAPTER 2
Section -c1

SAFETY

Methods

1. This subject could be expanded to many pages. It is our aim to merely outline a few of the more basic practices for the man new to elevator field work.

2. These include:

a) Never enter a hoistway unless you look up to be sure all is clear above.

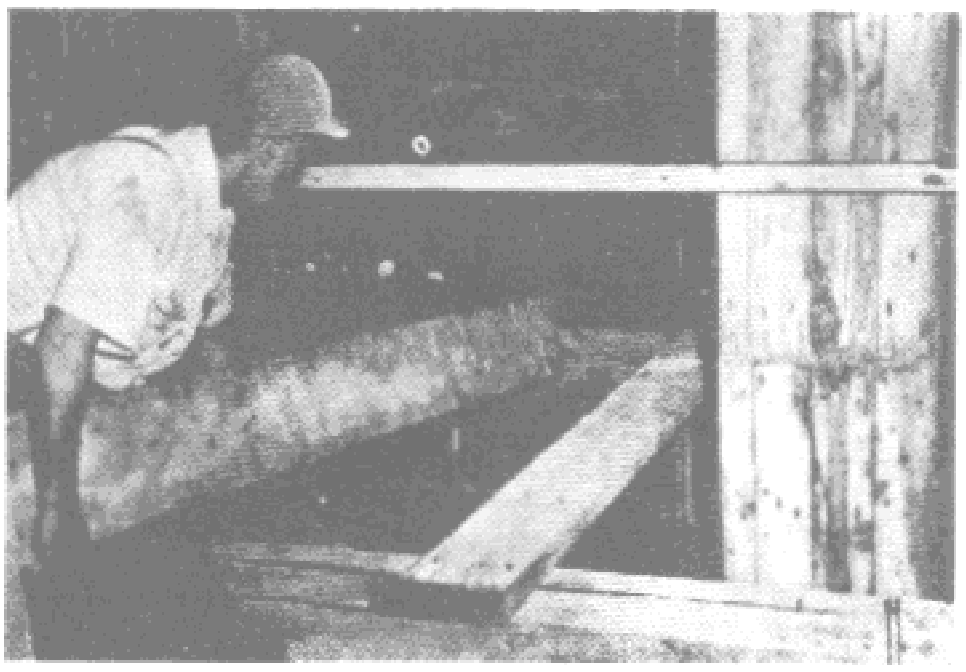
b) Check your planks or scaffolds before stepping out on them. Block them securely against tilting or slipping.

c) Do not work in a dark hoistway or under other men unless you have protective scaffolds over you.

d) "Skips" or "false elevator cars" should have safeties, if men are to work from them. The "haul" line or rope fall should not be removed from the car while men are using it.

e) Handle electric power carefully, especially in damp or wet weather.

3. Plan your jobs carefully. Make sure your methods are safe and sound. Several years ago the University of the State of New York sponsored a study of state wide industrial accidents. Seventy-three per cent of those studied were directly caused by unsafe action of some individuals. About twenty-five per cent more were caused by defective or dangerous equipment but a good part of these were created by acts of individuals. In all, about eighty-eight per cent of the accidents were therefore caused by unsafe acts of individuals. Fortunately, we have few fatal accidents but we have many "lost time" situations. Do your part to keep the rate low.



Sound Planks Should Be Well Secured

CHAPTER 2
Section -d1

SAFETY

Tools — Manual

1. In the intent of this article manual tools are described as those manually operated tools normally carried in a hand tool kit by elevator constructors. This includes the basic kit owned by the mechanic and those specialized supplementary ones which the companies supply to suit their equipment.

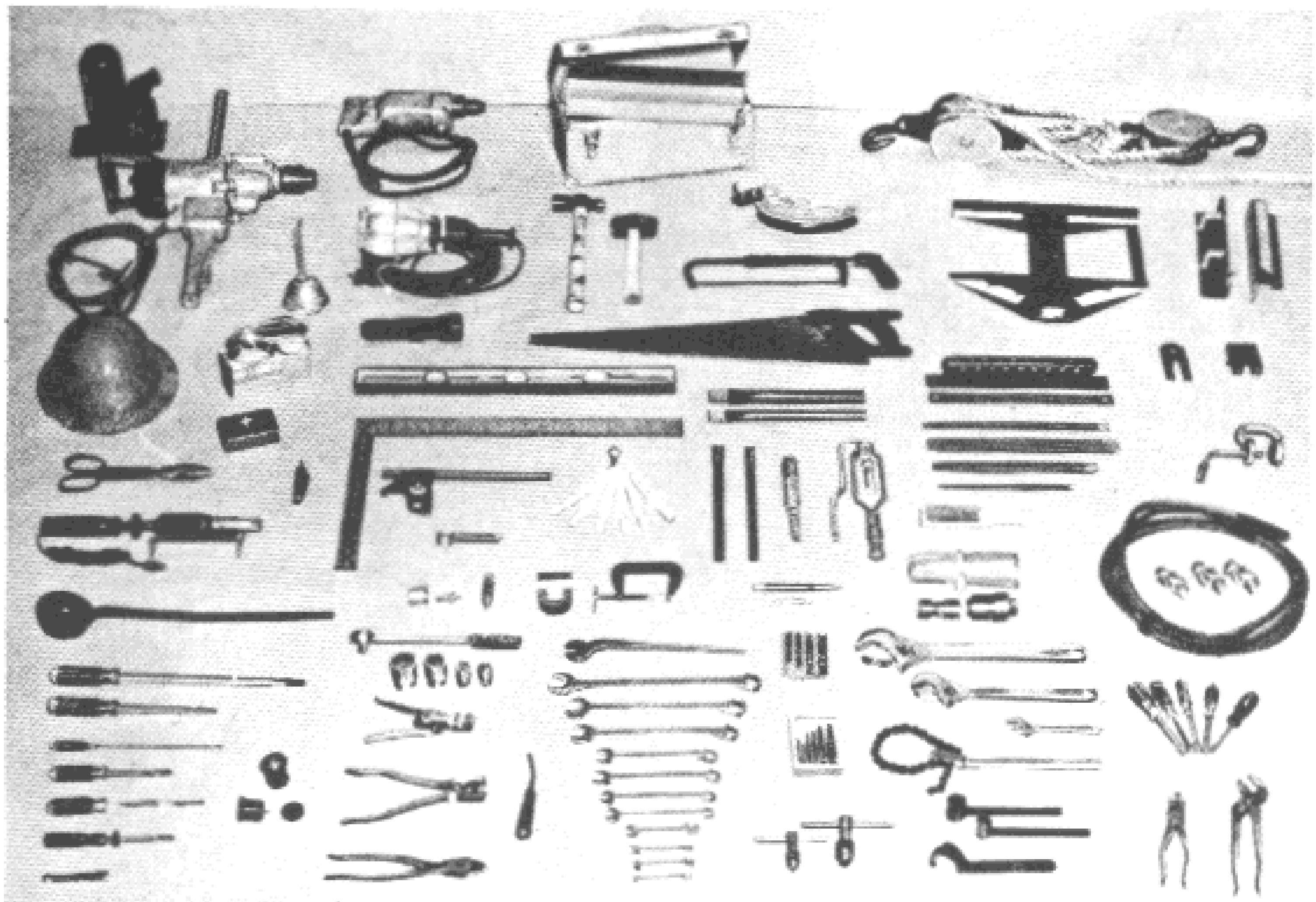
2. It is traditional that a good craftsman maintains an adequate kit of quality tools. It is also common sense since proper tooling makes hard work easier.

3. Good quality tools designed to do a particular job are safer than poorly designed, makeshift items. This does not mean that the most expensive tool of any type is the best. Chrome plate does not give any indication of the steel it covers. However, generally speaking, "name brand" tools are usually well designed for their job and are of good quality. When you are ready to buy tools, ask advice of the better mechanics you have been working with.

4. While helpers are not required to carry tool kits, we suggest that they can make their own jobs easier if they have at least a few items. A pair of slip-joint pliers, pocket knife and a 6' spring-joint folding rule are sufficient, in most cases. Gradually adding to this start will simplify obtaining a full kit when the helper becomes a mechanic.

5. When using tools, use the right tool properly:

Keep tools free of grease and oil. Hammer with a hammer only and use the proper type. Ball peins and claw hammers are not interchangeable in use. Ball



A Good Basic Tool Kit for Elevator Mechanics

peins are a machinist type whereas the flat face of the claw hammer is intended for driving nails. Stone mason's hammers are intended for extensive masonry chopping. The ball pein is therefore, considered most suited for general elevator installation work.

Steel hammers should be drop-forged of high grade steel such as chrome molybdenum. Non-ferrous hammers must be used in explosive atmospheres. These are generally bronze. Other specialized types include rubber, lead and rawhide faced hammers.

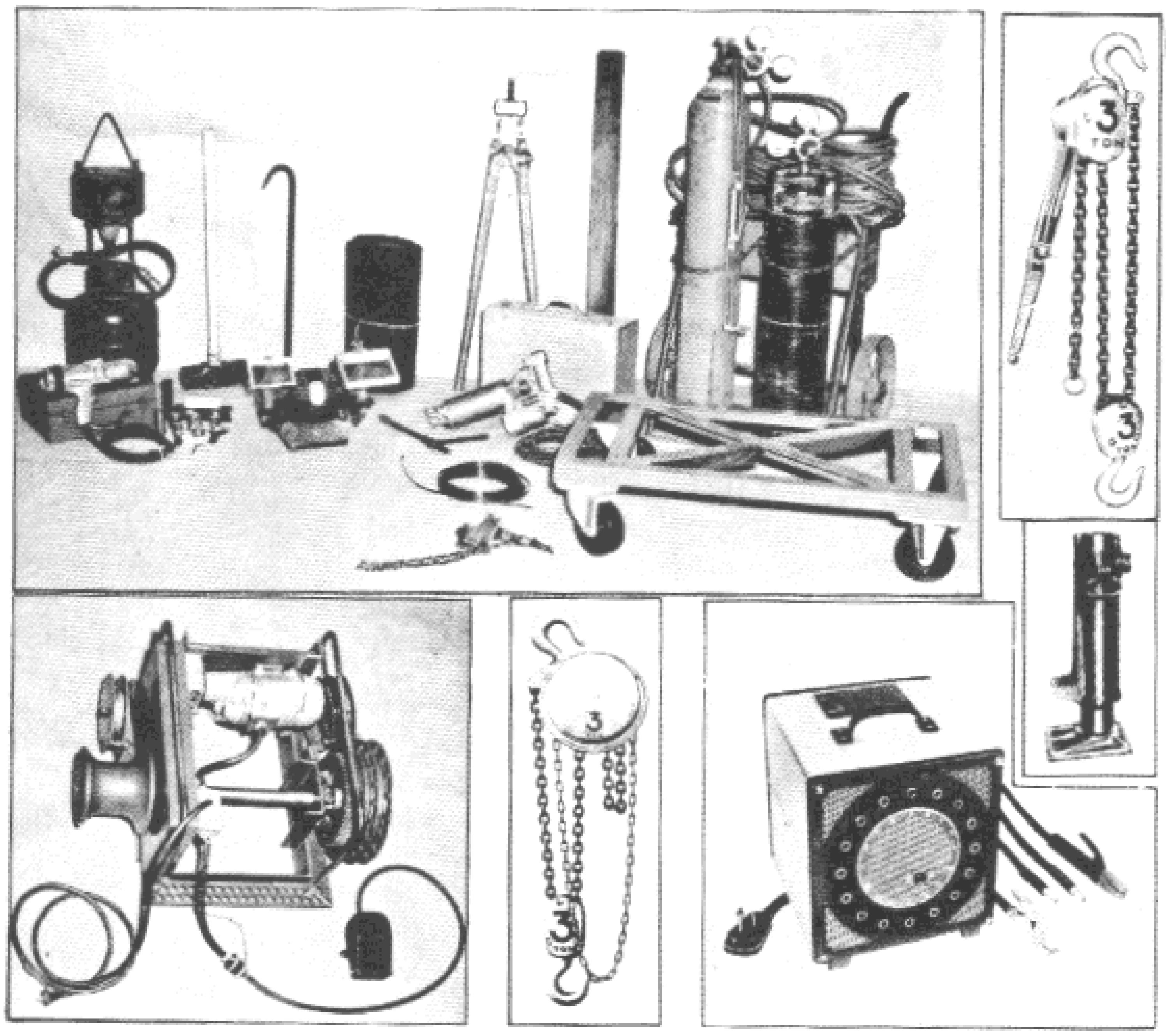
Cold chisels should be properly sharpened to do clean work. Striking heads must be dressed, if they begin to "mushroom" or roll over.

Goggles should be worn when chopping.

Screwdriver tips should fit the screw heads snugly and they should not be used as prys or chisels. Plastic handles are very practical but some are flammable. This does not detract from their utility beyond requiring care not to expose the handles to high temperatures.

Wrenches should be pulled whenever possible. When necessary to push a wrench, do so with the heel of the hand as far as possible. Use socket or box wrenches where practical, and open-end rather than adjustable wrenches. When adjustable must be

Power and Other Safe Tools For Heavy Work



used, set the wrench on the work so the stationary part of the jaw is opposite the direction of pressure. Socket, box and open-end wrenches should fit the nut and bolt head properly. Files should be used with handles to prevent injury from the tang end. File teeth should be kept clean to avoid slipping as well as to assure good cutting. Use a file card (wire brush) for this purpose. Do not use files as prys, center punches or in any way except as a file.

When using a knife, cut away from yourself. Keep knives sharp. Many types of pliers are available. Side cutting (or "lineman's") pliers are very commonly used in our work. Do not cut live wires. Serious burns and shock have resulted from failure to observe this common sense rule. Other electrical type pliers used are diagonals, needle nose, wire stripping pliers and eyelet setting pliers. Learn the use of each kind and apply the tool to its correct work. Slip-joint pliers with straight and angle heads are in most elevator constructor's tool kits. Application to work is wide but they should not be used instead of proper wrenches. Old fashioned gas pliers are very useful for turning in ropes. However, since their other usage is limited as compared to newer types, many men use slip-joint or even heavy lineman's pliers for turning in ropes. With them more care must be used to avoid deformed strand turn-in and to avoid injury to hands from the springy rope wires.

Hack-saw frames should be substantial and hold the blades straight and tight. Cracked blades or those with broken teeth should be discarded.

6. The list of precautions to be taken when using manual tools could be extended indefinitely. The ultimate result would not change however, unless each man exercises reasonable care, especially when working in an exposed area such as a hoistway.

Blow-torches are being replaced to a great extent by propane gas tanks with furnace heads or with hoses and torch heads. However, many blow-torches are still in use. Be sure they are in good condition, especially if gasoline is the fuel.

Connections should not leak, the check valve at the bottom of the air pump is extremely important in this respect. Do not pump while torch is lit. Do not fill a hot torch with gasoline or kerosene.

Handle filled babbitt ladles and pots with extreme care. Do not pour babbitt on wet or damp surfaces.

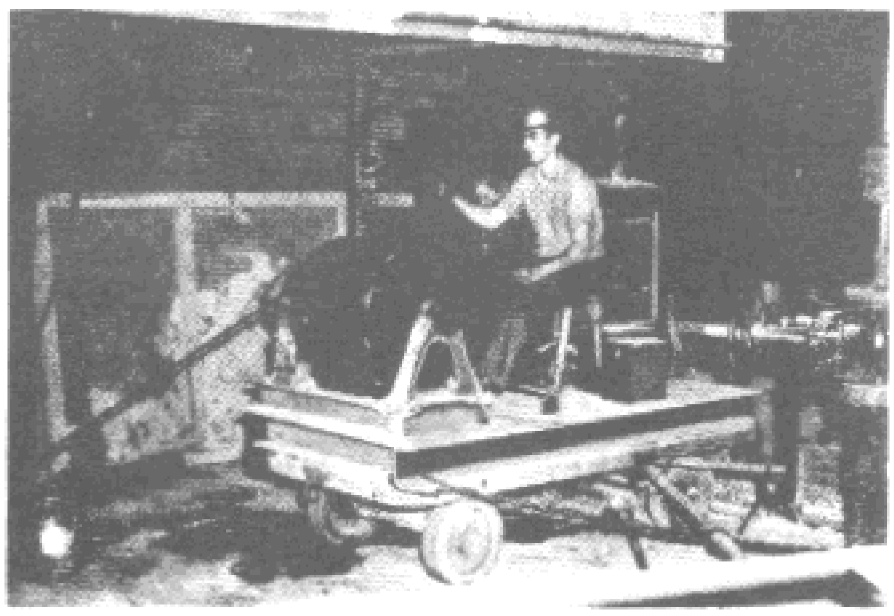
CHAPTER 2
Section -d2

SAFETY

Tools — Small (Power)

1. Most of us tend to think of "power tools" as only those electrically driven, such as drills and grinders. Actually the term can be more comprehensive and we intend it to be so in this article. Hydraulic jacks, punches and conduit benders for example, derive power from the oil compressed in their cylinders.

2. The building trades have adapted many small power tools to the industry in the past fifteen years. Elevator constructors and the companies of N.E.M.I. have been quick to apply these tools to our trade where practical. Without doubt, the greatest number of types are electrically powered. Generally these tools are safe, easily handled, efficient and do a good job if properly applied.



Medium Capacity Gasoline Powered Hoist

3. Some of the tools in this class which are commonly used in our

work are electric drills (normally equipped with "keyed" chucks), impact tools such as electric hammers (both manually rotated and self-rotating types), nut runners and also tapping tools. These latter types have torque clutches that are set to slip at a predetermined point and the drive units are reversible. Also used are portable electric reciprocating and band types of hack-saws, soldering irons and guns, blowers, grinders (both bench and portable), and of course various meters for testing and adjusting. Other tools are used on special jobs. These include buffing machines, spraying devices, sanders, and electric wood and metal cutting saws.

4. When using portable electric tools, observe the following precautions:

a) Be sure condition of extension wire is satisfactory, plug is good and also, that the wire has sufficient capacity to carry the required "load" or amperes.

b) Examine and test the switch. (Drilling in a hoistway can become very hazardous, if the switch of a large drill does not cut off the power when the switch is released.)

c) Do not overload the tool.

d) Do not stall the tool.

e) Be sure the tool housing is grounded by a third wire.

f) Do not lay the lead wire on greasy, oily or hot surfaces, and do not place it where it can be mechanically damaged or will cause a tripping hazard.

g) Check tools each day before beginning to use them and be sure motors, gear trains, and chucks are well maintained.

h) Never stand in water when using electricity.

5. Hydraulic jacks and similar tools save a tremendous amount of hard work, handle them carefully. See that oil levels are correct and the oil is of proper grade. Set bases firmly on sound supports. When blocking is used, be sure it is substantial and square with work and jack to avoid the danger of "kicking." These tools are powerful. Do not exert enough pressure to break the parts which are being shifted or the supports. A chip of broken casting thrown from a bedplate, because of excessive pressure being applied, can cause serious injury. Obviously material damage can also be great.

6. While furnaces and blow-torches fueled by propane gas are not strictly power tools and were mentioned in Chapter 2-dl, it is worth noting that the fuel used in these tools is highly inflammable. When using these be sure to handle tanks so that connections are not damaged and be sure no leaks exist. Note that threads of gas fittings are "SAE" (fine) and that they are cut in reverse of ordinary bolt or pipe threads.

7. See preceding sections of this chapter for general precautions.

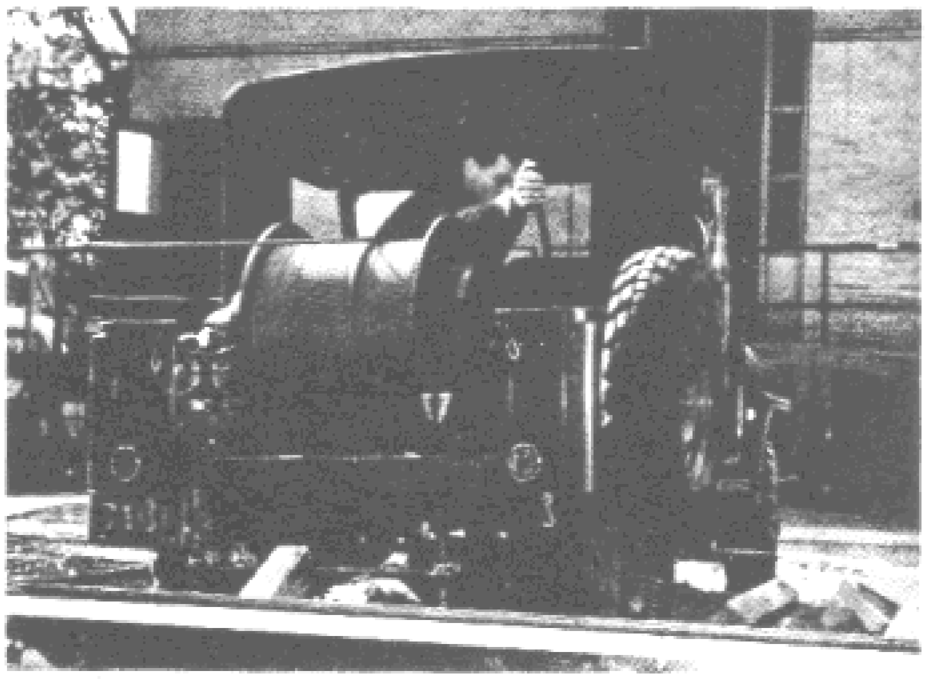
CHAPTER 2
Section -d3

SAFETY

Tools — Heavy (Power) — Skips — Scaffolds

1. The efficiency of any construction project is greatly affected by the ability of the general contractor to coordinate sub-contractors in the scheduled orderly and safe transfer of their materials from job-site entrances to their ultimate position. "Orderly" was noted first since orderly processes induce safety.

2. Ability to safely achieve high efficiency in material handling has been one of the factors that most impress foreign building tradesmen, many of whom visited the United States and Canada, during the past fifteen years. Whether the men were architects, builders or tradesmen, the general reaction has been surprise that large buildings can be completed within what are, to the visitors, short project schedules.



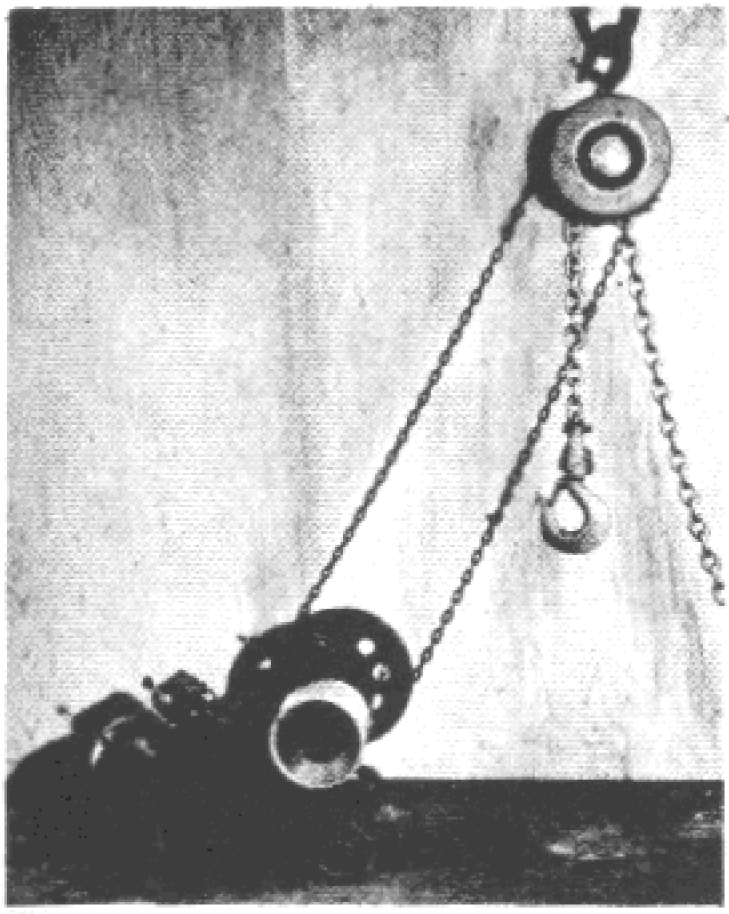
Drum Hoist Mounted on Jeep

3. Since relative skills of men in the industrialized countries are comparative, it is evident that much of our advantage is derived from exploitation of the use of power equipment. Sound safety practices make this usage "pay off" to all involved in the installation of elevators. (Incidentally, the gap in efficiency factors between the United States, Canadian (domestic) and the European building trades is narrowing considerably. England, Germany, France and Italy are continually mechanizing and improving field methods.

4. The use of heavy power equipment in our work involves secondary equipment such as "skips," false cars, scaffolds and sundry tools. Because their use is usually tied to power-driven equipment they will be mentioned here.

5. The two basic types of power sources for the elevator industries field tools are electricity and internal combustion engines. Both have specific advantages in similar fields under certain circumstances.

6. Gasoline or diesel engines often drive hoisting machines for large or medium sized elevator installations. They usually have a winding drum that is connected to the engine through a three or four speed transmission and clutch, which permits a choice of speeds, depending on the type of material being hoisted. The advantage of



Electric Powered Chain Hoist Driver

this type of power is that it is independent of building power supply. A few disadvantages exist. One is that an exhaust line to open air is required by many city ordinances. This can present a problem if the elevator hoistways are deep inside the building. It is important to exhaust the gas where it will not affect other men or yourself. Flexible metal tubing is often used. Another disadvantage is the need to maintain a fuel supply. If the fuel is gasoline, the allowable reserve may be quite limited. Warning signs should be prominently displayed around the fuel storage area and hoist. Combustion engine maintenance can be troublesome too, in comparison with electric motor maintenance.

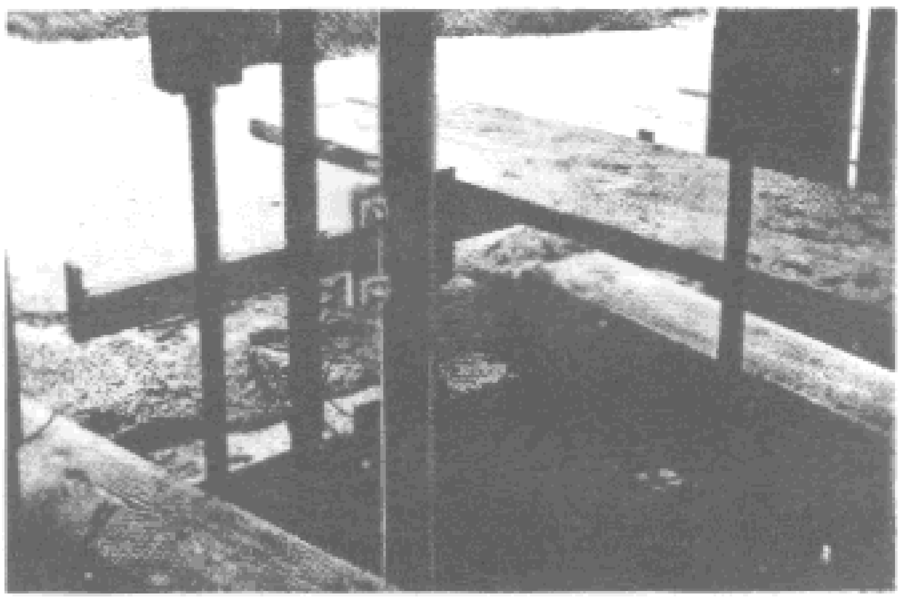
7. Combustion engine hoists range from small "wheelbarrow" type units with a single line pull of a few hundred pounds to heavy trailer units that can pull several tons on a single line. All can be "reeved" or roped through pulleys to lift heavier loads at slower speeds. Hoists should have manually released brakes that apply automatically.

8. These hoists must be tied or blocked to the building structure in such a way that the loads can not overbalance the hoists and lift them out of position. Rope leads should be guarded so men cannot walk into them. Rigging must be sound and all blocks and the ropes carefully inspected periodically. Intervals of inspection depend on usage. Loud single-stroke gongs should be used for signaling and these can be supplemented by field telephones or a "talk back" P.A. system. Operators should be thoroughly instructed in the safety features and in general hoist operation as well as load hoisting practices. Suitable fire extinguishers should be mounted on the hoist and near the fuel storage. Fuel supplies should be locked when unattended. Where a hoist platform is used it is good practice to mount a bell under it, arranged to ring constantly when the hoist is moving. Some cities require this.

9. Where no hoist platform is used, it is advisable to build a guide jack that will ride the permanent elevator main rails and guide the loads being hoisted (see chapter 3-c1). This practice minimizes the chance of a load "hooking up" under a beam or projection. It is most important when lifting machines, controllers and other bulky material.

10. Working areas around the hoists and its loading zones should be well lighted and kept clean.

11. Electric powered hoists are similar in most respects to the I.C. (internal combustion) engine hoists and are subject to the same general safety arrangements. However, there is little danger of fire or asphyxiation and no fuel depot is required. No clutch is used. The machine should be grounded. Some disadvantages are that



Special Channel Brackets for Plank Scaffolding

power is not always available and it is often costly to obtain a power supply. This is particularly true for larger sized hoists where three phase power is needed. Power consumption is sometimes high in cost too.

12. Electric hoists are available in many models and sizes. They range from simple gear box to drum drives on small motors, to large machines about identical to those driven by the larger I.C. engines. It is generally believed that some form of automatic brake should be on units to take over if the hoist operator should lose control. Warning signs should be posted on power supply switches.

13. Skips, moving scaffolds or false cars can be installed on the guide rails of the elevator being erected. These can be lifted by the power hoists or on small jobs by rope blocks and a fall. They should be adequately constructed of light-weight materials, have substantial working platforms and be equipped with an automatically applied safety. In some buildings a covering over the men's heads will be required. The hoist rope should not be removed from the lift ring or hook while men are on the platform.

14. As a matter of emphasis we repeat that when planks or scaffolds are used to install equipment, the material must be sound, carefully placed and blocked against movement. It may help you to appreciate the seriousness of this seemingly simple work to know that while this article was in process an accident report was received from one of the mid-east (Mediterranean) elevator agents. While placing a plank across a dark hoistway, a "green" helper slipped, fell and was killed by impact.

It can happen here!

15. Chain hoists and chain pullers are useful tools. See that they are hung plumb, unless the manufacturer specifically advises that they can be used at angles to the loads. Hooks should be "moused," that is, a wire tied across the hook so the supporting steel wire rope sling cannot slip off the hook. Special clamps for this purpose are commercially available also. Chain hoists should never be overloaded. The hoist should be inspected before use to assure that the load and hand chain feeds are correct, and that the brakes are in good condition. If "pullers" with roller or bicycle type chains are used, be sure that the "flats" of the chain are in line with the pull of the load.

16. Rope falls should be manila hemp, not sisal, and should be kept as clean as possible. Never store rope in a barrel or any other place where air cannot dry out wet or damp sections. Keep rope away from chemicals, including lime.

17. Rope-fall blocks should be iron or steel bound; preferably they should have ball or roller bearings and wood cheeks. The sheaves should fit the rope fall. If "bushing" type blocks are used instead of ball bearing, lubricate the bushing shaft, or "axles" and check the "axles" to be sure no serious wear exists.

18. All wire rope slings should be steel. They should be protected where loops of slings pass over sharp edges such as steel beam flanges. Clamps should be of Fist-Grip, Crosby or equal and installed correctly. (See chapter 3 on rigging.)

19. Gas and oxygen tanks, hoses and gauges should be carefully handled. Oxygen should never be used to blow dust from clothing as the oxygen will cause a flash fire if exposed to spark or flame. Leaky equipment should be repaired or replaced.

20. Burning, cutting or welding should not be done in hazardous atmospheres. Fire extinguishing apparatus of proper types should be at hand and you should learn their correct use. As an alternate, buckets of sand or dirt may be used to extinguish oil or most other types of fire. Water can be used on wood or cloth fires.

21. Welding units are of two general types — transformer units, powered by a primary electric line, or internal combustion engine power types. Both are subject to the same general safety precautions that apply to their respective kinds of power hoists. In addition, however, care must be exercised to have clear working areas and fire protection before striking an arc. Warn other men to keep clear. Before striking an arc, select a safe area in which the electrode holder may be placed when finished welding to avoid possibility of accidental flash.

22. Light all working areas and keep them clear of refuse.

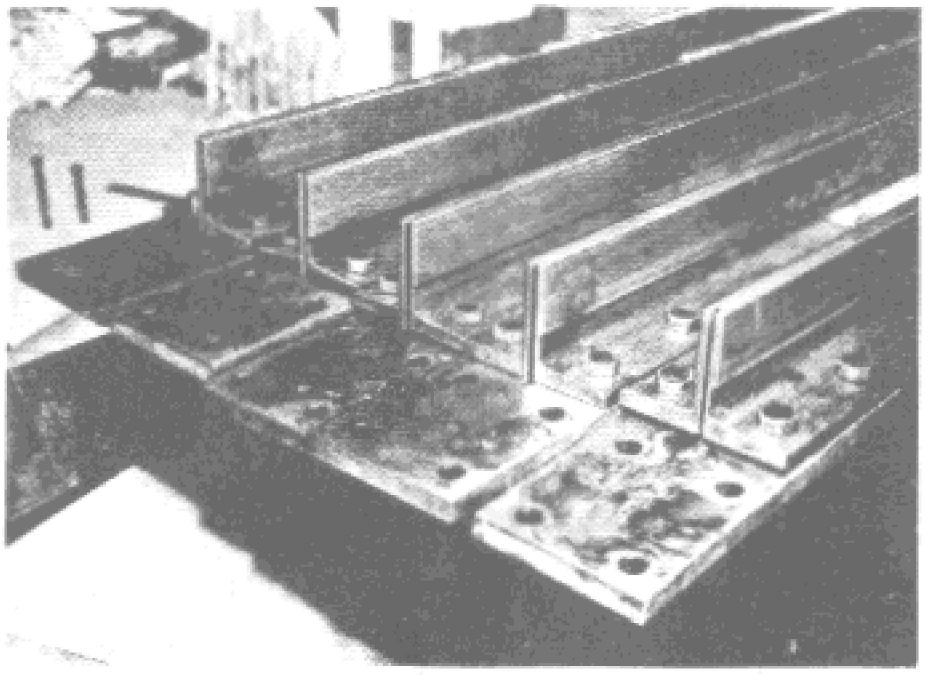
CONTENTS

CHAPTER 3

CHAPTER 3
Section -a1

HANDLING MATERIALS, RIGGING AND HOISTING

General



Orderly Guide Rail Storage

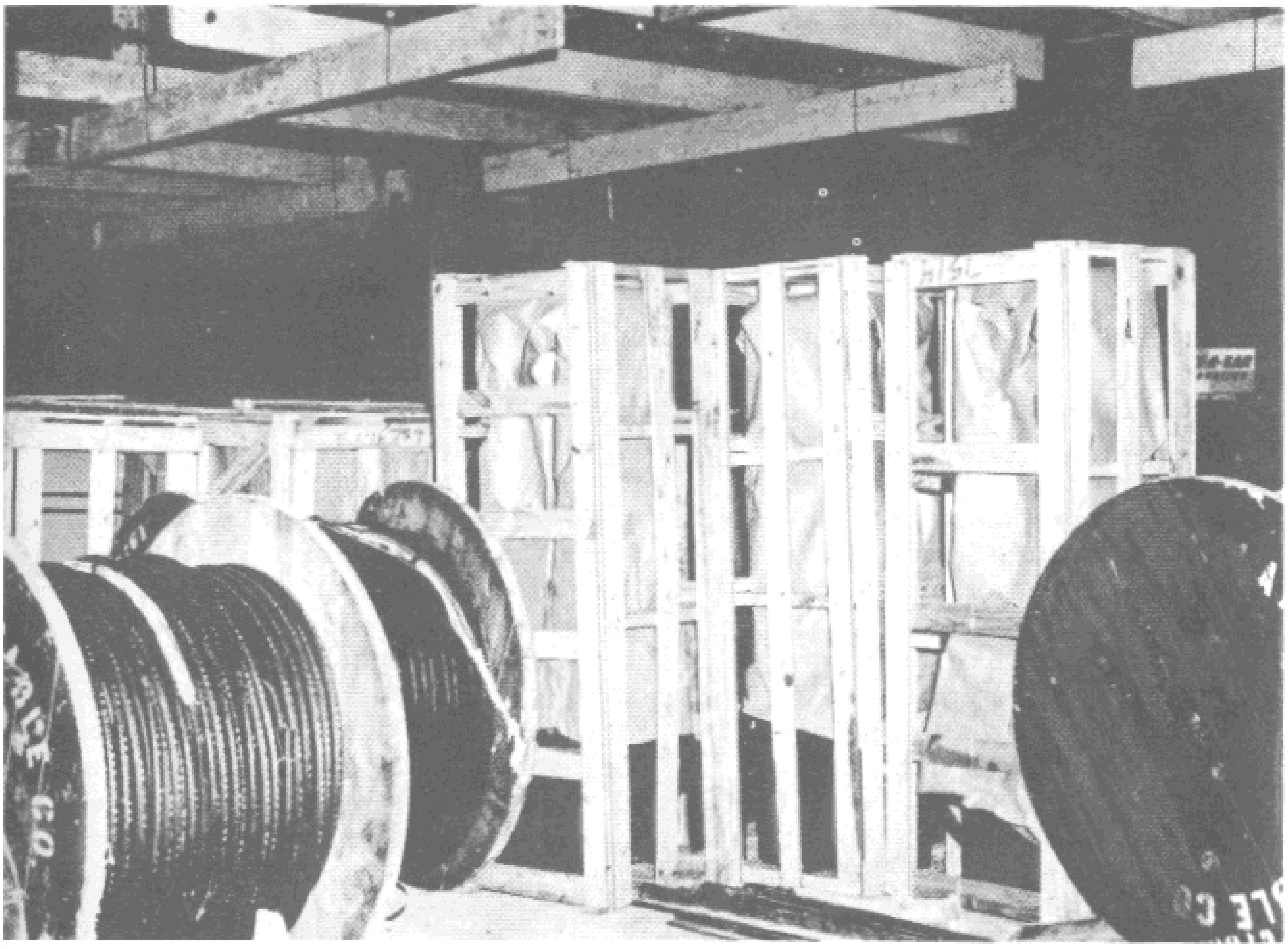
1. The storage and handling of elevator materials on a new construction or modernization site are important factors in the satisfactory processing of the work. This is a point that is sometimes overlooked. The job will progress more smoothly and the men will have less heavy work if proper planning is devoted to these preliminary field operations.

2. Tools for the proper handling of materials should be provided for each job. These are usually sent by the elevator contractor with the first shipment of materials. Where building steel booms or derricks of sufficient capacity and in the proper location are available, it is safer and often more economical to lift the machine room equipment directly from the delivery truck to the machine room. In other cases this heavy equipment must be unloaded, stored and hoisted by alternate means. Sometimes portable cranes are available. Often machines are unloaded from trucks by means of rollers on skids, using a chain puller or rope fall to hold back the load.

3. Storage area on the jobsite is arranged between the superintendent, foreman or lead mechanic and the building contractor's superintendent. Material should be placed as near the hoistway as safely and conveniently possible. On conventional jobs an effort should be made to place the guide rails on blocking with alternate ends facing the hoistway (i.e., half the tongues and half the grooves). The machine room equipment, which is heavy, should also be set adjacent to the hoistway and in such a way that the machine will be the last piece hoisted. This minimizes double handling and permits the machine to be set in its permanent position immediately after hoisting.

4. Where building conditions permit it, entrance frame boxes should be placed near their respective positions at the various floors.

5. Small boxes and packages, especially ornamental or fragile parts, are best stored in shanties, locked rooms, or large boxes.



Typical Storage of General Materials

6. Shortages, such as missing boxes, should be so indicated on the delivery sheets presented by the truck driver for signature. Damage to packages should also be noted on these sheets. In most cases, it is also advisable to report shortages or damage to the superintendent or office by telephone before the truck driver leaves the site. Damaged packages should be left unopened until the elevator superintendent and/or an insurance claim adjustor have approved their being opened.

7. Once materials have been received and stored, rigging is set up for rail work and subsequent operations. These steps are more completely described in their normal sequence throughout the book.

8. During the course of the installation all work areas should be kept clear of debris. Tool and material inventories should be carefully watched for shortages, especially small sundry items such as bolts, drills, cleaning agents and rags. Orders telephoned to the office in advance will often avoid unnecessary delays that could occur if shortages develop.

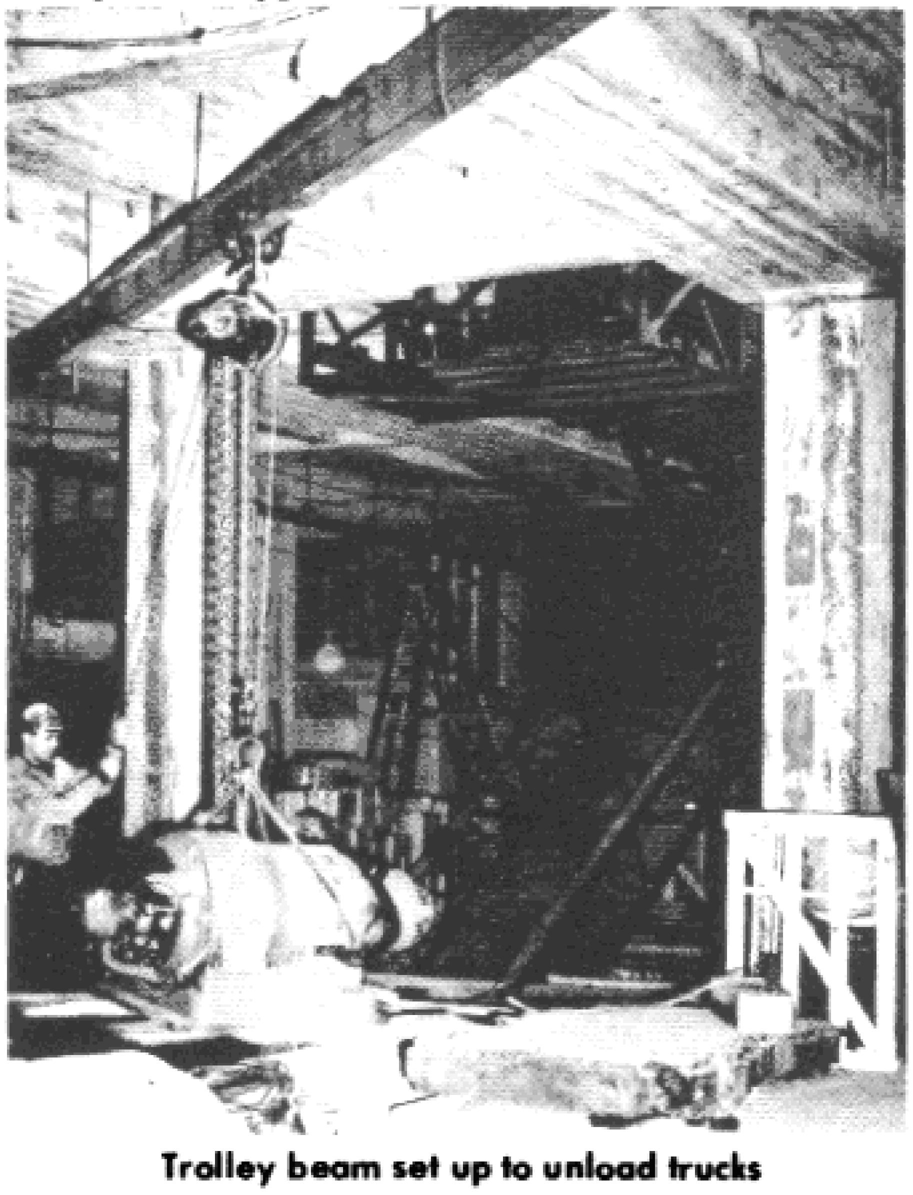
9. At the conclusion of the job the foreman should assemble all excess material, tools and boxes in one place, then call for a truck and return them to the shop or office, or get the "supers" approval to otherwise dispose of them.

CHAPTER 3
Section -a2

HANDLING MATERIALS, RIGGING AND HOISTING

Tools

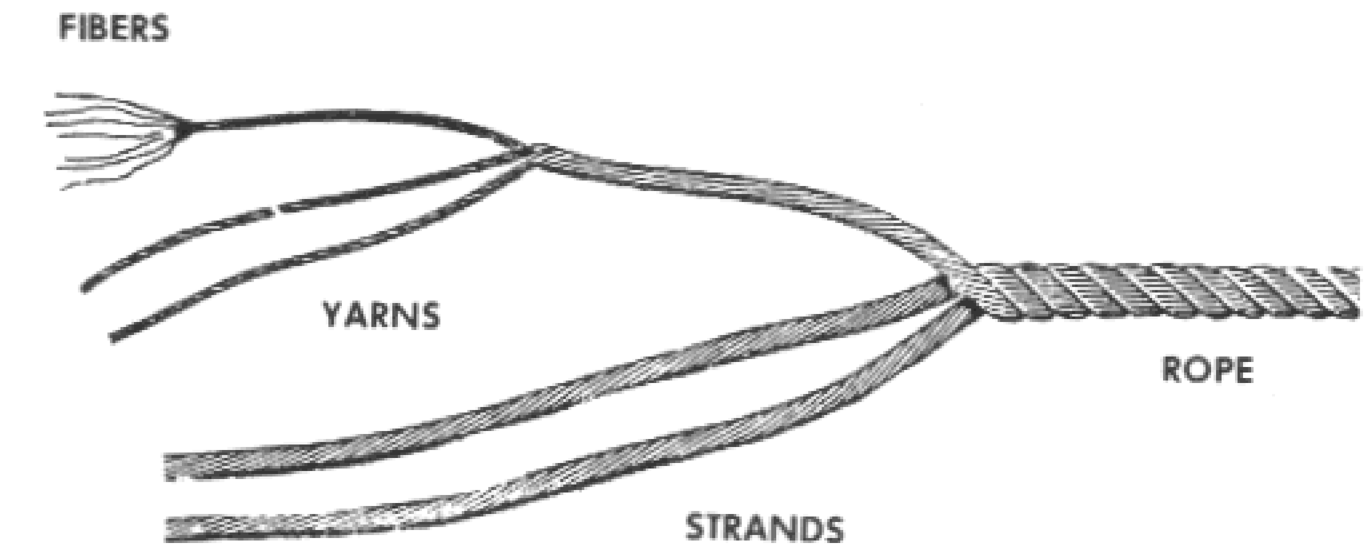
1. The impact on industry of the tremendous advancements made in portable tools for handling of materials during World War II was not felt until after the first edition of this book was released. The stress on need for quicker, lighter, tougher and more easily handled tools for moving heavy equipment from landing craft to beach and in the field operations not only caused development of new materials for tools and their manufacture; it also conditioned us to look for and use these tools. The Korean War developments added to this. As a result, we today employ in our industry many field tools and techniques that "old timers" never had. For example, although heavy power hoists were used on large elevator installations for many years, we now have small, light-weight hoists on a great percentage of installations. Some of these are used for direct hoists but a number are designed as "tackle drivers" and eliminate the laborious part of using chain hoists and rope falls by hand. The chain hoists themselves are often made of aluminum alloys so light that a 3 ton hoist can be easily slung with one hand. Chain "pullers" are even more convenient for limited work. Some are equipped with conventional link chain. Others have the "roller" or "bicycle" type chain. Both can handle their rated loads safely but the "bicycle" type should be hung vertically with respect to its flat sides. Some elevator companies standardize on the conventional chain type because of this limitation.

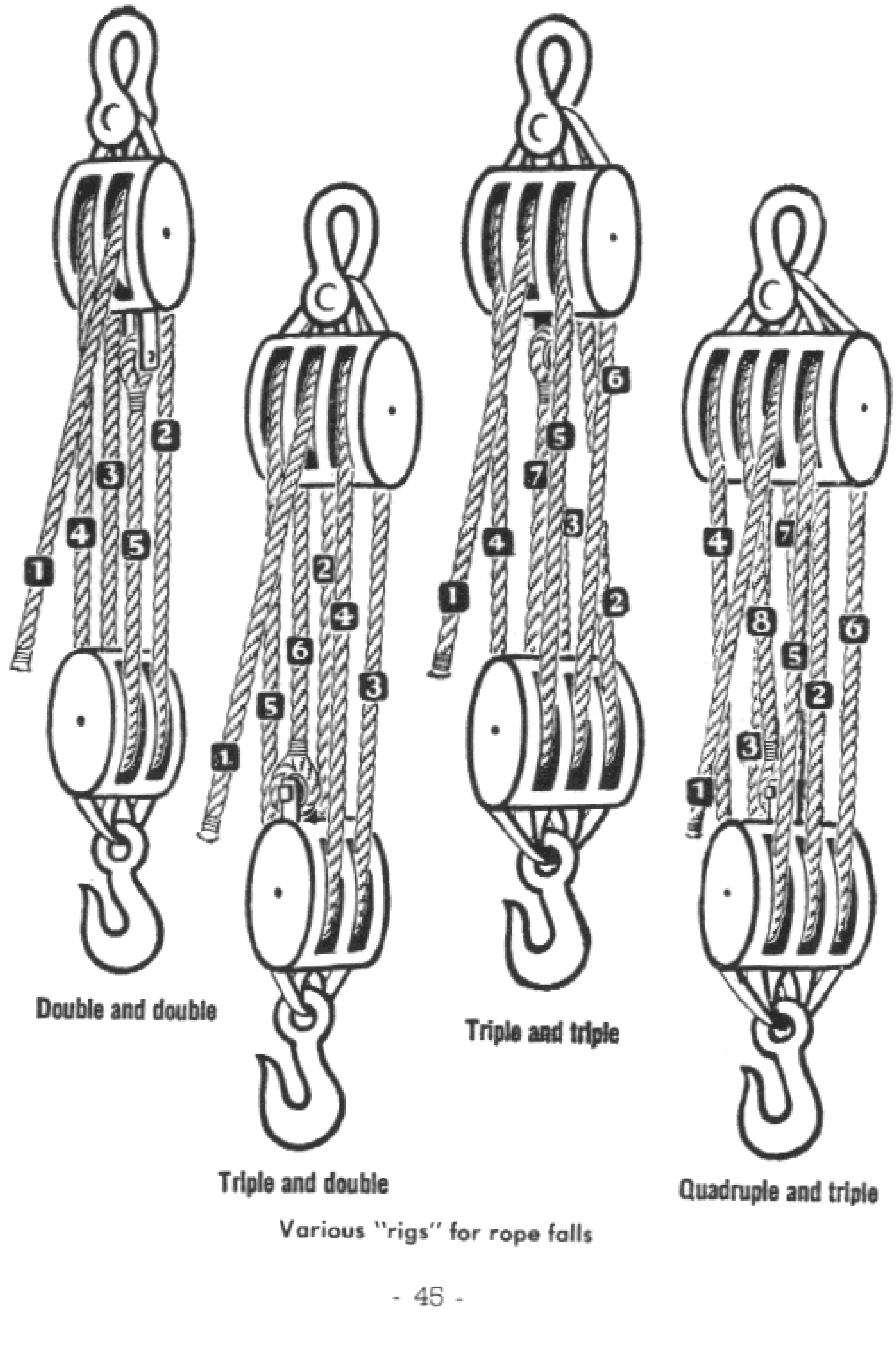


Trolley beam set up to unload trucks and handle material

2. More compact hydraulic jacks also assist in our work. Pry dollies, conventional dollies, fork lift trucks, derrick equipped jeeps and other motorized equipment are also used by elevator constructors. The old standard Crosby clamps and the newer "Fistgrips" offer a choice in the area of securing slings. Crowbars, rollers, skids, jacks and planks are still among the most important of our material handling tools.

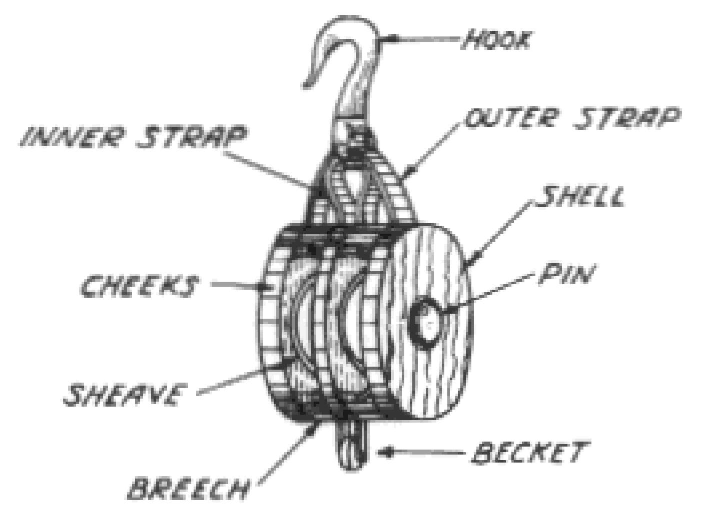
3. The next few pages illustrate some of these items. Knots, rope capacity charts and data on reeving rope falls are also included.





Various "rigs" for rope falls

4. A few suggestions on tools are:



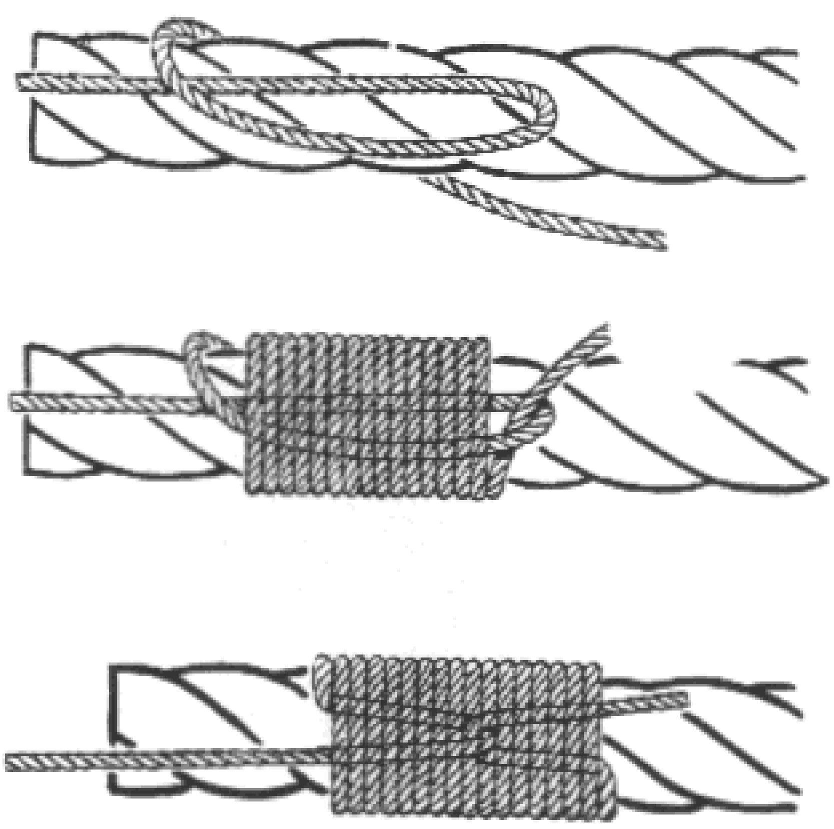
PARTS OF A BLOCK

Where timbers are used to support rope or chain tackle, they should be set on edge to obtain the benefit of their full strength. They must, however, be carefully braced so that they cannot tip or slide. Where there is any chance of "end-thrust" on such supports, install kick blocks to compensate for it.

Use standard clamps on wire rope ends. Never use less than two on each. The various manufacturers of these clamps issue data on their own products. It is recommended that such information be distributed among the men of the elevator industry in accordance with the tools supplied to them.

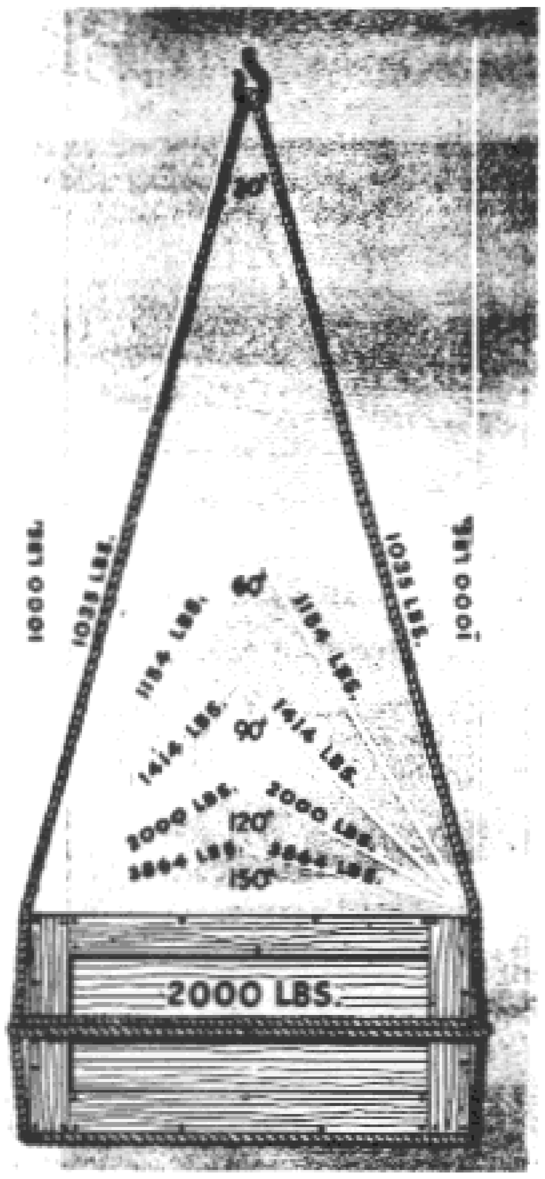
Use only conventional knots on hemp ropes. These have been time tested, some of them for centuries, and their characteristics are well known.

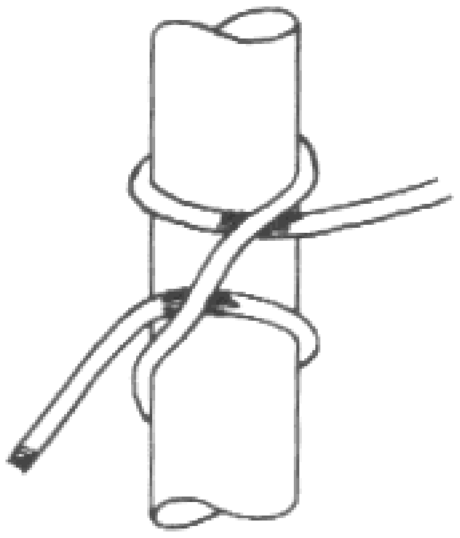
Other items are listed in chapter 2 under "Safety."



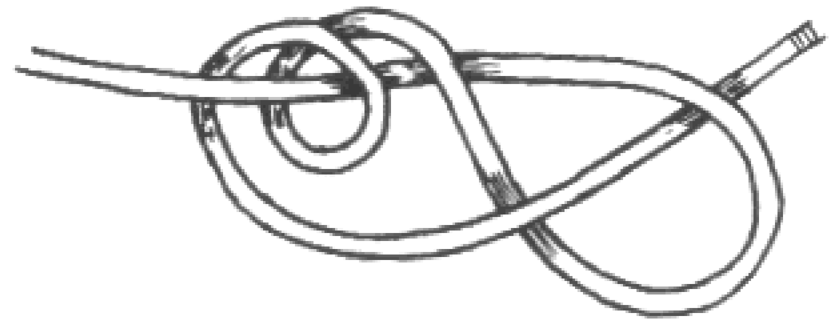
Method used to "whip" a rope end

Demonstrating that the angle of a sling affects its strength

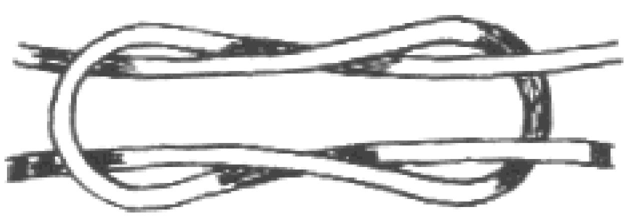




Clove Hitch



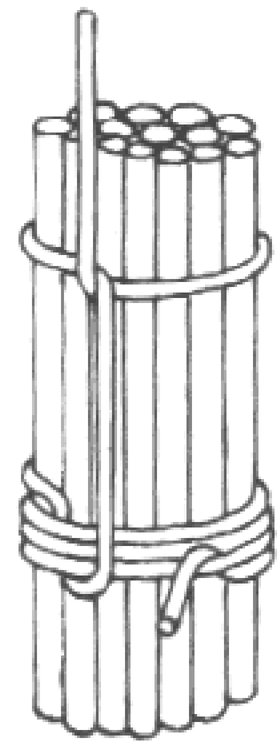
Stevedore's Knot



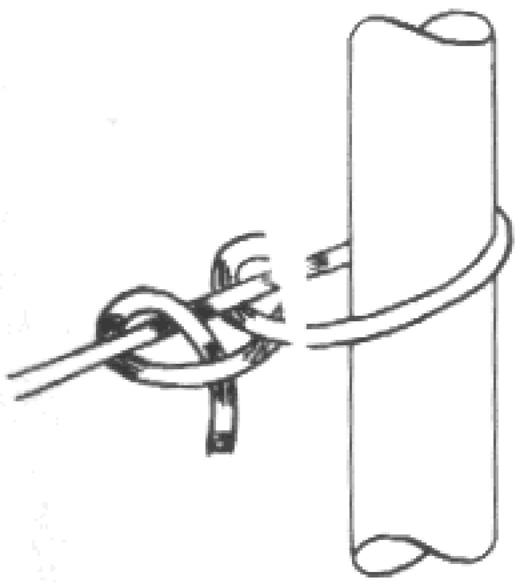
Square Knot

Bowline

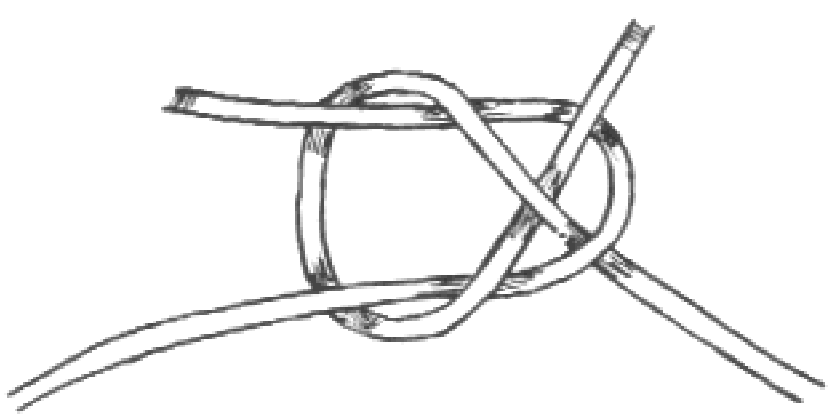
Slip Knot



Pipe Hitch



Two Half Hitches



Sheet Bend

COMMON KNOTS

NOMINAL SIZE			WEIGHT PER 100 FEET (NET)	LENGTH NO. OF FEET PER POUND	GROSS WGT. APPROXIMATE FOR FULL COIL	FEDERAL SPECIFICATION TR-601a (MANILA ROPE)	FEDERAL SPECIFICATION TR-631 (No. 1 SISAL ROPE)
THREADS	CIRCUMFERENCE	DIAMETER					
	Inches	Inches	Pounds	Feet	Pounds	Pounds	Pounds
6-Fine	9/16	3/16	1.40	71.6	50	450*	360*
6	3/4	1/4	1.92	52.2	50	600*	480*
9	1	5/16	2.71	36.9	50	1,000*	800*
12	1 1/8	3/8	3.77	26.5	50	1,350*	1,080*
15	1 1/4	7/16	5.15	19.4	63	1,750	1,400
18	1 3/8	15/32	6.14	16.3	75	2,250	1,800
21	1 1/2	1/2	7.36	13.6	90	2,650	2,120
24	1 3/4	9/16	10.2	9.8	125	3,450	2,760
27	2	5/8	13.1	7.65	160	4,400	3,520
30	2 1/8	11/16	14.7	6.82	180	4,900	3,920
33	2 1/4	3/4	16.4	6.12	200	5,400	4,320
	2 1/2	13/16	19.1	5.23	234	6,500	5,200
	2 3/4	7/8	22.0	4.54	270	7,700	6,160
	3	1	26.5	3.78	324	9,000	7,200
	3 1/4	1 1/16	30.7	3.26	375	10,500	8,400
	3 1/2	1 1/8	35.2	2.84	432	12,000	9,600
	3 3/4	1 1/4	40.8	2.45	502	13,500	10,800
	4	1 5/16	46.9	2.13	576	15,000	12,000
	4 1/2	1 1/2	58.8	1.70	720	18,500	14,800
	5	1 5/8	73.0	1.37	893	22,500	18,000
	5 1/2	1 3/4	87.7	1.14	1,073	26,500	21,200
	6	2	105.	.949	1,290	31,000	24,800
	6 1/2	2 1/8	123.	.816	1,503	36,000	28,800
	7	2 1/4	143.	.699	1,752	41,000	32,800
	7 1/2	2 1/2	163.	.612	2,004	46,500	37,200
	8	2 5/8	187.	.534	2,290	52,000	41,600
	8 1/2	2 7/8	211.	.474	2,580	58,000	46,400
	9	3	237.	.422	2,900	64,000	51,200
	9 1/2	3 1/8	264.	.379	3,225	71,000	56,800
	10	3 1/4	292.	.342	3,590	77,000	61,600
	11	3 1/2	360.	.278	4,400	91,000	72,800
	12	4	427.	.234	5,225	105,000	84,000

*IN THE FOUR SIZES INDICATED BY A STAR, present-day Plymouth Manila Rope and Plymouth Sisal Rope have a minimum breaking strength slightly under that shown in the Federal Specification (TR-601A) columns.

**The figures shown in this column are 80% breaking strength of Manila rope. Federal Specification TR-631 Amendment-2, dated March 15, 1944 permits this minimum breaking strength to be reduced to 75% of that of Manila.

SAFE WORKING LOADS - TONS OF 2000 POUNDS NEW WIRE ROPE		
DIAMETER IN INCHES	6 x 19	6 x 37
5/16"	.85	.80
3/8"	1.22	1.15
1/2"	2.1	2.0
5/8"	3.5	3.1
3/4"	4.7	4.5
1"	8.3	7.9
The above is based on a 5x1 safety factor for improved plow steel wire rope with fibre center.		

Rope capacity tables

CHAPTER 3
Section -b1

HANDLING MATERIAL, RIGGING AND HOISTING

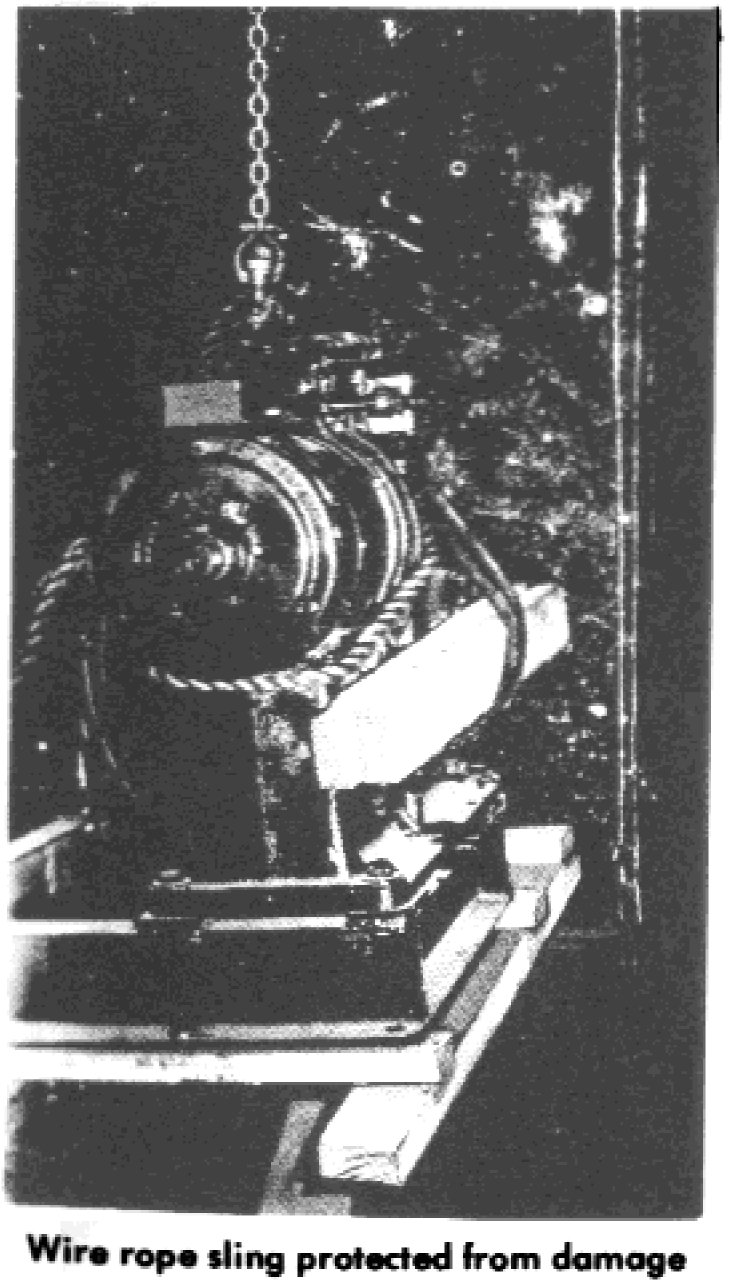
Rigging

1. The proper rigging of tackle for hoisting material can help to make the work safer and easier.

2. Safety for both men and materials is of course the prime factor to be considered. As a chain is no stronger than its weakest link, so hoisting tackle is no stronger than its weakest support, block, fall, or sling.

3. It is suggested that all companies stamp the safe capacity on all blocks, before sending them to the field man. Color codes, such as red for 2 ton, green for 3 ton, etc., would help the men to choose the one he wanted from a group. This color code, however, should supplement and not replace an actual, numbered capacity stamp. The blocks should be shop tested at frequent intervals to be sure they are capable of supporting their rated loads.

4. Manila rope falls and slings should be in good condition. Spread the strands to examine the inside of the rope. If it looks doubtful, replace the rope rather than the machine being hoisted! Refer to the appended manila rope capacity chart for rated strength of the various rope sizes. Remember that this chart (which is included through the courtesy of the Plymouth Cordage Company) is for new rope. Allow an ample safety factor.



Wire rope sling protected from damage

5. Where ropes, either wire or hemp, come in contact with sharp edges of the supports or the material being hoisted, be sure to protect the rope with pads or soft wood blocks, placed so they cannot work out.

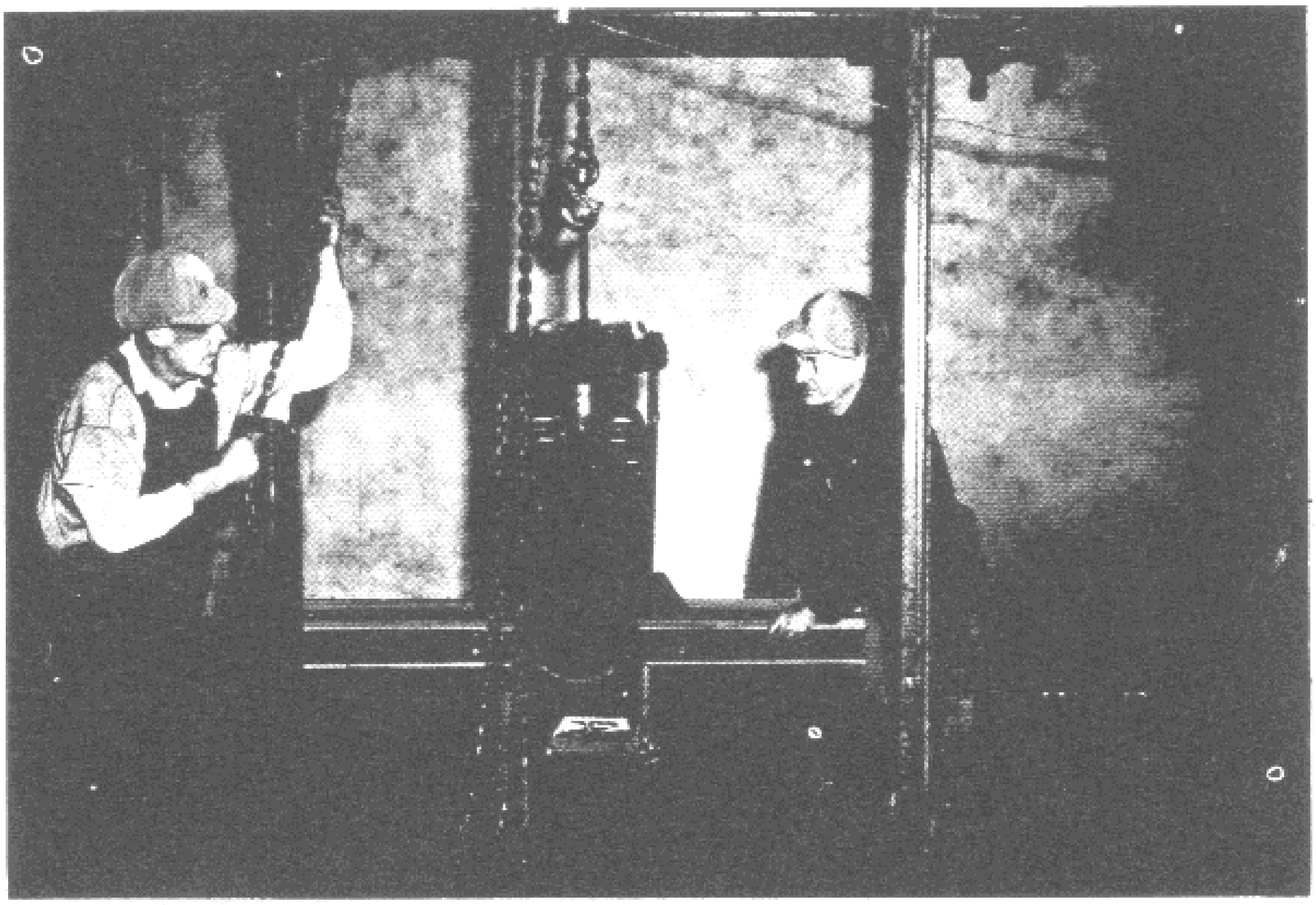
6. A prominent wire rope manufacturer states that it is never advisable for the working load of a wife rope, used for general purposes, to exceed one-fifth of the breaking strength. This is particularly true of "running" ropes. This means that the factor of safety should not be less than five.

7. Power hoists are now so commonly used in the elevator industry field installation that a word of caution on handling this equipment is advisable.

8. We recommend that no power hoist be strong enough to break the drum rope (hoist rope). It is better to have a hoist stall than to break a rope and drop the equipment being hoisted.

9. All rigging, including slings, supports, sheave bearings and tie-downs must be strong enough to withstand the "stalled" condition.

10. As far as chain hoists are concerned, it is obvious that all hoists must be maintained in good condition and that both load and hand chains must be kept clean and free of kinks. Load chains should be lubricated. Load tests to determine brake holding power should be made periodically and at any time there is suspicion of damage. Chains, especially the load chain, should be inspected. If broken or damaged links exist, call this to the attention of your "super" and ask for a replacement hoist. Knicks and gouges can damage the hoist guides and/or the lift wheel.



Installing a gravity oil buffer

CHAPTER 3
Section -c1

HANDLING MATERIAL, RIGGING AND HOISTING

Hoisting

Suggested:

Materials —
- a. sundries

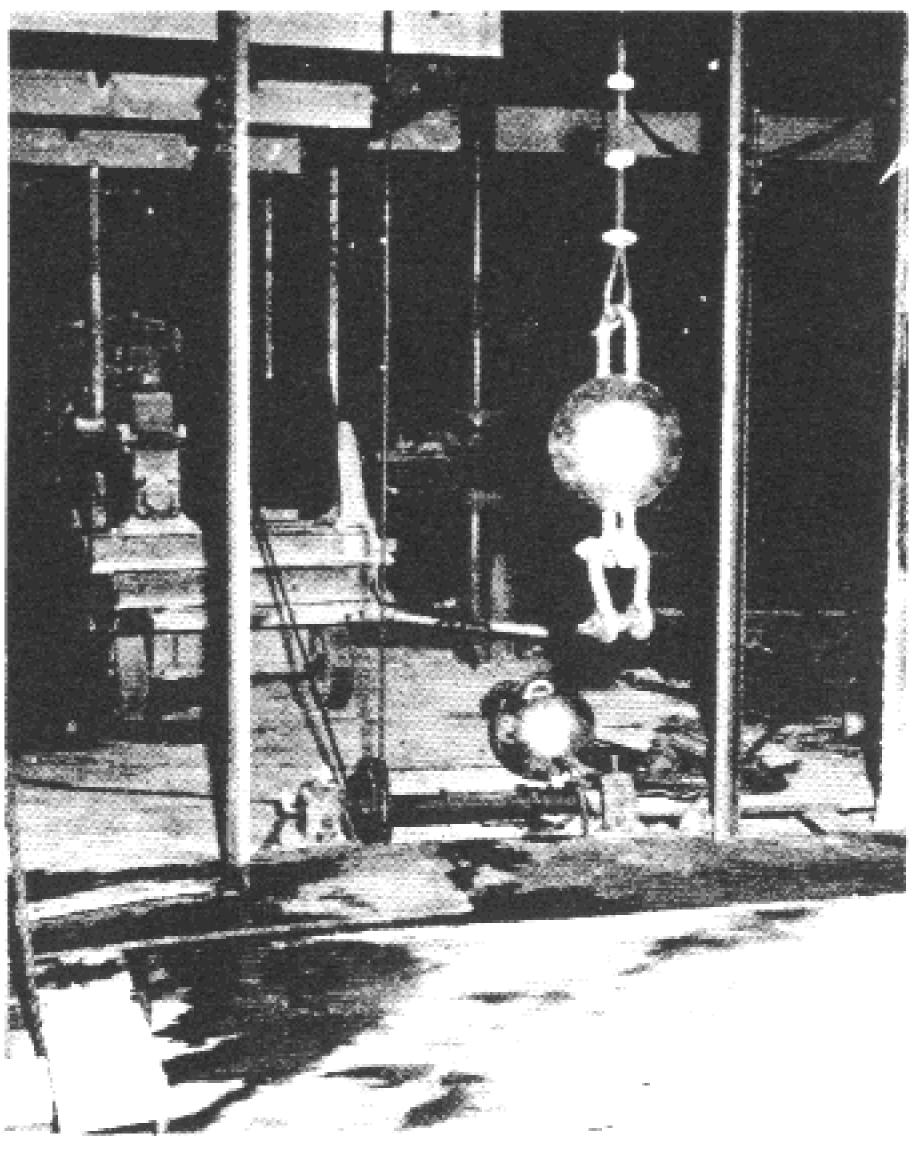
Tools —
- a. hand tool kit
- b. timbers
- c. slings
- d. chain or rope falls
- e. rollers
- f. planks

1. The "old timers" used to say that any man with a strong back could hoist, but it took a good man to rig up for him! That may have been true in the past, but it is certainly not true today.

2. Well planned and executed hoisting not only will expedite a job, but can also make the work safer and easier for the men.

3. Little, if any, more time is required to do a job right. Always be sure that rigging is strong enough and that the hoistway is clear of men, planks and scaffolding.

4. No men should be permitted to "ride the ball" or a load of material! Crates, boxes and other material to be hoisted should be rolled or carried to the hoistway where they are convenient. On jobs where power hoists are used, the "loading" gang starts a piece of equipment up the hoistway, then rolls the next load into position and puts a sling around it while the first load is on its way up. Extra slings are needed for this. Three or more are used, one on the ascending load and one on the "waiting load." Once the load is landed at the top, the hook is sent down immediately. The first sling is sent down on the hook after the second load. The second sling sent down after the third load, etc

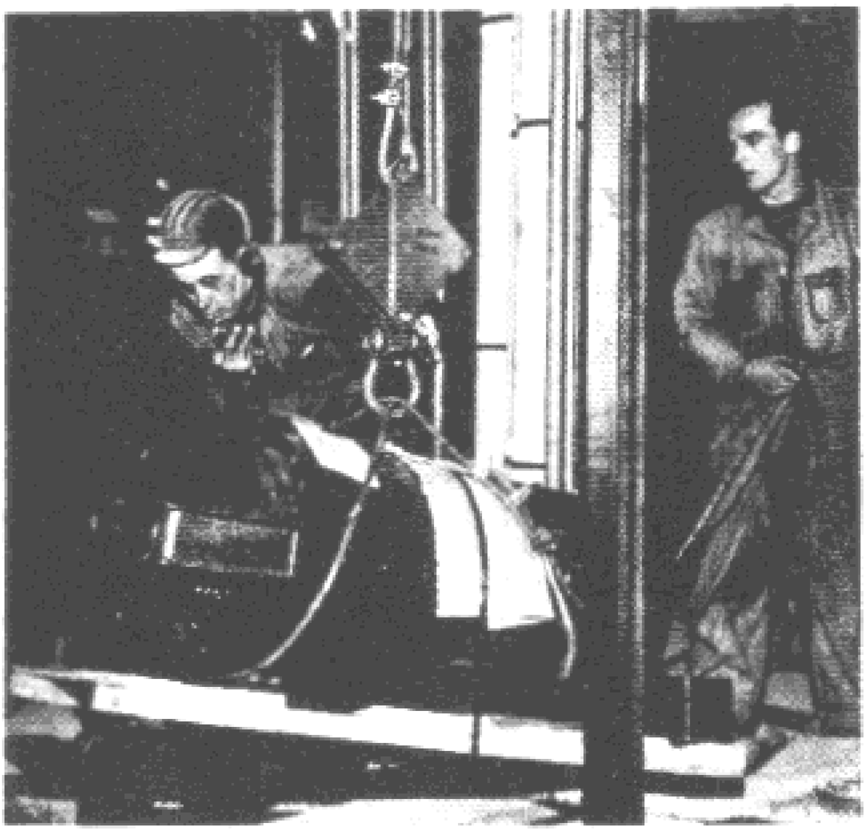


Hoisting equipment rigged ready to begin work

5. Men are needed only at the top and bottom of the hoistway for low buildings. The men at the top of the hoistway can guide the load with the hoist rope. For higher rises, men are generally stationed at intermediate floors to guide the load and to signal the hoist operator, if the material hooks-up under a beam or on other obstructions.

6. Careful planning and preliminary work in the early stages of rigging is needed on all elevator contracts. It is especially important on large installations. Proper location of the rig will generally enable the crew to hoist all machine-room equipment in one hoistway. This in turn makes it economically feasible to build a temporary skip and to use a "jack" to guide the loads since one jack will suffice for the entire job. Such a tool reduces to a minimum the chance of a piece of equipment hooking up under a beam while being hoisted. The photograph illustrates one form of jack that is used. Sketch 1 outlines a common arrangement of hoisting rig for power hoists.

Showing use of a guide "jack" for hoisting

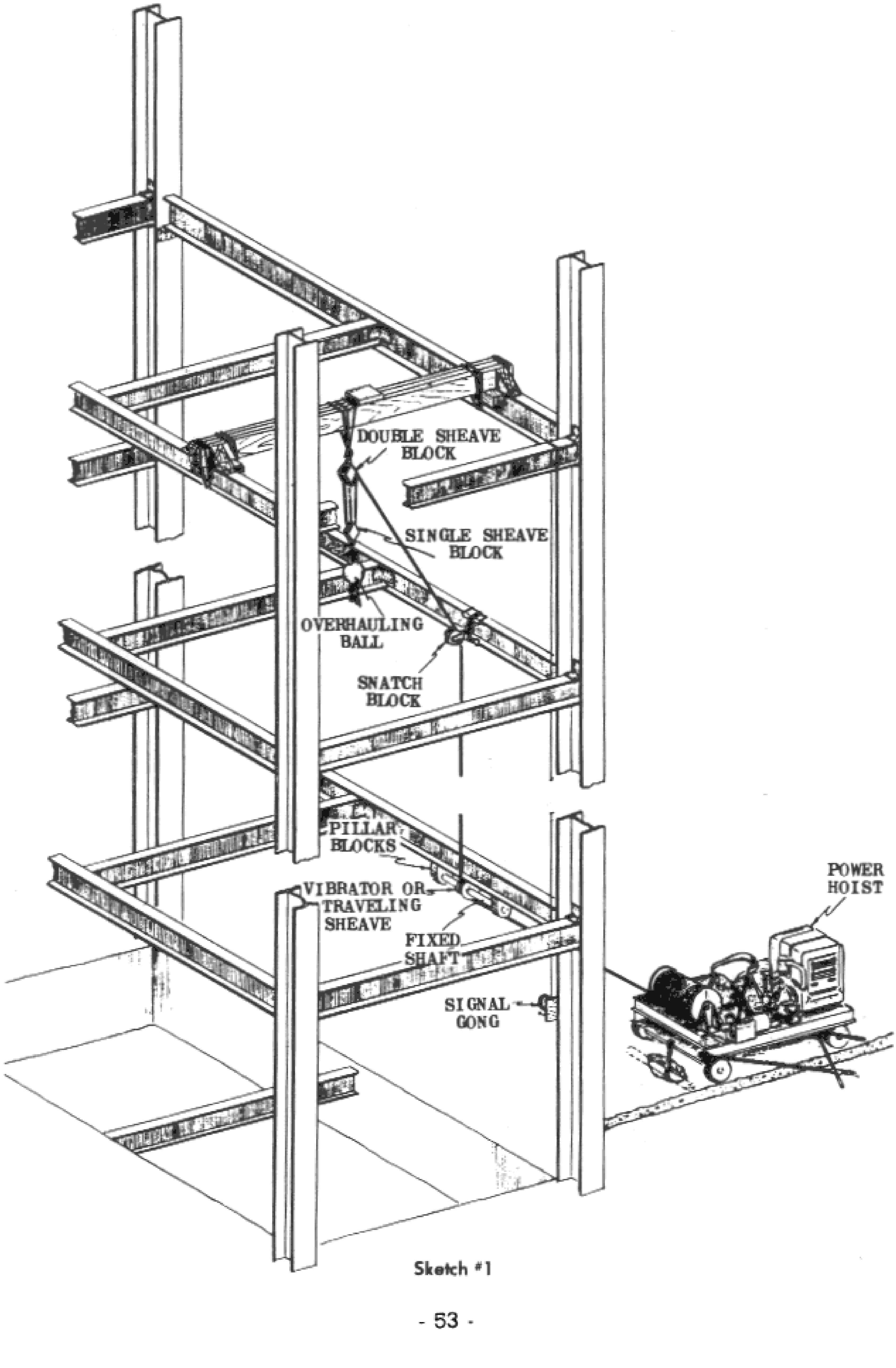


Field telephones aid hoisting

7. Usually a system of signaling is arranged. One method used for this is to install a large mechanical gong at the hoist and run a wire from it to the top of the hoistway in such a manner that lifting the wire sharply rings the gong.

8. Some city codes require that an electric bell be mounted on any power operated platform that is temporarily installed in an elevator or other internal building hoistway. The bell is arranged to ring continuously as the hoist descends.

9. It may be a matter of interest to note that areas outside the United States and Canada are now using


DOUBLE SHEAVE BLOCK
SINGLE SHEAVE BLOCK
OVERHAULING BALL
SNATCH BLOCK
PILLAR BLOCKS
VIBRATOR OR TRAVELING SHEAVE
FIXED SHAFT
SIGNAL GONG
POWER HOIST

Sketch #1

large power hoists for elevator work. Three of the most widely spaced are Brazil, England and Hong Kong. All have purchased the equipment in the United States and adopted our installation procedures for using these and other tools.

10. Field type telephones are often used but should supplement rather than replace the gong. They are of considerable assistance and a safety factor in loading and unloading where near level stops are important.

11. The customary gong signal code for hoisting is as follows:

1 Stroke	Stop
2 Strokes	Up Direction
3 Strokes	Down Direction
"Jingle" or group of bells	Full Speed — either direction

12. The drum rope can be painted to indicate approximate top level. This provides another safety factor.

13. The men are divided into two or more gangs, one for loading and the other for unloading, as described in paragraphs 4 and 5. There must be one "gaffer" who knows where and how to load and/or unload and store materials for each gang.

14. For power hoisting, heavy and fragile materials should be lifted slowly. Higher speeds are used in raising light materials. Use the lowest possible speed for the machine, controller, floor controller and relay panel. Rails can be raised at higher speeds, if they are carefully watched to prevent their hooking-up on obstructions, such as beams or scaffolds.

15. It is advisable to take up the lighter equipment first because it can be moved away from the hoistway to clear space for the controller, floor controller, etc. The machine is, as noted generally, the last part hoisted to the machine room.

16. Refer to the packing lists to determine the weight of all heavy parts before hoisting them. Do not attempt to overload hoisting equipment.

17. Remove boxes or crates from equipment before hoisting it. It is sometimes advisable to leave the skids on machines, generators, and controllers. Machines should be hoisted assembled whenever possible.

18. Machines are hoisted at the slowest possible speed, preferably about 25 f.p.m.

19. Drill and set the beams in advance. Scribe their positions on the supports. They should then be shifted to one side until the machine has been hoisted a foot or more above them in the machine room.

20. The beams then can be slid into place and bolted or clipped. Next, the machine can be lowered directly onto the beams and secured in place.

21. Where the machine is to be taken up in a "knocked down" condition, motor or armature is hoisted first. Then (on gearless) the top of the motor frame and the lower frame and bedplate are hoisted. The brake parts can be hoisted separately also, if necessary. (On geared machines the procedure varies with field conditions and machine types.)

CONTENTS

CHAPTER 4

CHAPTER 4
Section -a1

DRAWINGS AND MISCELLANEOUS PAPERS

General

1. It may be startling and it is often distasteful to we field men but it is a definite fact that paper is one of the most important tools used in elevator installation work. The first definite work on an elevator begins when the purchaser signs the order. Paper work flows from this initial action until the customer signs an agreement that the elevator has been installed in accordance with the contract specifications and that, therefore, he accepts it and will complete his payments to the seller. This last makes the payment of wages possible. We **are** interested in that.

2. We often believe that paper work on jobs is excessive. Possibly this is true but routines are necessary and fortunately most of the routine work does not involve the field man.

3. Types of ''paper work'' that are used in the field include:

a) **Delivery receipts (or ''tickets'')**. These inform the field man what material should be included in the delivery.

b) **Factory order sheets (or specified order sheets)**. Some companies provide these for the mechanic to give him detailed information about equipment shipped and also data on exactly what material was ordered.

c) Copies of local permits. Need for such copies vary widely. They might be required on the job for such items as burning or welding in particular areas, for storing gasoline and possibly a permit for scaffolds or hoisting over a sidewalk might be needed.

d) Mechanical drawings. These vary somewhat between companies and even within the individual companies they vary from job to job. However, on all contracts they are based on a master plan of the elevator which is called the "Final Approved Layout." Secondary drawings may include details of special items or of standard parts, such as entrances, sheaves, machine foundation plans, carframe and enclosure assembly or even guide rail brackets.

e) Electrical Drawings. Each year the circuitry of elevators becomes more complex. The days when a mechanic had only to learn "plus from minus" to read his wiring diagrams are long past. The "relative" voltages of present day electronic circuits and many control refinements make sound knowledge of wiring diagram fundamentals mandatory for the mechanic who wants to install the highest quality of control equipment. All elevator contractors supply wiring diagrams to their field mechanics. Most contractors provide several types of wiring diagrams which include a "straight line" drawing (showing essentially the entire "plan" of the wiring installation). The "field" or "WD" drawing (which often arranges the physical parts of the installation in a manner to show the wiring connections to each piece of equipment) and the "conduit layout." The latter is a modified form of the field diagram and sometimes is arranged to act as both a drawing and order sheet for materials. "Conduit layouts" and "WD's" are really mechanical drawings adapted to provide specific electrical connection information.

f) Time Tickets and Expense Slips. Few mechanics would consider this particular bit of paper work as superfluous. Its primary function is to serve as a basis for payment of wages to the men but it also provides statistical data such as a check to determine if sales estimating for labor is correctly performed. The "expense slip" is a means to enable men to collect for any petty cash they may have laid out.

g) Miscellaneous Paper Work. Each elevator company has its own routines which dictate the flow of "paper work." All companies want to keep this flow as small as possible. Common items include accident reports, which are important to anyone who may be involved in an accident and should be filled out to conform to the applicable law of the state in which the accident occurred. (See chapter 2 -a1, paragraph 6.). Short or damaged shipment reports are also common to most companies and are important. Trouble reports and test reports are used by some companies. When the elevator is completed, the "super" will generally "turn the car over," or deliver it, to the owner. At that time, some companies ask the owner to sign a "Final Acceptance" form, which then becomes the authority for the company to issue billing for final payment. Mechanics generally handle the "turning over" procedures in outlying areas.

4. It will simplify your job to learn how to understand and act on forms, reports and drawings used by the company for which you are installing elevators.

CHAPTER 4
Section -b1

DRAWINGS AND MISCELLANEOUS PAPERS

Mechanical Drawing Symbols

1. Elevator layouts and detail drawings of components are specialized forms of mechanical drawing. Generally, they are prepared by the elevator draftsman, after he has studied building plans.

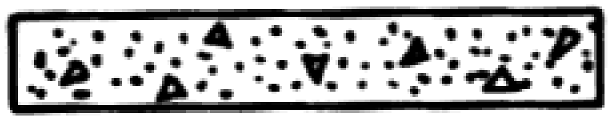
2. Mechanics are frequently asked by the building contractor's superintendent or others to review elevator layouts and coordinate details with conditions shown on general building plans.

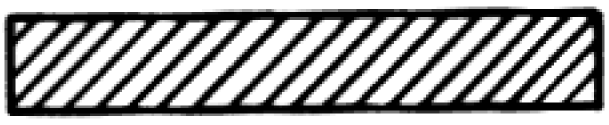
3. Since basic material and method symbols are reasonably standard it is advisable to learn these. Several pages in this section illustrate a few of the more common standard symbols.

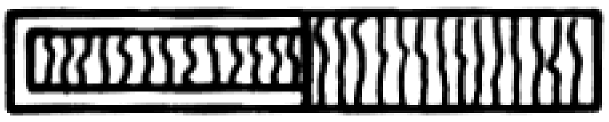
4. Since elevator layouts are specialized drawings, draftsmen have developed techniques peculiar to our trade. For example (and in keeping with good drafting practice), the more important or key components are outlined in heavy lines. The hoistway inner walls (clear hoistway) and outline of the car platform are good examples of this. Car enclosure areas are in lighter lines. Car door positions are shown closed but the space required when doors are opened is indicated by dotted lines to assure that no interference will occur. The sizes of carframe members are shown on each member in the elevation. "Pit of car" and counterweight dimensions are also shown, as is an allowance for rope stretch. This is given to assist the mechanic in calculating the measurement at which to cut the hoist ropes so that when they have stretched under load (as all ropes will) the proper pit-of-counterweight will result.

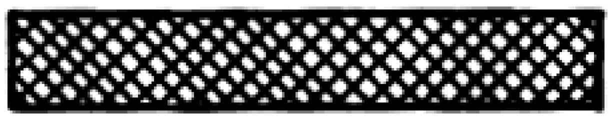
5. The draftsman uses many of these techniques in addition to notes and symbols. Here again it is important to learn the routines followed by the particular N.E.M.I. contractor on whose job you are working.

EXAMPLE OF SYMBOLS USED FOR MATERIALS


CONCRETE

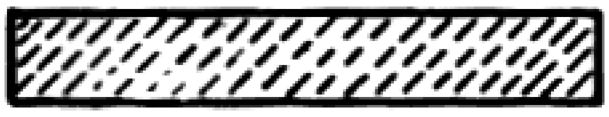

BRICK

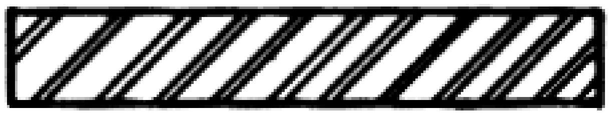

HOLLOW TILE

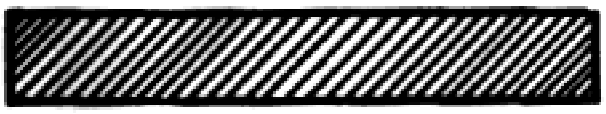

TERRA COTTA

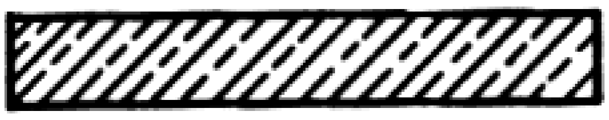

PLASTER

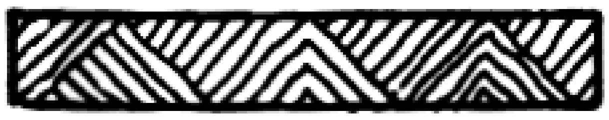

(WIRE) (WOOD)
LATH AND PLASTER


MARBLE

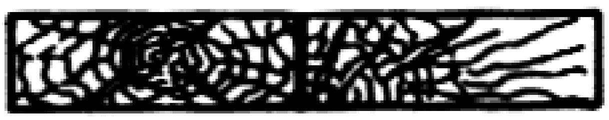

STEEL


CAST IRON


BRONZE, BRASS & COMPOSITIONS

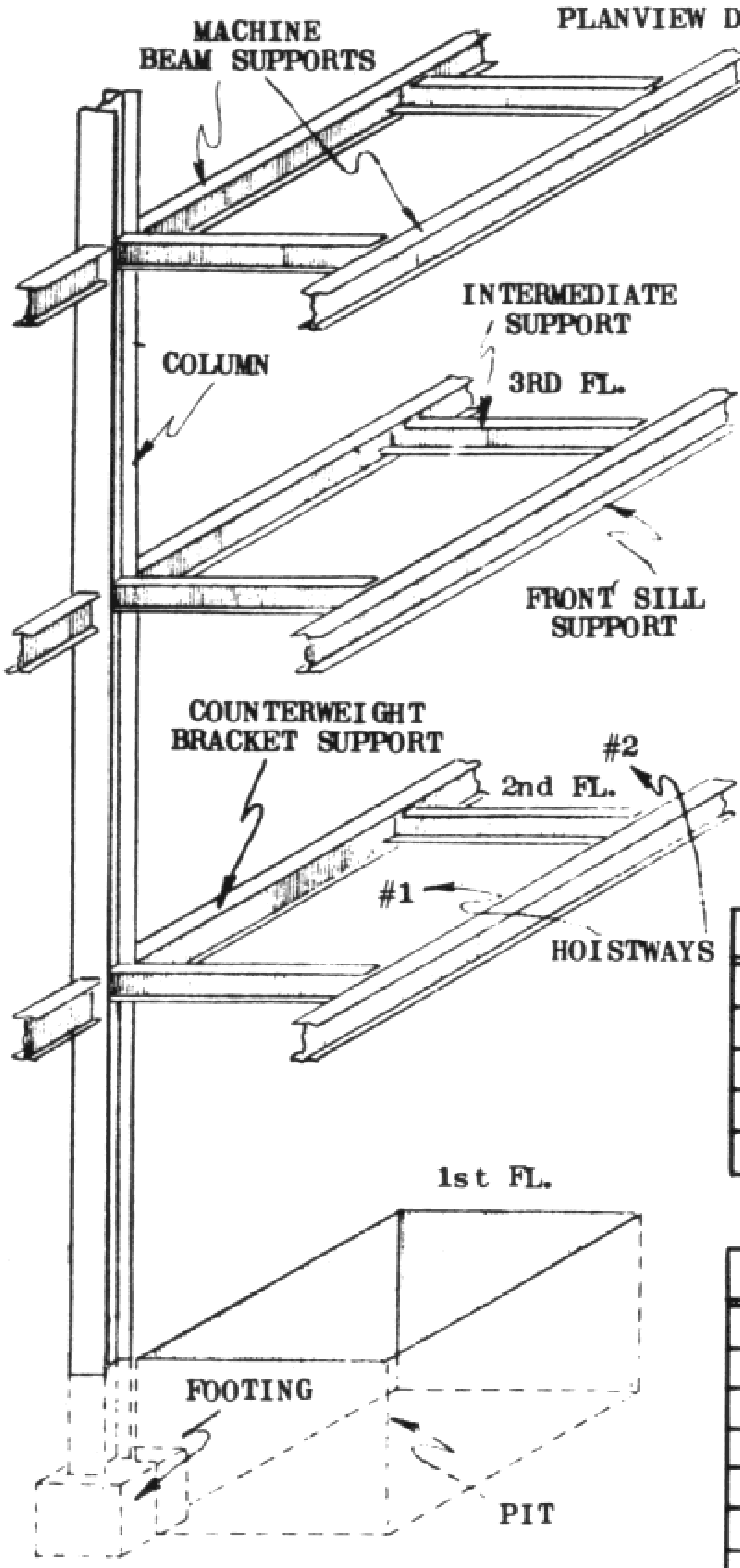

EARTH


WOOD - WITH THE GRAIN

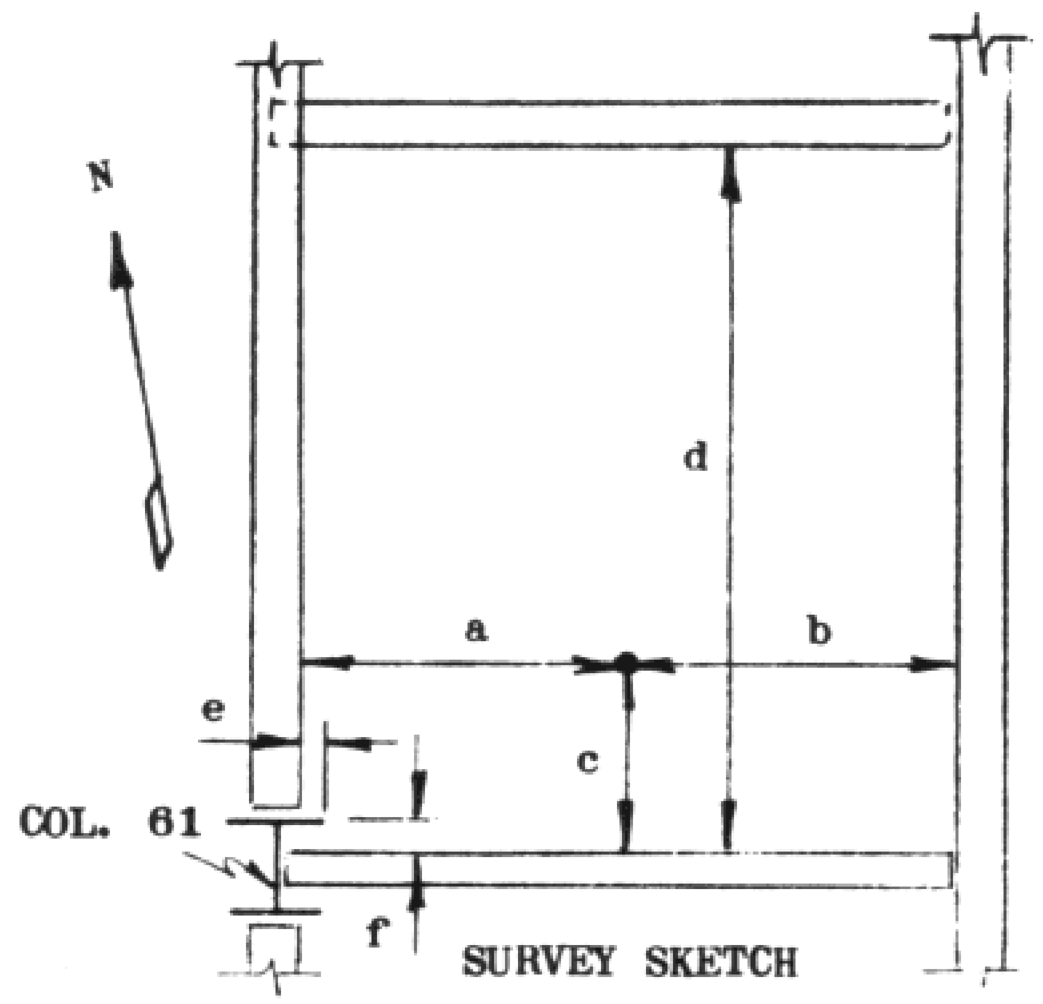

WOOD - ACROSS THE GRAIN

FLOOR	a	b	c	d	e	f	COL.
SUPPORTS	3'-7" TO 18" I x 6"	3'-5-1/4" TO 15" I x 5"	21" TO 8" I x 4"	9' 3" TO 12" I x 6"	3"	4"	12" x 12"
THIRD	3'-6-1/2" TO 18" I x 6"	3'-5" TO 15"I x 5-1/2"	20-1/2" TO 8" I x 4"	9'-3-1/2" TO 12" I x 6"	3"	4"	12" x 12"
SECOND	3'-6-3/4" TO 18" I x 5"	3'-4-3/4" TO 15" I x 5"	21" TO 10"I x 4-1/2"	9'-3" TO 12" I x 7"	3-1/2"	3-3/4"	12" x 12"
FIRST	3'-4" TO CONCRETE	3'-2" TO CONCRETE	18" TO CONCRETE	8'-9" TO CONCRETE	0"	0"	12" x 12"
PIT FLOOR (+ 12")	3'-4-1/2" TO CONCRETE	3'-2" TO CONCRETE	18-1/2" TO CONCRETE	8'-8-1/2" TO CONCRETE	12"	15"	FOOTING

PLANVIEW DIMENSION SCHEDULE



STEEL PLAN OF HOISTWAY AND PIT



SURVEY SKETCH

ABOVE SUPPORTS	9'-0" TO FLAT SLAB
SUPPORTS TO THIRD	16'-9" TO STEEL
THIRD TO SECOND	14'-3-1/2" TO STEEL
SECOND TO FIRST	17'-0" TO FINISHED CONCRETE
PIT DEPTH	4'-6" TO FINISHED CONCRETE
FOOTING HEIGHT	2'-7" ABOVE PIT FLOOR

ELEVATION DIMENSION SCHEDULE

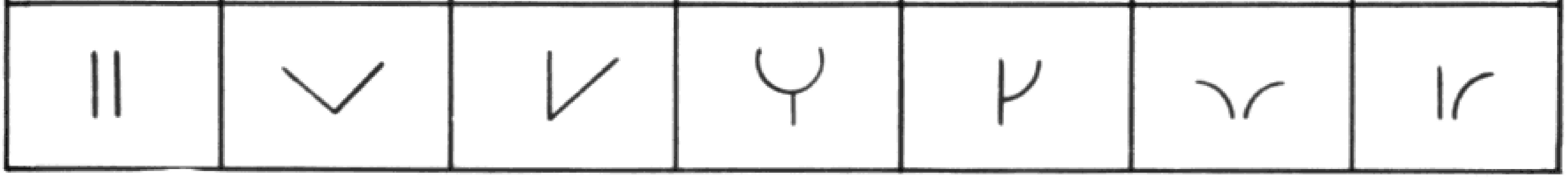
FROM BUILDING PLANS
FIREPROOFING ON BEAMS - 2" TILE
FIREPROOFING ON COLUMNS - 3" TILE
FINISH OVER FIREPROOFING - 1" PLASTER
FLOOR THICKNESS ON TOP OF BEAMS - 4"
OPENINGS AT SOUTH END OF HOISTWAY
PIT FLOOR THICKNESS - 8" CONCRETE REINFORCED
WATERPROOFING IN PIT - NONE

BUILDING DATA SCHEDULE

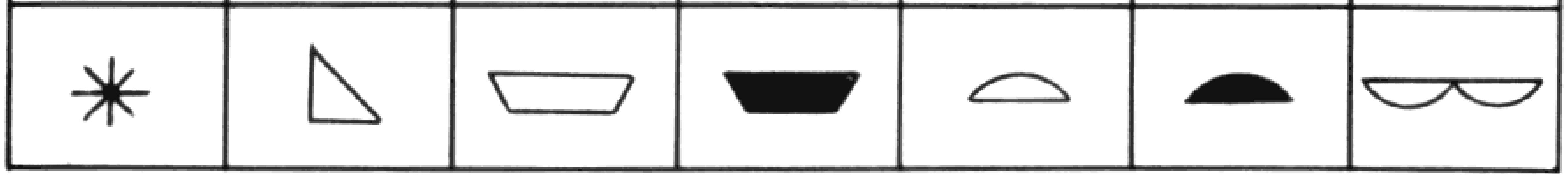
TYPICAL ARCHITECTURAL DATA

COMMON WELDING SYMBOLS

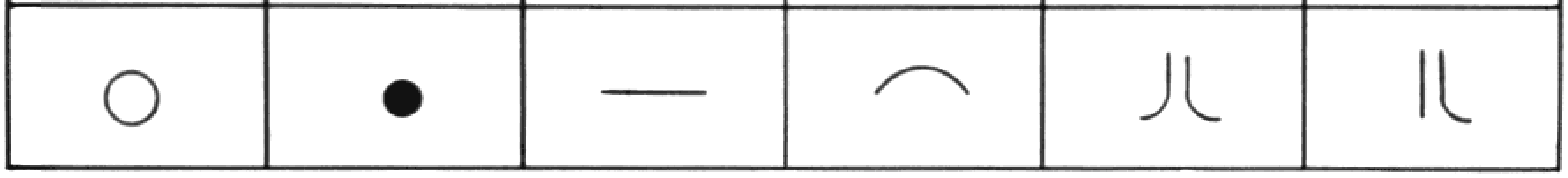
GROOVE						
SQUARE	V	BEVEL	U	J	FLARE-V	FLARE BEVEL

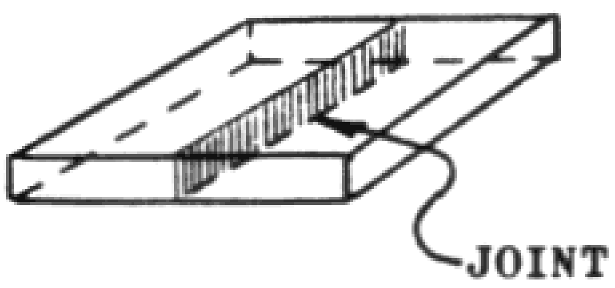


SPOT	FILLET	PLUG OR SLOT	ARC-SPOT OR ARC-SEAM	BACK OR BACKING	MELT-THRU	SURFACING



WELD ALL AROUND	FIELD WELD	CONTOUR		FLANGE	
		FLUSH	CONVEX	EDGE	CORNER

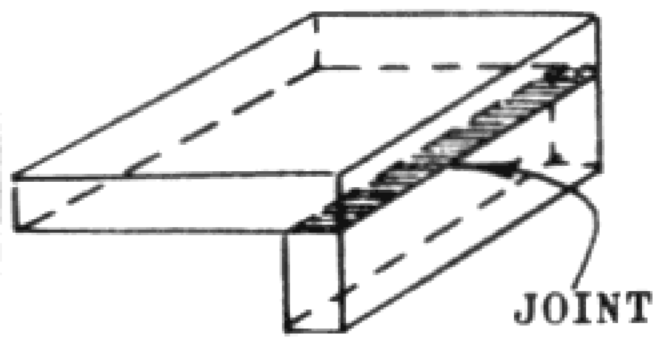




BUTT JOINT

APPLICABLE WELDS

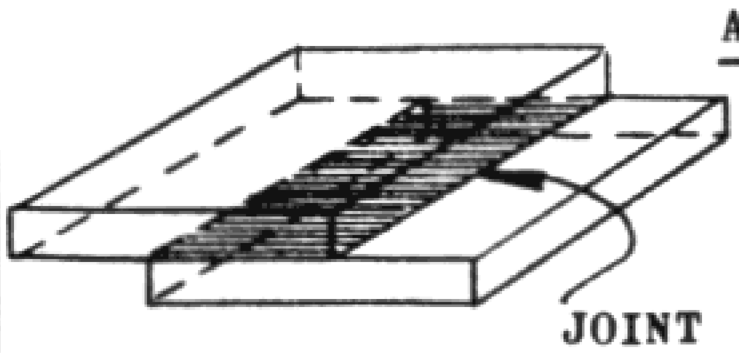
SQUARE-BUTT
BEVEL-GROOVE
V-GROOVE
U-GROOVE
J-GROOVE



CORNER JOINT

APPLICABLE WELDS

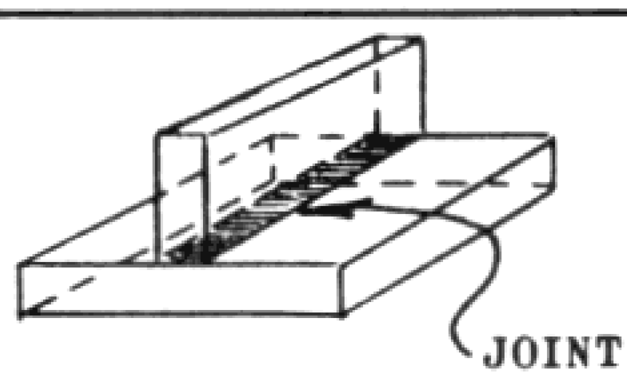
SQUARE-BUTT
BEVEL-GROOVE
V-GROOVE
U-GROOVE
J-GROOVE



LAP JOINT

APPLICABLE WELDS

FILLET
BEVEL-GROOVE
J-GROOVE
PLUG
SLOT
SPOT



TEE JOINT

APPLICABLE WELDS

FILLET
BEVEL-GROOVE
J-GROOVE
PLUG
SLOT

BASIC TYPE OF JOINTS AND APPLICABLE WELDS

OBJECTS IN THE HOISTWAY

OUTLINES - MEDIUM - CONTINUOUS

SECONDARY LINES - LIGHT - CONTINUOUS
(CAR INSIDE, HOISTWAY WALLS, OUTSIDE)

OBJECTS ABOVE THE CAR

OUTLINES - MEDIUM - ALTERNATING LONG AND SHORT DASHES

SECONDARY LINES - LIGHT ALTERNATING LONG AND SHORT DASHES

OBJECTS BELOW THE CAR

OUTLINES - MEDIUM - SHORT DASHES

SECONDARY LINES - LIGHT - SHORT DASHES

CENTER LINES

LIGHT - ALTERNATING LONG AND SHORT DASHES

DIMENSION

SECTION, EXTENSION LINES - LIGHT - CONTINUOUS

CUTTING PLANE LINES

MEDIUM - ALTERNATING ONE LONG AND TWO SHORT DASHES

ALTERNATE POSITION

OUTLINES - MEDIUM - SHORT DASHES

SECONDARY LINES - LIGHT - SHORT DASHES

The engineer uses relatively heavy lines for the outlines of the object, and lighter lines for dimensions. A very widely used standard alphabet of lines, adopted by most of the large companies in the elevator industry, is given above.

INTERPRETATION OF LINES ON DRAWINGS

6. In the United States and Canada we generally coordinate our work so the builders leave the machine-room floors and secondary slabs unpoured until the elevator machinery is hoisted and placed. Some European building contractors still follow the practice of pouring floor slabs before elevator machine-room equipment is hoisted. This not only makes it difficult to hoist assembled machines but it also requires that holes for ropes, tapes and conduit be blocked out in the forms before concrete is poured. This method is time consuming because the elevator constructor must often check the carpenters blocking and for several other reasons, including waiting time while floor slabs dry.

7. In relation to drawings, it imposes the need for locating all these holes on the layout or a special drawing.

CHAPTER 4
Section -b2

DRAWINGS AND MISCELLANEOUS PAPERS

Preliminary Drawings

Suggested:

Materials –	Tools –
a. nails	a. hand tool kit
	b. plumb wire
	c. planks

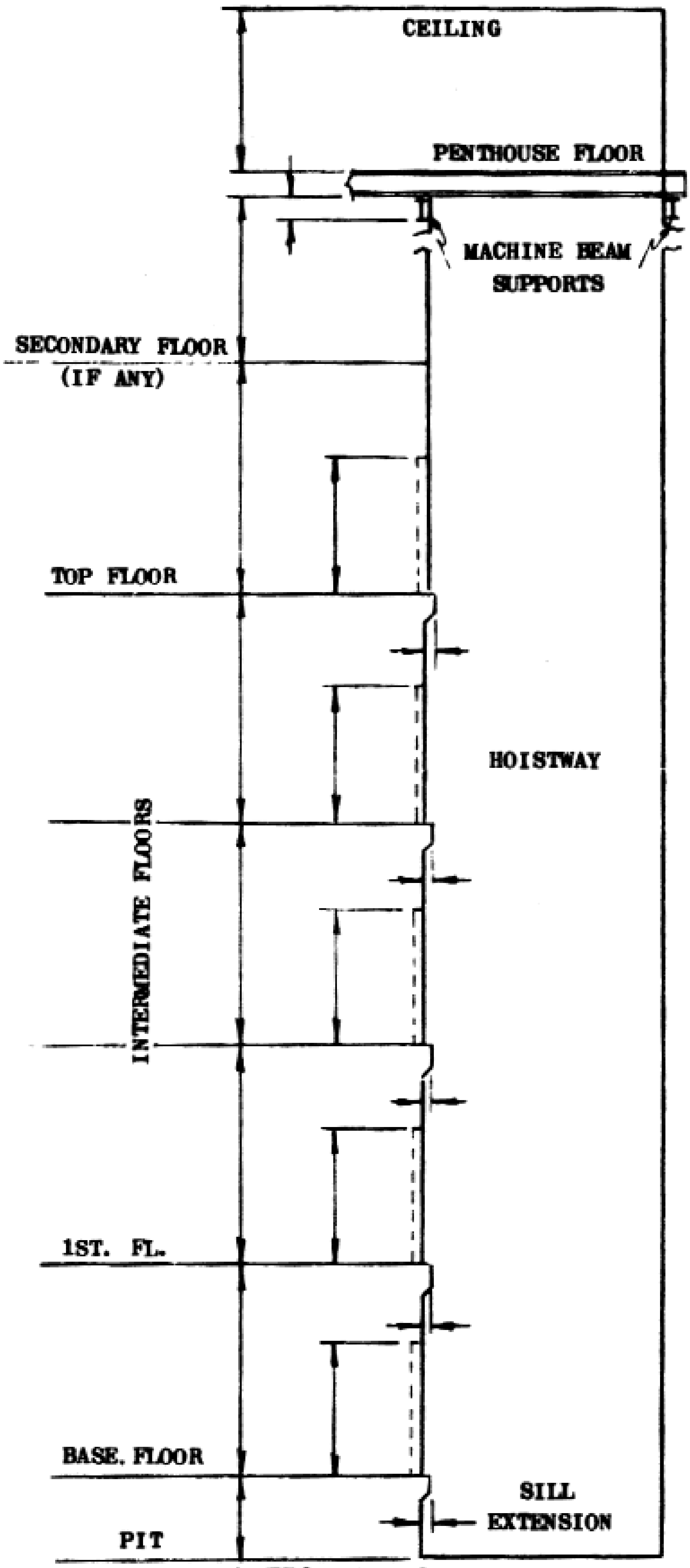
1. The preliminary drawings are prepared for each installation by the elevator company's draftsmen. These drawings are checked with the plan of the structure or, for an existing building, with the actual hoistway conditions.

2. After preliminary drawings have been checked and found correct in all details, the final layout is prepared, using the preliminary as a guide.

3. Obviously, therefore, it is most important that all possible care be used in preparing the preliminary drawings.

4. Ordinarily none of this would concern a field man. The interested office personnel would make all necessary arrangements. The mechanic would not see the preliminary drawings but would receive a working copy of the approved layout, when the job was ready to start.

5. However, where the elevator was to be installed in an existing structure, a mechanic might be sent to the jobsite to check the actual layout of the hoistway.



SKETCH NO. 2
SURVEY IN ELEVATION

6. This work is termed "surveying" a hoistway. It is done by going to the overhead or machine room and placing a plank postwise across the hoistway. It should be about 18" from the front wall.

7. Weighted plumb wires are dropped to within a few inches of the pit floor, at locations illustrated in sketch #1.

8. Two charts are prepared. They should be similar to those of sketches #1 and #2.

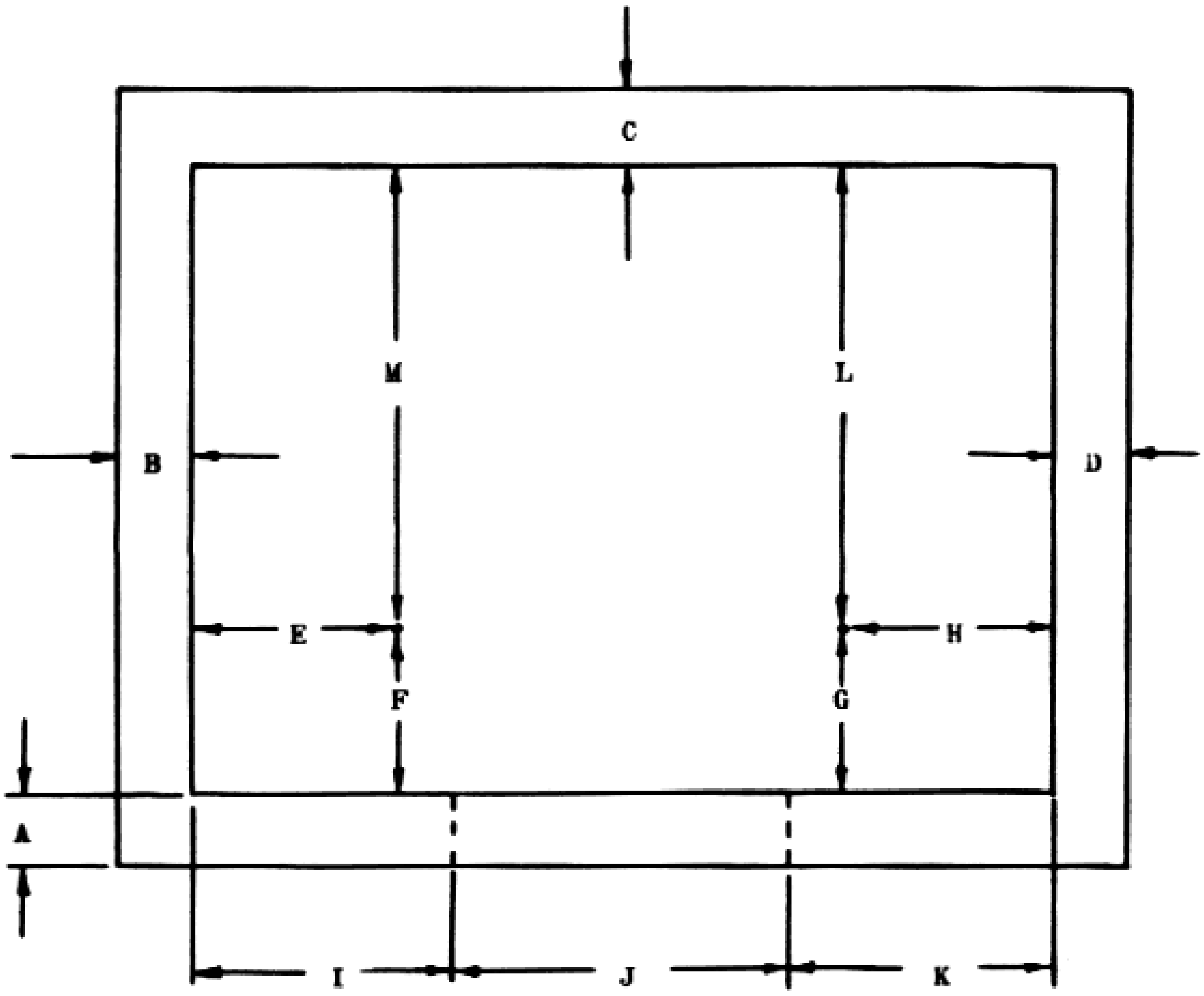
9. Plumb wires are steadied and then the table included in sketch #1 is filled in, taking all measurements very carefully. This must be done at each landing.

10. The floor heights, door heights and thickness of sill extensions and entrance walls are entered on sketch #2 at their respective floors.

11. The measurements "L" and "M" can be taken with a long, light piece of wood. This will eliminate the necessity of going into the hoistway.

12. Any unusual conditions, such as offsets or columns in the pit, hoistway, or overhead should be carefully marked in their proper locations. Make notes on the chart as to the construction of the walls and types of materials used, also, whether rough openings were left for doors and sills.

13. With these drawings and dimensions, the draftsman can



FLOOR	A	B	C	D	E	F	G	H	I	J	K	L	M
TOP													
Intermediate Floors													
1													
BASE													
PIT													

SKETCH NO. 1

SURVEY IN PLANVIEW

prepare a preliminary layout. When this is approved, it is marked "final" and is eventually sent to the field for use in the installation of the elevator.

CHAPTER 4
Section -b3

DRAWINGS AND MISCELLANEOUS PAPERS

Final Layout

Suggested:

Materials —	Tools —
a. none	a. none

1. When a man earns the title of "mechanic" in a Local of the I.U.E.C., he assumes certain responsibilities. His fellow workers do not take off their hats to him as apprentices and journeymen did to the old-time craftsmen but they acknowledge, in many ways, the fact that the mechanic is a man whose judgment and ability is respected. A primary obligation of a mechanic is to know how to read blueprints. It is evident that a qualified craftsman must be able to read prints correctly and the final layout is the most important of all.

The "final layout" is the drawing that shows the general arrangement of the elevator equipment, car size, distance between guides, hoistway size, door entrance size and location, pit depth, floor height, overhead height, machine-room size, cutouts in machine-room floor, beam reactions, and other information. It is based on the elevator contract specifications and prepared by a manufacturer's draftsman, from architects or other data. It is submitted in preliminary form to the owner or representative, for approval. Upon receipt of approval, and guarantee that the hoistway will be provided plumb within 1" of figures shown, the layout is completed and marked "Final." Copies of it are then printed and sent to the mechanic. It is important that no layout be used for erection purposes unless it has the approval stamp filled in, the "Final" space dated, and a guarantee of either hoistway sizes or plumbs received. It also is essential that the erector use the final layout bearing the latest revisions. This terminology may seem ambiguous but the fact is that "final" layouts are sometimes revised. The mechanic should destroy all previous prints or mark them "void."

2. The mechanic should bear in mind the fact that the elevator layout is also used for purposes other than the installation of equipment. It is used to order the material and to guide its manufacturer; it is used by the door manufacturer, the architect, the steel designer, the builder, and the code authority. Eventually, it is placed in the manufacturer's file for future reference when repairs or alterations are to be made. It will be seen, therefore, that the final layout is an important "tool" that serves many purposes.

3. If there are any hoistway or construction variations from the final layout, these should be brought to the attention of the superintendent, who will in turn report them to the office. Layouts should be corrected so that the Service Department record agrees with building conditions.

4. The elevator layout is in many ways different from the usual mechanical drawing. It shows all of the essential equipment in the hoistway looking down the hoistway from the top of the machine-room roof to the bottom of the pit and also the position, dimensions, and locations of such parts as machine, machine beams, controller, motor generator, starter and its drive, main and counterweight guide rails, governor; limit, leveling, stopping and door zone switches; space for door operators, junction box outlets, traveling cable, etc. It also locates the hoistway in the building and orients the installation with respect to compass points. The general plan is usually supplemented with a machine room plan. Sometimes a secondary level plan is added, also. This extra data helps to clarify the drawing by removing many confusing lines from the main plan.

5. The elevation approximates a conventional drawing and shows a section through the hoistway. It gives pit depth, floor heights, and overhead heights, as approved by the architect. It also shows the heights of the car and counterweight, buffers, vertical spacing for rail brackets, inserts and other details, as well as the dimensions necessary to maintain proper and legal car and counterweight runbys.

6. The final layout should be checked with the builder's engineer or superintendent to be certain that all dimensions shown will be adhered to and any discrepancies corrected. The layout must not be altered without consulting the drafting section as the drawing is based on many factors which are not all shown on the layout.

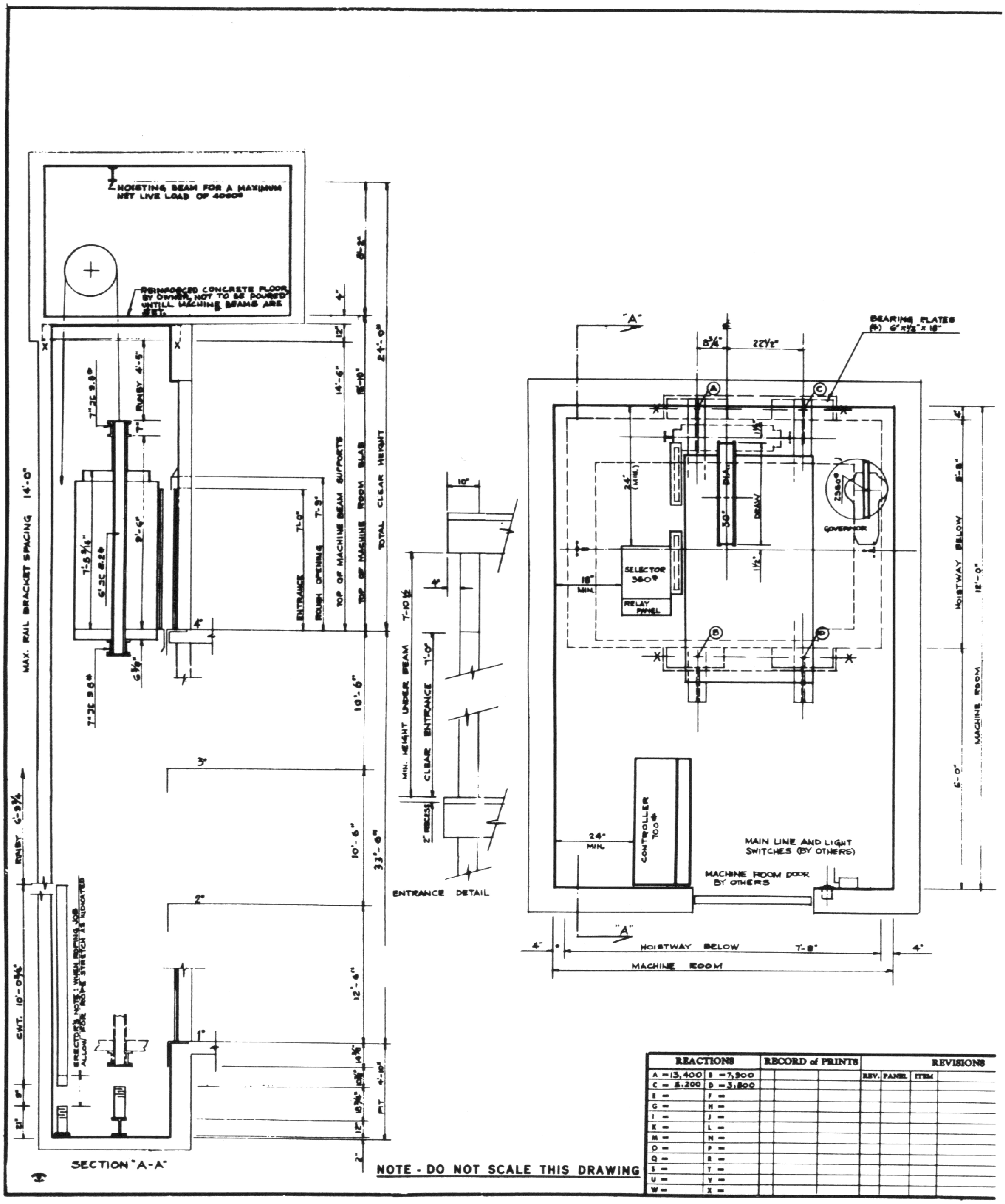
7. The layout illustrated in this article is typical of modern design. The elevator layout shows a wide, shallow car with center opening doors. This arrangement facilitates easy access and exit to the car and thereby speeds loading and unloading the car. The clearances throughout are ample to permit good installation of auxiliary parts, such as traveling cables, governor rope, conduit risers, and hoistway switches.

8. The overhead and pit clearances are sufficient for the car speed and meet "code" requirements.

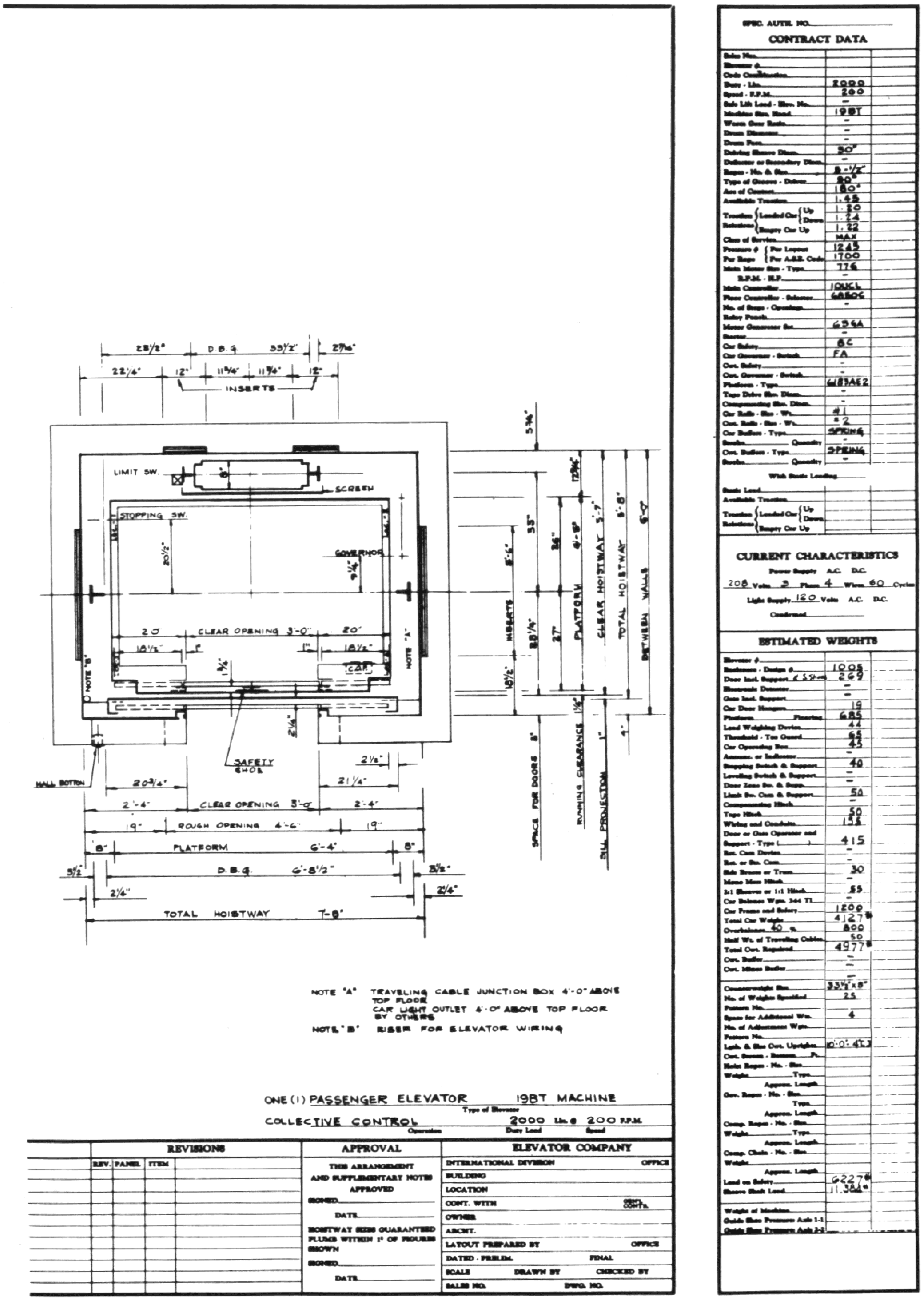
9. Runbys are noted on the elevation. In connection with this, it is worth noting that these measurements are to be closely watched when the elevator is roped.

10. For example, the counterweight runby is given as 6' 9-3/4". Few field men can cut ropes and hold that measurement exactly. Most mechanics would figure that a 6' 10" runby was satisfactory. However, if the mechanic cuts the ropes to maintain a 6' 10" runby, the pit of counterweight would be only 8-3/4". In a short time the new ropes would stretch, the pit of counterweight would be reduced, and the hoist ropes would have to be shortened.

11. Because of this many companies instruct the draftsmen to show on the layout two dimensions for the pit of counterweight, that is, the one which should be obtained after the hoist ropes have achieved their normal stretch under load. The larger amount is the position at which the counterweight should be placed at the time the job is roped. The ropes should then be cut to provide the greater pit of counterweight. Obviously the difference between the two pit of counterweight dimensions is the amount it is expected that the hoist ropes will stretch.



REACTIONS		RECORD of PRINTS			REVISIONS			
A = 13,400	B = 7,900				REV.	PANEL	ITEM	
C = 8,200	D = 3,800							
E =	F =							
G =	H =							
I =	J =							
K =	L =							
M =	N =							
O =	P =							
Q =	R =							
S =	T =							
U =	V =							
W =	X =							



EXAMPLE OF FINAL LAYOUT

SPEC. AUTH. NO.______

CONTRACT DATA

Sales Nos.		
Elevator #		
Code Combination		
Duty - Lbs.	2000	
Speed - F.P.M.	200	
Safe Lift Load - Elev. No.	—	
Machine Size, Hand	19BT	
Worm Gear Ratio	—	
Drum Diameter	—	
Drum Face	—	
Driving Sheave Diam.	30"	
Deflector or Secondary Diam.	—	
Ropes - No. & Size	5 - 1/2"	
Type of Groove - Driver	90°	
Arc of Contact	180°	
Available Traction	1.45	
Traction Relations: Loaded Car Up	1.20	
Traction Relations: Loaded Car Down	1.24	
Traction Relations: Empty Car Up	1.22	
Class of Service	MAX	
Pressure # Per Rope: Per Layout	1245	
Pressure # Per Rope: Per A.S.E. Code	1700	
Main Motor Size - Type	77G	
R.P.M. - H.P.	—	
Main Controller	10UCL	
Floor Controller - Selector	6850C	
No. of Stops - Openings	—	
Relay Panels		
Motor Generator Set	639A	
Starter	—	
Car Safety	8C	
Car Governor - Switch	FA	
Cwt. Safety	—	
Cwt. Governor - Switch	—	
Platform - Type	6183AE2	
Tape Drive Shv. Diam.	—	
Compensating Shv. Diam.	—	
Car Rails - Size - Wt.	#1	
Cwt. Rails - Size - Wt.	#2	
Car Buffers - Type	SPRING	
Stroke ____ Quantity	—	
Cwt. Buffers - Type	SPRING	
Stroke ____ Quantity	—	
With Static Loading		
Static Load		
Available Traction		
Traction Relations: Loaded Car Up		
Traction Relations: Loaded Car Down		
Traction Relations: Empty Car Up		

CURRENT CHARACTERISTICS

Power Supply A.C. D.C.

208 Volts 3 Phase 4 Wires 60 Cycles

Light Supply 120 Volts A.C. D.C.

Confirmed______

ESTIMATED WEIGHTS

Elevator #		
Enclosure - Design #	1005	
Door Incl. Support & S Shoes	269	
Electronic Detector	—	
Gate Incl. Support	—	
Car Door Hangers	19	
Platform ____ Flooring	685	
Load Weighing Device	44	
Threshold - Toe Guard	65	
Car Operating Box	45	
Annunc. or Indicator	—	
Stopping Switch & Support	40	
Leveling Switch & Support	—	
Door Zone Sw. & Supp.	—	
Limit Sw. Cam & Support	50	
Compensating Hitch	—	
Tape Hitch	50	
Wiring and Conduits	155	
Door or Gate Operator and Support - Type ( )	415	
Ret. Cam Device	—	
Ret. or Sta. Cam	—	
Side Braces or Truss	30	
Mono Mass Hitch	—	
2:1 Sheaves or 1:1 Hitch	55	
Car Balance Wgts. 344 TI	—	
Car Frame and Safety	1200	
Total Car Weight	4127#	
Overbalance 40 %	800	
Half Wt. of Traveling Cables	50	
Total Cwt. Required	4977#	
Cwt. Buffer	—	
Cwt. Minus Buffer	—	
	—	
Counterweight Size	33½"x8"	
No. of Weights Specified	25	
Pattern No.		
Space for Additional Wts.	4	
No. of Adjustment Wgts.		
Pattern No.		
Lgth. & Size Cwt. Uprights	10'-0"- 4"[ ]	
Cwt. Screen - Bottom ____ Ft.		
Hoist Ropes - No. - Size		
Weight ____ Type		
Approx. Length		
Gov. Ropes - No. - Size		
Type		
Approx. Length		
Comp. Ropes - No. - Size		
Weight ____ Type		
Approx. Length		
Comp. Chain - No. - Size		
Weight		
Approx. Length		
Load on Safety	6227#	
Sheave Shaft Load	11,384#	
Weight of Machine		
Guide Shoe Pressure: Axis 1-1		
Guide Shoe Pressure: Axis 2-2		

WEIGHT COLUMN OF FINAL LAYOUT (SEE PREVIOUS PAGE)

12. Where these two dimensions are not given the mechanic must calculate an amount to allow for rope stretch. This point is covered under the subject of "Ropes" in a later chapter. However, for general interest we can outline the reasoning as follows: A study of the elevation will show that the pit of car is only 10-7/8". The car buffer is a spring type and can compress only about half of its total 1' 6-3/4" height or 0' 9-3/8". Add the 10-7/8" to 0' 9-3/8" for result of 1' 8-1/4".

13. Subtract this from the counterweight runby (6' 9-3/4") and the result will be 5' 1-1/2".

14. In theory then, the ropes could be shortened 5' 1-1/2", although obviously, this would never be done in the field. The ropes might possibly be shortened 2' 6" with the assurance that the counterweight would not strike the overhead, even if we allow for its "jump" due to momentum, should the car overspeed to its buffer.

15. Before cutting the ropes another check must be made. The car overhead runby is 4' 5". The normal pit of counterweight, plus buffer stroke (9") is about 1' 1" (estimating 4" for buffer stroke). Add to this the 2' 6" that the ropes were to be shortened and a total of 3' 7" would result.

16. Since this is not greater than the runby of the car, it would allow the mechanic to shorten the ropes 2' 6". He would probably shorten the ropes less than 2' 6" depending on the rise and knowledge of the stretch factor of the ropes.

17. A study of the contract data in the box at the right of the layout (see enlarged section on back of layout) gives much data of interest to the mechanic. With it he can check much of his equipment. Any discrepancies should be brought to the attention of his superintendent.

18. The mechanic should study the final layout in its entirety and learn to read and understand all the details and reasons for their being on the sheet.

CHAPTER 4
Section -b4

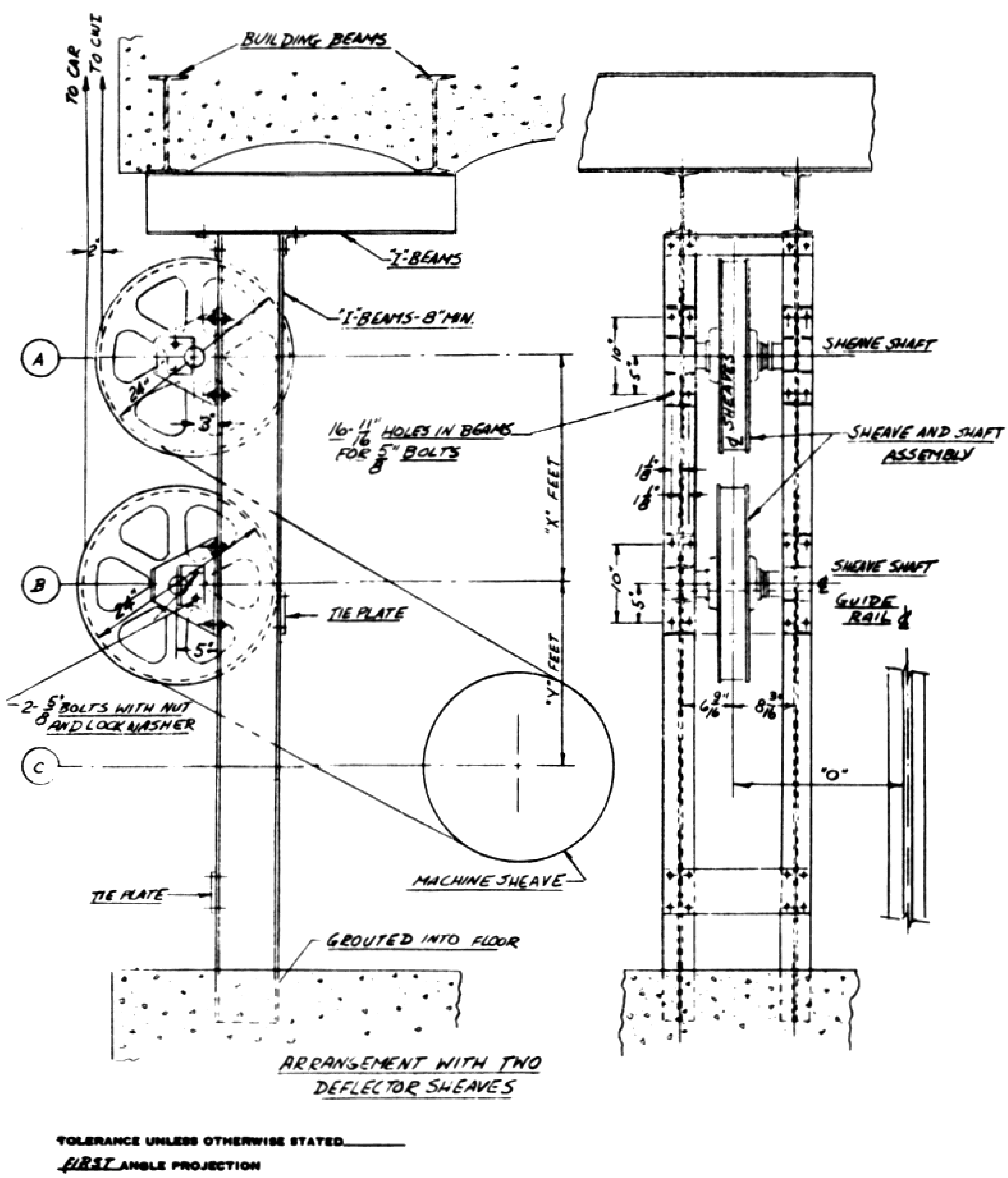
DRAWINGS AND MISCELLANEOUS PAPERS

Detail Drawings

Suggested:

Materials —	Tools
a. none	a. none

1. No one drawing could include all the details of an elevator installation and still remain small enough to be easily handled.



MANY BASEMENT INSTALLATIONS REQUIRE SPECIAL
DEFLECTOR SHEAVE ARRANGEMENT

2. Because of this, final layouts are designed to include the basic details and are supplemented by detailed drawings of many parts.

3. Detailed drawings are usually sent to the mechanic at the start of installation work along with the final layout and the wiring drawings. They are forwarded in an envelope termed the "Construction Folder" and should be kept as clean and legible as possible.

4. Examples of these are the drawings for door closers, hangers and sills; for car assembly, limit settings and auxiliary sheave arrangements.

5. The example of a detail drawing shown in the beginning of this section is one for the deflector sheaves of an elevator with the machine below.

6. Note that the centers of the rims of the deflector sheaves are aligned with the drive sheave rim center. This latter point is dimensioned from a guide rail on the final layout.

7. This again serves to emphasize the importance of stacking the guides as nearly perfectly as possible.

8. The vertical ''I'' beam centers are dimensioned from the sheave center.

9. The bearing locations are also obtained from the sheave center line, since the sheave diameters are given.

10. The exact distance from the building steel to the sheave shaft center line is not shown, since this is a ''standard'' drawing. It would be sent to the field ''marked-up'' for the particular contract it was intended for.

CHAPTER 4
Section -cl

DRAWINGS AND MISCELLANEOUS PAPERS

Wiring Diagram Symbols

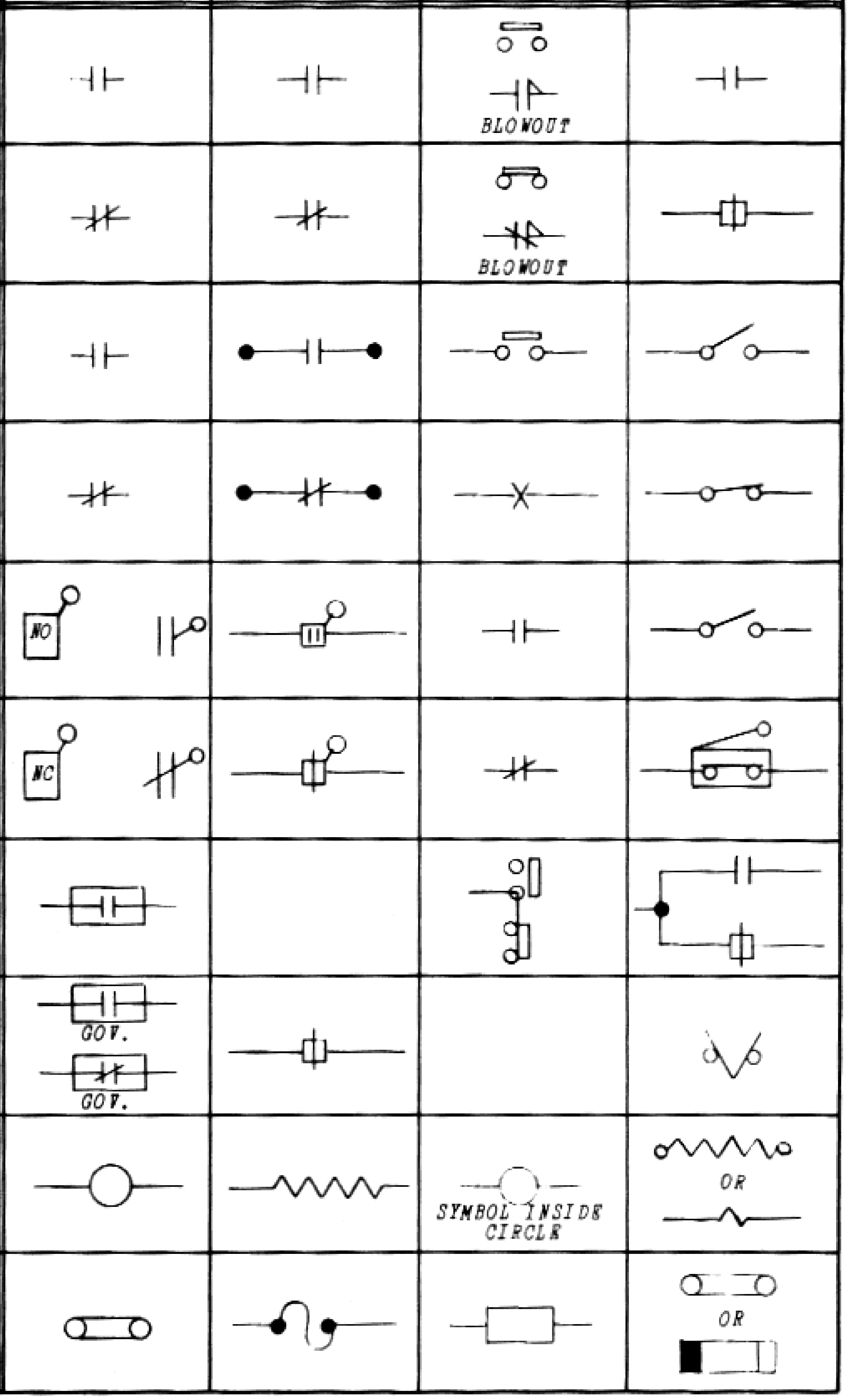
1. To date there has been no standard form of wiring diagram symbols used by all of the elevator manufacturers although with the introduction of ''electronics'' into our work the standardization of symbols is far more common than it was even fifteen years ago. Wide use of commercial components such as rectifiers, vacuum tubes and electrolitic condensers automatically induces company engineers to use standard electrical trade symbols.

2. We have again invited all of the N.E.M.I. member firms to contribute samples of a few of the wiring diagram symbols that they normally use, for publication in this manual. Those submitted appear in the balance of this section.

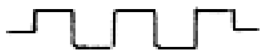
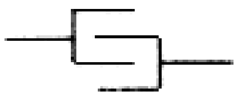
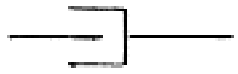
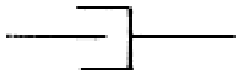
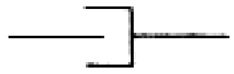
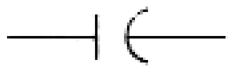
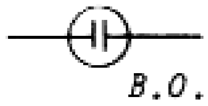
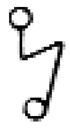
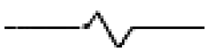
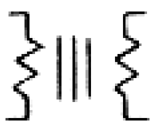
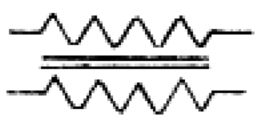
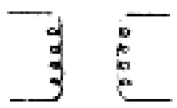
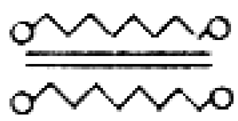
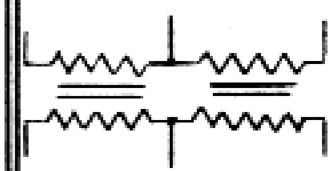
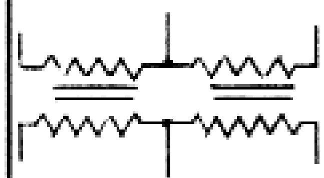
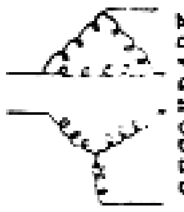
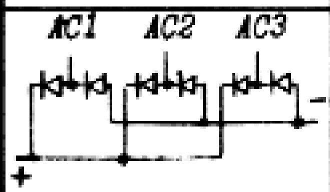
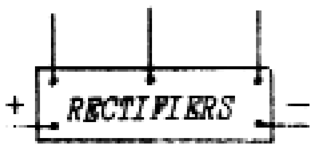
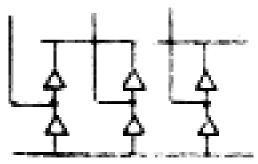
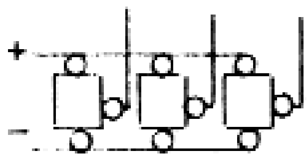
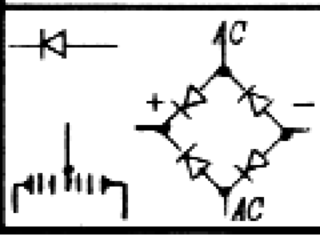
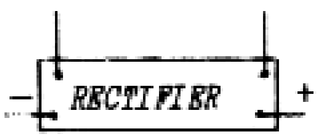
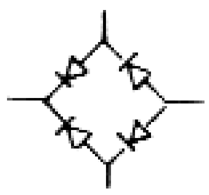
3. It is hoped that these charts will prove of interest and that they will simplify the task of preparing field data that will be clear and understandable to all mechanics.

WIRING DIAGRAM SYMBOLS

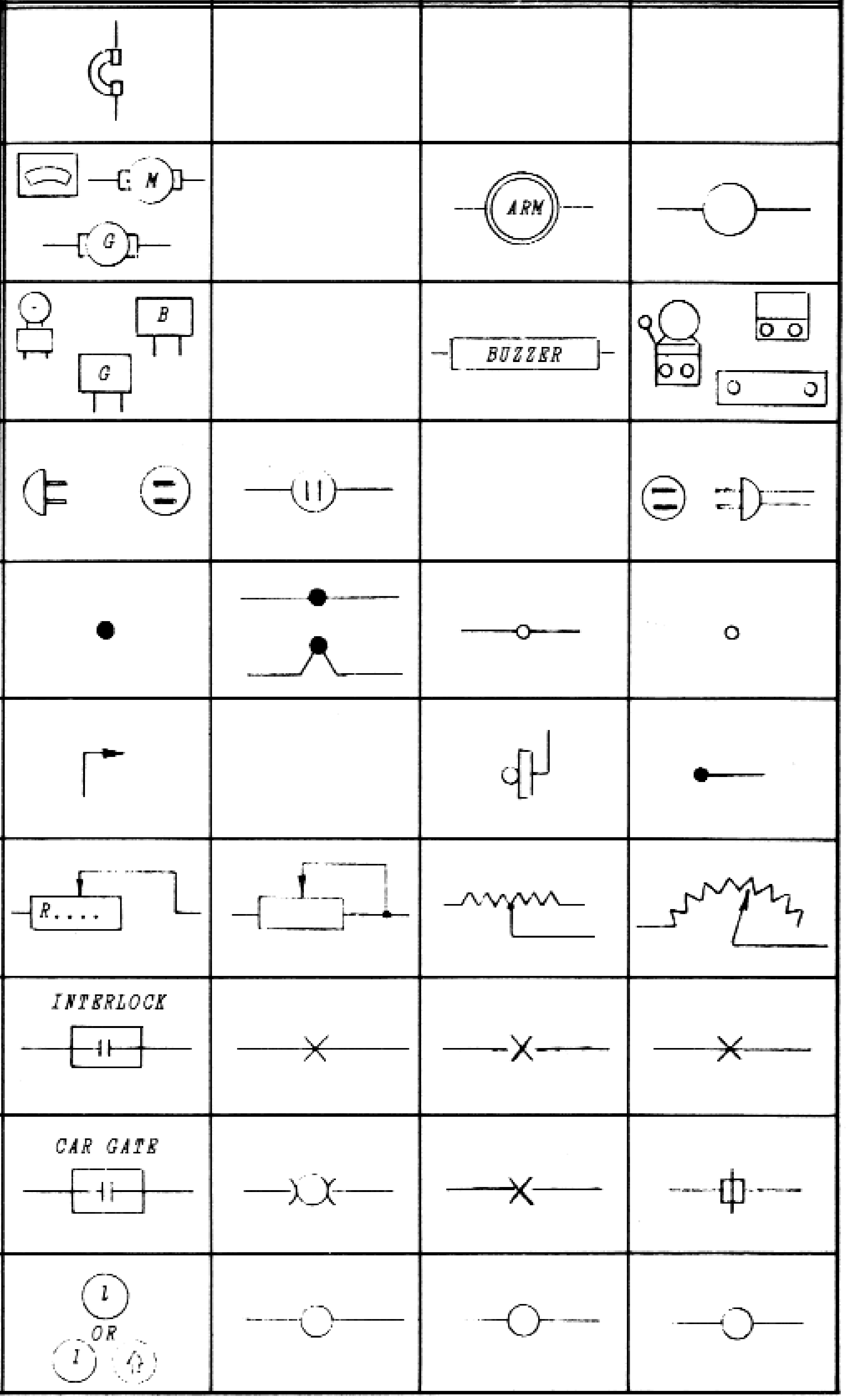
NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
NORMALLY OPEN CONTACT *(Switch Mounted on Panel)*			BLOWOUT	
NORMALLY CLOSED CONTACT *(Switch Mounted on Panel)*			BLOWOUT	
NORMALLY OPEN CONTACT *(Switch NOT Mounted on Panel)*				
NORMALLY CLOSED CONTACT *(SWITCH NOT MOUNTED ON PANEL)*				
NORMALLY OPEN MECHANICALLY OPERATED SWITCH	NO			
NORMALLY CLOSED MECHANICALLY OPERATED SWITCH	NC			
MAGNET SWITCH MAKE AND BREAK CONTACTS THROWOVER CONTACTS				
GOVERNOR SWITCH MAKE AND BREAK CONTACTS	GOV. GOV.			
COIL			SYMBOL INSIDE CIRCLE	OR
FUSE				OR



NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
NORMALLY OPEN CONTACT *(Switch Mounted On Panel)*				
NORMALLY CLOSED CONTACT *(Switch Mounted On Panel)*				
NORMALLY OPEN CONTACT *(Switch NOT Mounted On Panel)*		TERMINAL IDENTIFIED		
NORMALLY CLOSED CONTACT *(Switch NOT Mounted On Panel)*		TERMINAL IDENTIFIED		
NORMALLY OPEN MECHANICALLY OPERATED SWITCH				
NORMALLY CLOSED MECHANICALLY OPERATED SWITCH				
MAGNET SWITCH MAKE AND BREAK CONTACTS THROWOVER CONTACTS		MAKE CONTACT		
GOVERNOR SWITCH MAKE AND BREAK CONTACTS	MAKE BREAK			
COIL			RELAY MAGNETIC	
FUSE				

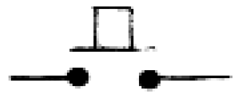
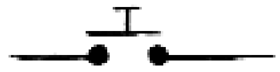
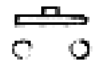
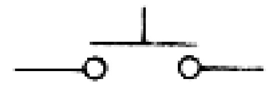
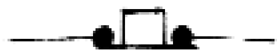
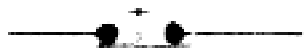
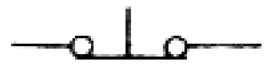
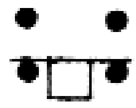
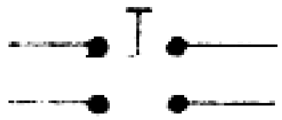
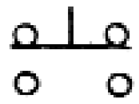
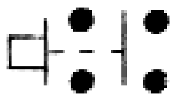
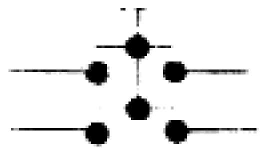
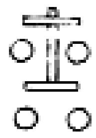
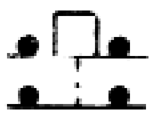
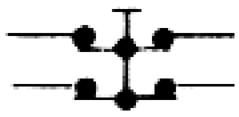
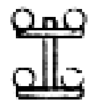
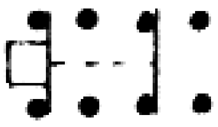
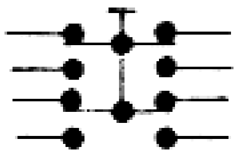
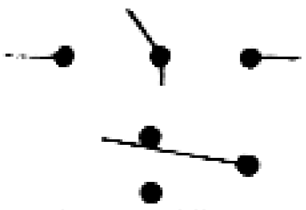
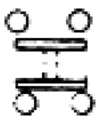
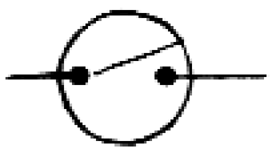
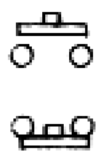
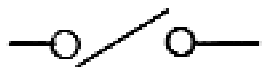
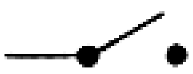
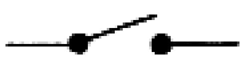
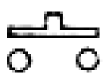
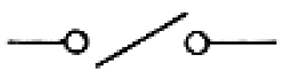
NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
SHUNT				
CONDENSER				 OR 
CONSTANT RESISTANCE				
RESISTOR (OPTIONAL)	 (WHEN REQUIRED)			
BLOWOUT			 OPEN  CLOSED	
MOTOR OR GENERATOR INTERPOLE	 (INT'PL.)			
TRANSFORMER (SINGLE PHASE)				
TRANSFORMER (POLYPHASE)			 SECONDARY IN SIMILAR MANNER	
RECTIFIER (POLYPHASE)				
RECTIFIER (SINGLE)				

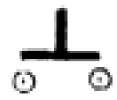
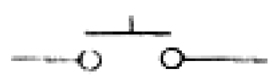
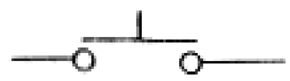
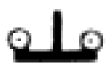
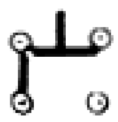
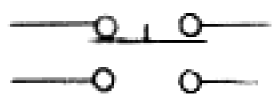
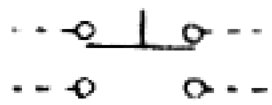
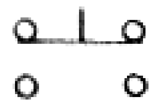
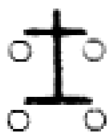
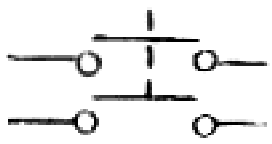
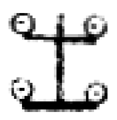
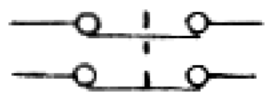
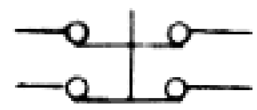
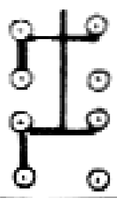
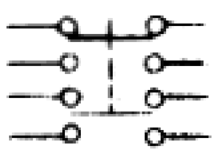
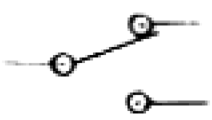
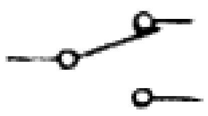
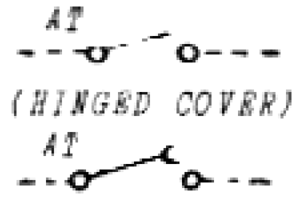
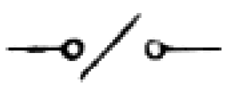
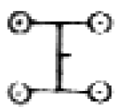
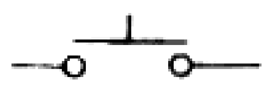
NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
SHUNT				
CONDENSER		POLARIZED NON-POLARIZED	POLARIZED (+) NON-POLARIZED	
CONSTANT RESISTANCE				
RESISTOR (OPTIONAL)				
BLOWOUT		COIL PM		
MOTOR OR GENERATOR INTERPOLE			INTERPOLE	
TRANSFORMER (SINGLE PHASE)	OR			
TRANSFORMER (POLYPHASE)	OR		SHOWN AS SEPARATE SINGLE PHASE TRANSFORMER WITH NOTE	
RECTIFIER (POLYPHASE)			ETC.	
RECTIFIER (SINGLE)				(-) (+)

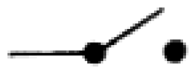
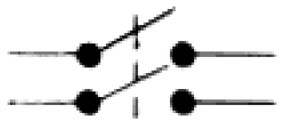
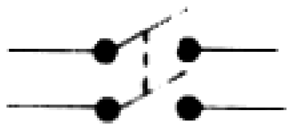
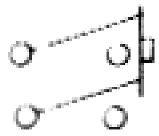
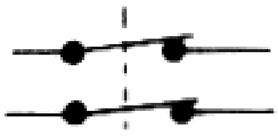
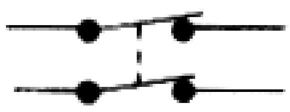
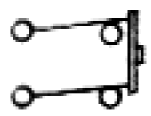
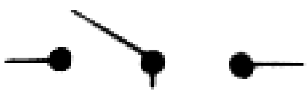
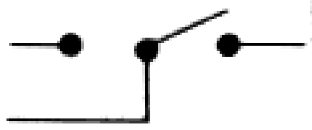
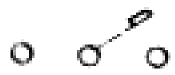
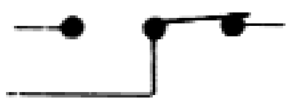
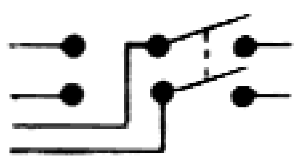
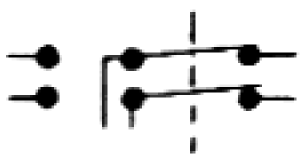
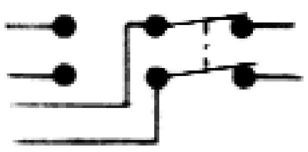
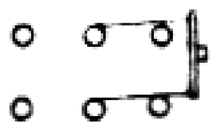
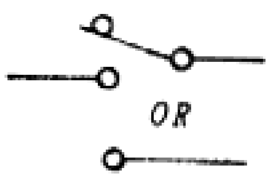
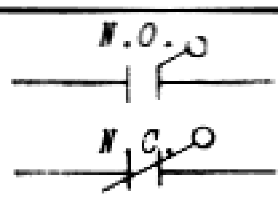
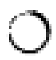
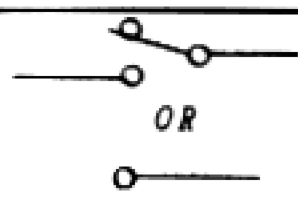


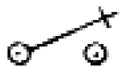
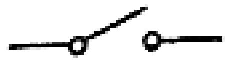
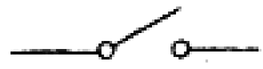
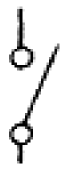
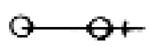
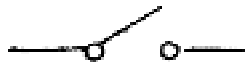
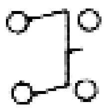
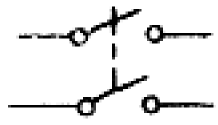
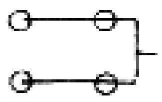
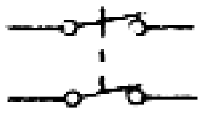
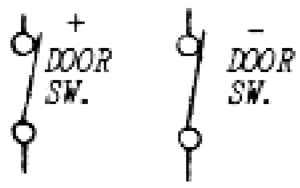
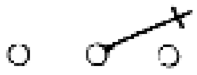
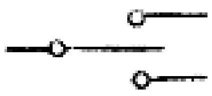
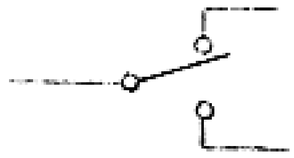
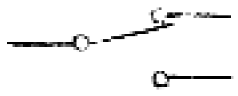
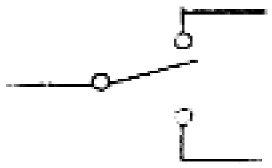
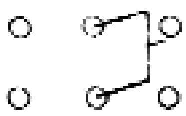
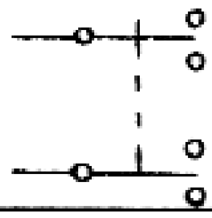
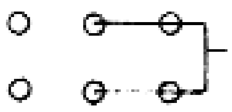
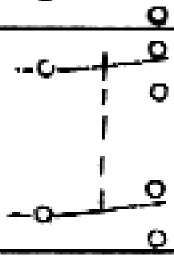
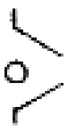
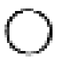
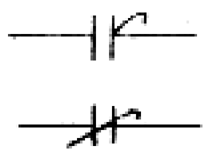
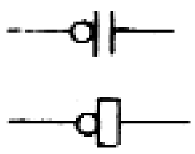
NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
CIRCUIT BREAKER				
METERS - MOTOR OR GENERATOR ARMATURE	M G		ARM	
BELL-BUZZER GONG	B G		BUZZER	
PLUG AND RECEPTACLE				
TERMINAL STUD				
SELECTOR BRUSH				
VARIABLE RESISTOR OR POTENTIOMETER	R			
DOOR CONTACT	INTERLOCK			
GATE CONTACT	CAR GATE			
INDICATOR LIGHT	l OR l			

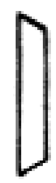
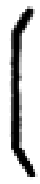
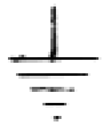
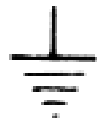
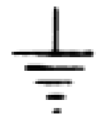
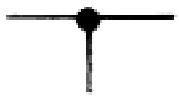
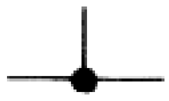
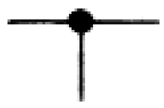
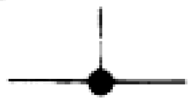
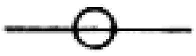
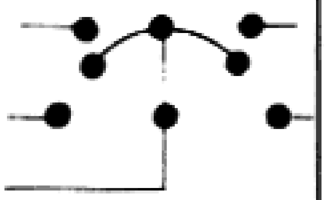
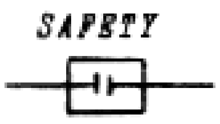
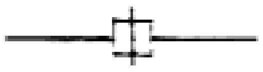
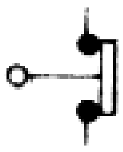
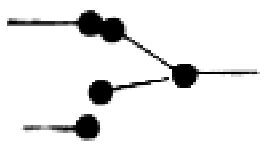
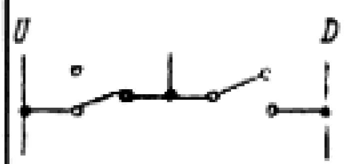
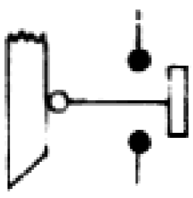
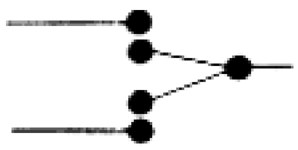
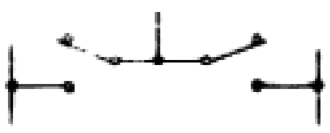
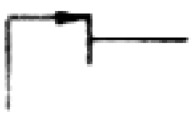
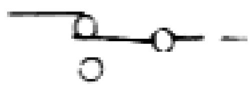
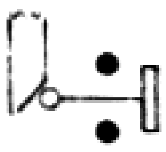
NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
CIRCUIT BREAKER			HEATER CONTACT	O.L.
METERS - MOTOR OR GENERATOR ARMATURE		VOLTMETER V	METER D.C. ARMATURE	METER MOTOR GEN.
BELL - BUZZER GONG		BELL BZ GONG G		BELL GONG BUZZER
PLUG AND RECEPTACLE				
TERMINAL STUD			CONT. SEL. R.P.	
SELECTOR BRUSH			STATIONARY MOVING	
VARIABLE RESISTOR OR POTENTIOMETER				
DOOR CONTACT		DOOR CONTACT	DOOR INTERLOCK CONTACTS	
GATE CONTACT		GATE CONTACT	G	GATE
INDICATOR LIGHT				IND.

NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
SINGLE MAKING BUTTON				
SINGLE BREAKING BUTTON				
BREAK-MAKE BUTTON				
DOUBLE MAKING BUTTON				
DOUBLE BREAKING BUTTON				
DOUBLE BREAK-MAKE BUTTON				
THROWOVER-OPERATING SWITCH				
MOTOR GENERATOR SET STARTING SWITCH				
SNAP SWITCH				
EMERGENCY STOP, CAR LIGHT SWITCH, et cetera				

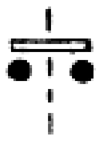
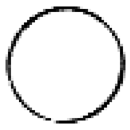
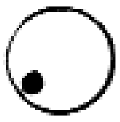
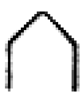
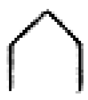
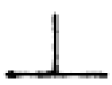
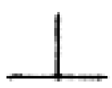
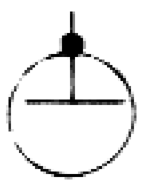
NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
SINGLE MAKING BUTTON				
SINGLE BREAKING BUTTON				
BREAK-MAKE BUTTON				
DOUBLE MAKING BUTTON				
DOUBLE BREAKING BUTTON				
DOUBLE BREAK-MAKE BUTTON			SHOWN AS TWO SEPARATE BREAK-MAKE BUTTONS	
THROWOVER-OPERATING SWITCH				(NIGHT SERVICE) 
MOTOR GENERATOR SET STARTING SWITCH			M.G. 	M.G. 
SNAP SWITCH				
EMERGENCY STOP, CAR LIGHT SWITCH et cetera		 EMERGENCY STOP SW.	STOP  LIGHT 	STOP  LIGHT 

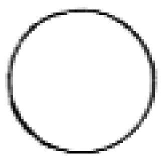
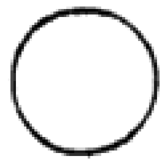
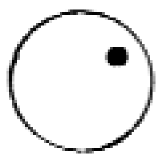
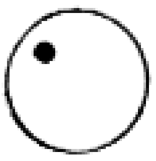
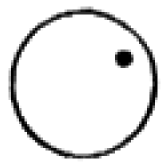
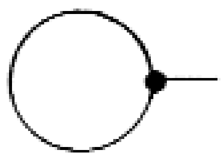
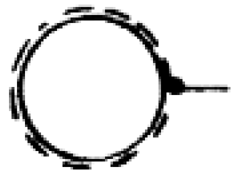
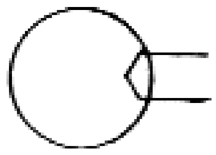
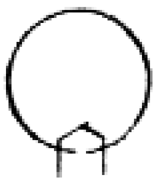
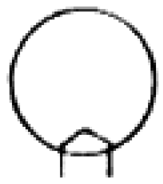
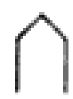
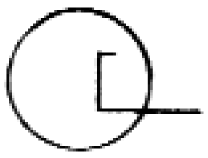
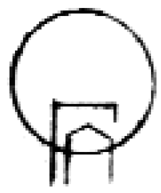
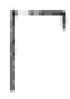
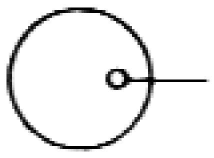
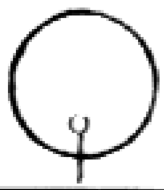
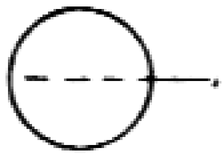
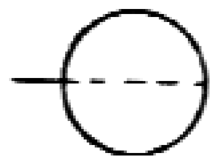
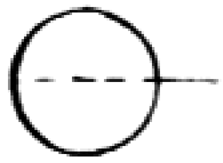
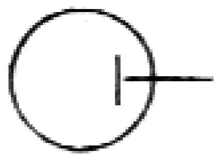
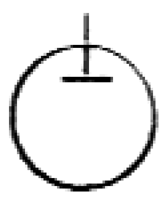
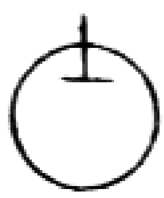
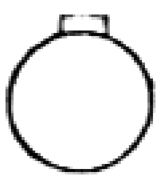
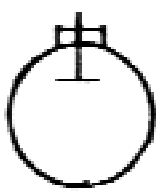
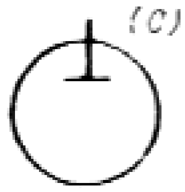
NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
SPST KNIFE SWITCH (OPEN)				
SPST KNIFE SWITCH (CLOSED)				
DPST KNIFE SWITCH (OPEN)				
DPST KNIFE SWITCH (CLOSED)				
SPDT KNIFE SWITCH (OPEN)				
SPDT KNIFE SWITCH (CLOSED)				
DPDT KNIFE SWITCH (OPEN)				
DPDT KNIFE SWITCH (CLOSED)				
SELECTOR STOP CONTROL SWITCH				
SELECTOR CONTACT				

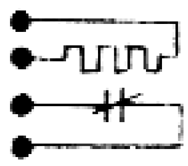
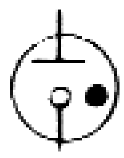
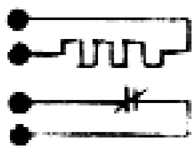
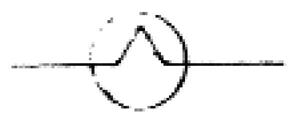
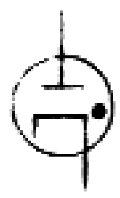
NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
SPST KNIFE SWITCH (OPEN)				
SPST KNIFE SWITCH (CLOSED)				
DPST KNIFE SWITCH (OPEN)			*SHOWN AS TWO SEPARATE SPST SWS*	
DPST KNIFE SWITCH (CLOSED)			*SHOWN AS TWO SEPARATE SPST SWS*	
SPDT KNIFE SWITCH (OPEN)				
SPDT KNIFE SWITCH (CLOSED)				
DPDT KNIFE SWITCH (OPEN)			*SHOWN AS TWO SEPARATE SPDT SWS*	
DPDT KNIFE SWITCH (CLOSED)			*SHOWN AS TWO SEPARATE SPDT SWS*	
SELECTOR STOP CONTROL SWITCH				
SELECTOR CONTACT				

NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
SELECTOR CAMS				
GROUND				
WIRE TAP				
FIELD CONNECTION BETWEEN TERMINALS ON TWO PIECES OF FACTORY-WIRED EQUIPMENT				
CAR SWITCH (REGULAR)				
SAFETY OPERATED SWITCH				
FLOOR STOP SWITCH (SET FOR DIRECTION)				
FLOOR STOP SWITCH (SHOWN AT LANDING)				
SELECTOR BREAKING CONTACT ON FLOOR BAR AND CAM ON CROSSHEAD				
SELECTOR BREAKING CONTACT ON FLOOR BAR NORMALLY CLOSED				

NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
SELECTOR CAMS			STATIONARY MOVING	
GROUND				
WIRE TAP				
FIELD CONNECTION BETWEEN TERMINALS ON TWO PIECES OF FACTORY-WIRED EQUIPMENT			OR	WIRE NO.
CAR SWITCH (REGULAR)			ALSO USED FOR SAFETY EDGE	
SAFETY OPERATED SWITCH			S	SAFETY SW.
FLOOR STOP SWITCH (SET FOR DIRECTION)	AUX. CONT.		CLOSED WHEN CAR BELOW	
FLOOR STOP SWITCH (SHOWN AT LANDING)				
SELECTOR BREAKING CONTACT ON FLOOR BAR AND CAM ON CROSSHEAD				
SELECTOR BREAKING CONTACT ON FLOOR BAR NORMALLY CLOSED				

NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
SIGNAL CONTROL CAR OPERATING CONTACT				
TUBE ENVELOPE (GLASS OR METAL)				
DENOTING GAS-FILLED TUBE				
SHIELD CONNECTION				
FILAMENT TYPE CATHODE OR HEATER				
INDIRECTLY HEATED CATHODE				
COLD CATHODE				
GRID				
ANODE (PLATE)				
TUBE WITH CAP CONNECTION				

NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
SIGNAL CONTROL CAR OPERATING CONTACT				
TUBE ENVELOPE (GLASS OR METAL)				
DENOTING GAS-FILLED TUBE				
SHIELD CONNECTION				
FILAMENT TYPE CATHODE OR HEATER				
INDIRECTLY HEATED CATHODE				
COLD CATHODE				
GRID				
ANODE (PLATE)				
TUBE WITH CAP CONNECTION				

NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
AMPERITE				
NEON GLOW TUBE				
NEON TUBE (COLD CATHODE)				
AMPERITE TUBE (WITH HEATER ELEMENT)				
MERCURY VAPOR RECTIFIER TUBE				
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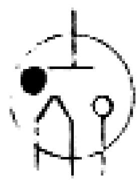
NEON TUBE (WITH HEATED CATHODE)				
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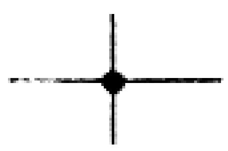
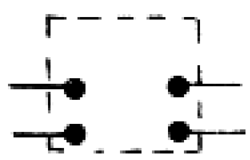
INTERCONNECTED STUD				
BENCH ASSEMBLY WIRING				

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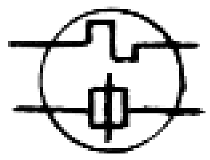
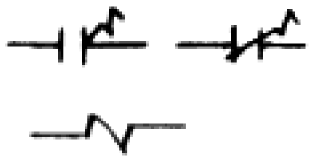
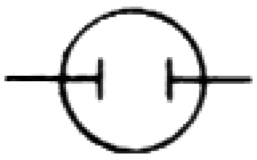
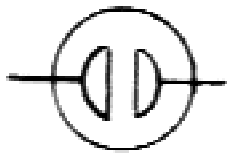
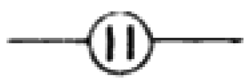
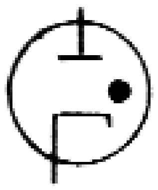
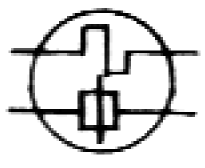
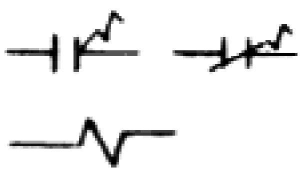
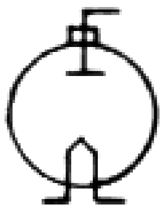
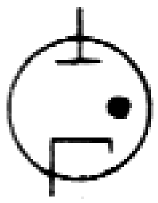
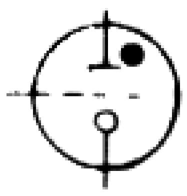
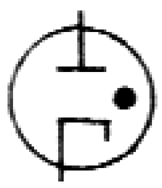
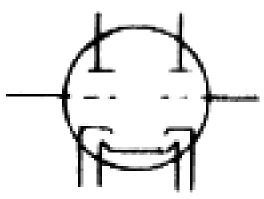
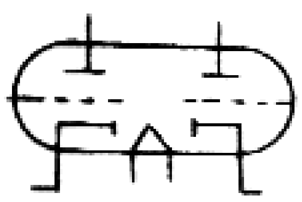
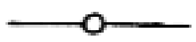
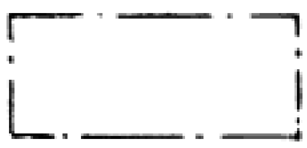
AMPERITE				
NEON GLOW TUBE				
NEON TUBE (COLD CATHODE)				
AMPERITE TUBE (WITH HEATER ELEMENT)				
MERCURY VAPOR RECTIFIER TUBE				
TOUCH BUTTON OR ELECTRONIC DETECTOR TUBE (COLD CATHODE)				
NEON TUBE (WITH HEATED CATHODE)				
DUAL TUBE				
INTERCONNECTED STUD				
BENCH ASSEMBLY WIRING				

NAME	DOVER CORP. ELECT. ELEV. DIVISION	GENERAL ELEVATOR COMPANY INC.	HAUGHTON ELEVATOR COMPANY	MONTGOMERY ELEVATOR COMPANY
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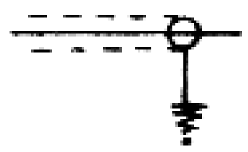
SHIELDED WIRE				
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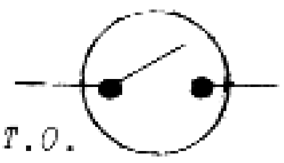
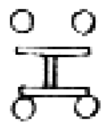
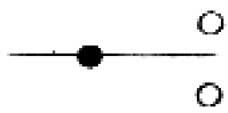
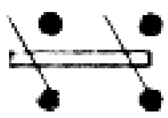
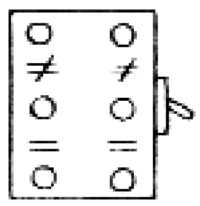
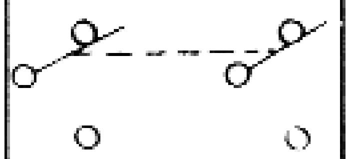
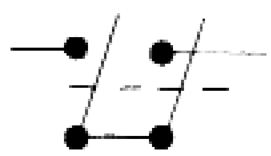
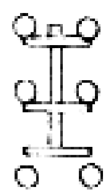
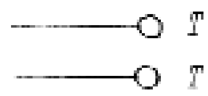
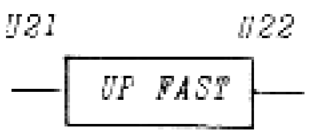
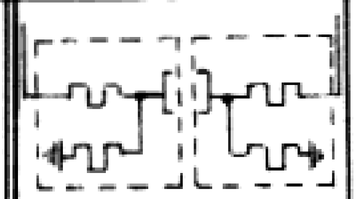
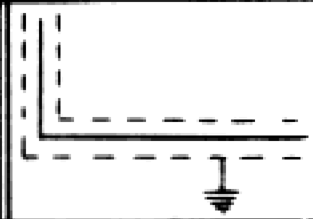
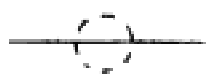
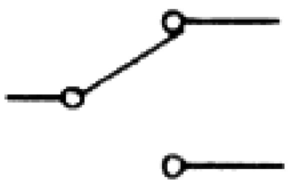
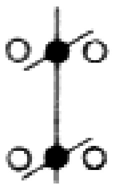
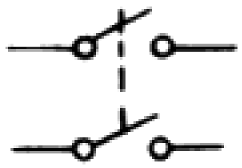
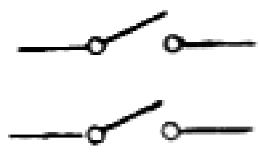
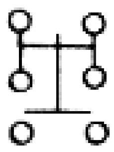
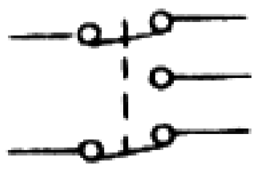
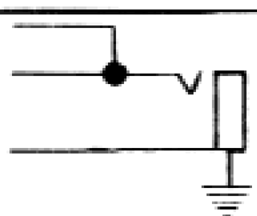
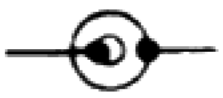
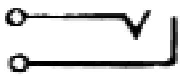
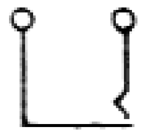
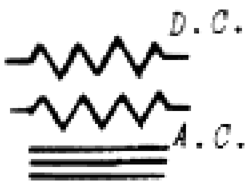
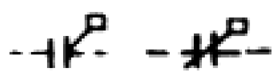
THROWOVER SWITCH OPERATING SWITCH				
DOUBLE TOGGLE SWITCH				
DOUBLE BREAK SINGLE MAKE SWITCH				
TELEPHONE JACK				
SOLENOID COIL				

NAME	OTIS ELEVATOR COMPANY	ARMOR ELEVATOR COMPANY INC.	TURNBULL ELEVATOR INCORPORATED	WESTINGHOUSE ELECTRIC CO. ELEV. DIV.
HOIST DOOR AND POST SIGHT GUARDS				
SHIELDED WIRE			*INDICATED BY A NOTE ON WIRING DIAGRAM*	*SHIELD* 
DUAL RHEOSTAT			*SHOWN AS TWO SEPARATE RHEOSTATS*	
THROWOVER SWITCH OPERATING SWITCH				
DOUBLE TOGGLE SWITCH				
DOUBLE BREAK SINGLE MAKE SWITCH				
TELEPHONE JACK				
SOLENOID COIL				
INDUCTOR CONTACTS				

CHAPTER 4
Section -c2

DRAWINGS AND MISCELLANEOUS PAPERS

Wiring Diagram – Conduit Layout

Suggested:

Materials –	Tools –
a. none	a. none

1. There are three types of wiring drawings commonly used in the erection of elevators. They are:

Conduit Layouts
Field Diagrams
Straight Line Drawings

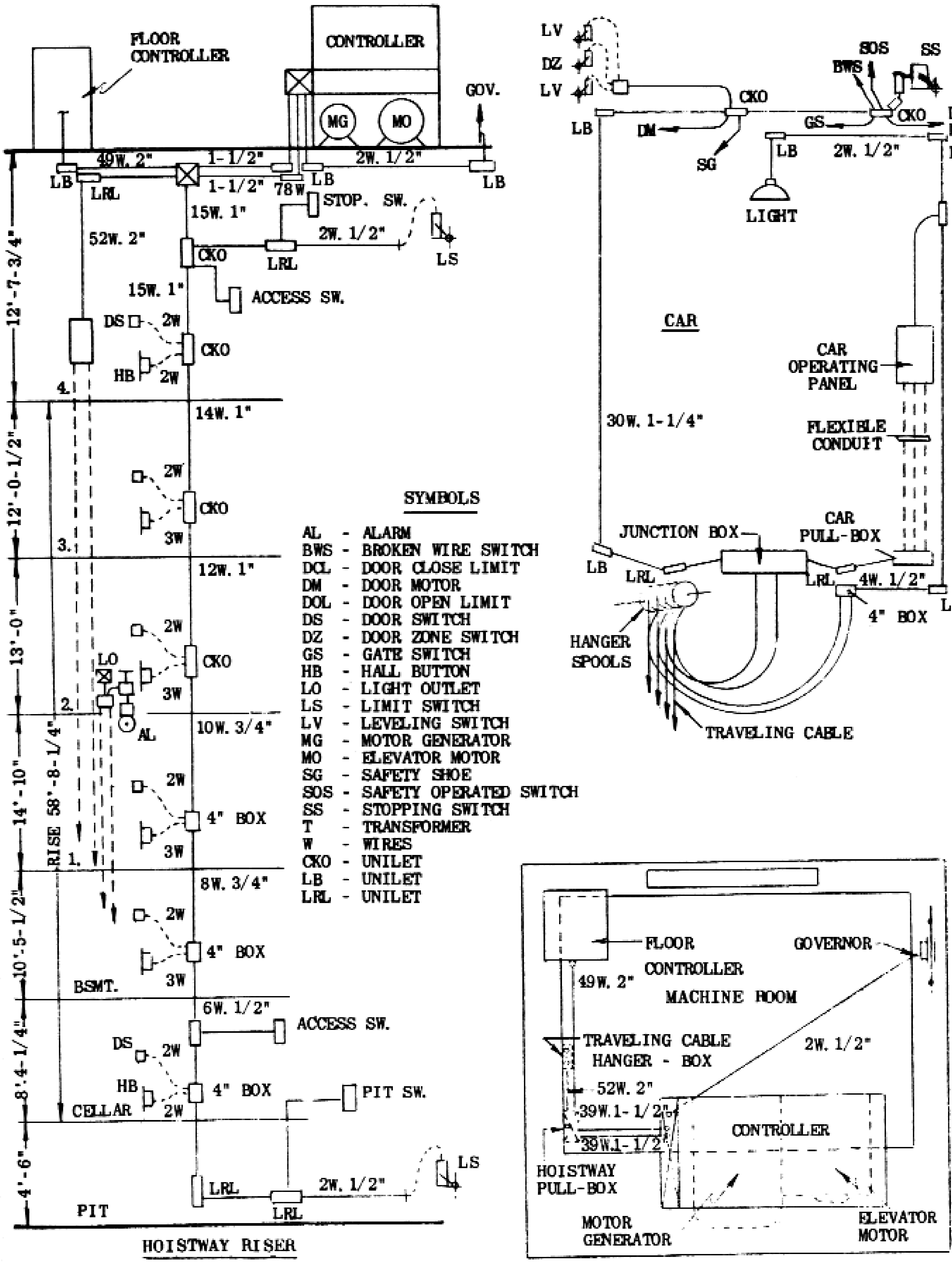
2. Conduit layouts are part of the preliminary data given to the mechanic. They include data on risers, machine room, and car conduit layouts. The arrangement and grouping of the various switches, interlocks, limit switches, etc., into a conduit system, which is continuous and complete, is indicated. The various numbers and sizes of wires are usually noted on the sheets also. When a conduit system for the machine room becomes complicated, it is handled as a separate layout. Vertical conduit risers are shown schematically. Floor heights and approximate location of limit and other switches are shown. The methods of fastenings are not always shown. However, data on the order sheets indicates the material supplied and thus specifies the recommended type of fastenings.

3. A conduit layout is included in this article. Notice that it is divided into three sections: the hoistway, car, and machine room. It is a typical, though condensed, layout as supplied by many companies.

4. The riser drawing indicates vertical location of the conduit and boxes as well as the pipe sizes and the number of wires to be included in each. It does not locate the conduit in ''plan view'' but a glance at the machine-room plan establishes this.

5. A few minutes spent in studying a conduit layout will give the mechanic a clear picture of the wiring raceway arrangement, and thereby save time and effort during the progress of the work.

6. It should be noted that forms of wiring material have changed considerably since this book was first written. Conduit is eliminated to a great extent on larger installations by use of sheet metal troughing or ducts. Wires in cable form are also used. These changes are outlined in chapter 10, titled ''Construction Wiring.''



BASIC EXAMPLE OF CONDUIT LAYOUT

CHAPTER 4
Section -c3

DRAWINGS AND MISCELLANEOUS PAPERS

Field Wiring Diagram

Suggested:

Materials –	Tools –
a. none	a. none

1. Field Wiring Diagrams, or W.D.'s, are actually condensed pictures of the major portions of the wiring for elevators.

2. Many W.D.'s show, as a central figure, an outline of the elevator controller and include the board wiring. The locations of the controller switches are indicated on this type of layout.

3. Lines representing wires are led from this controller drawing to smaller symbols on the sheet. These symbols portray the motor, brake, door contact, car operating box, and limit wiring, as well as the supply switch.

4. The W.D. shown in this article is a typical diagram for medium speed D.C. elevator.

5. This type of print is used for "hooking up" equipment, ringing out and identifying wires.

6. W.D.'s do not indicate the number of floors served. This must be borne in mind when connecting door contacts, push-button wires, and hall buttons.

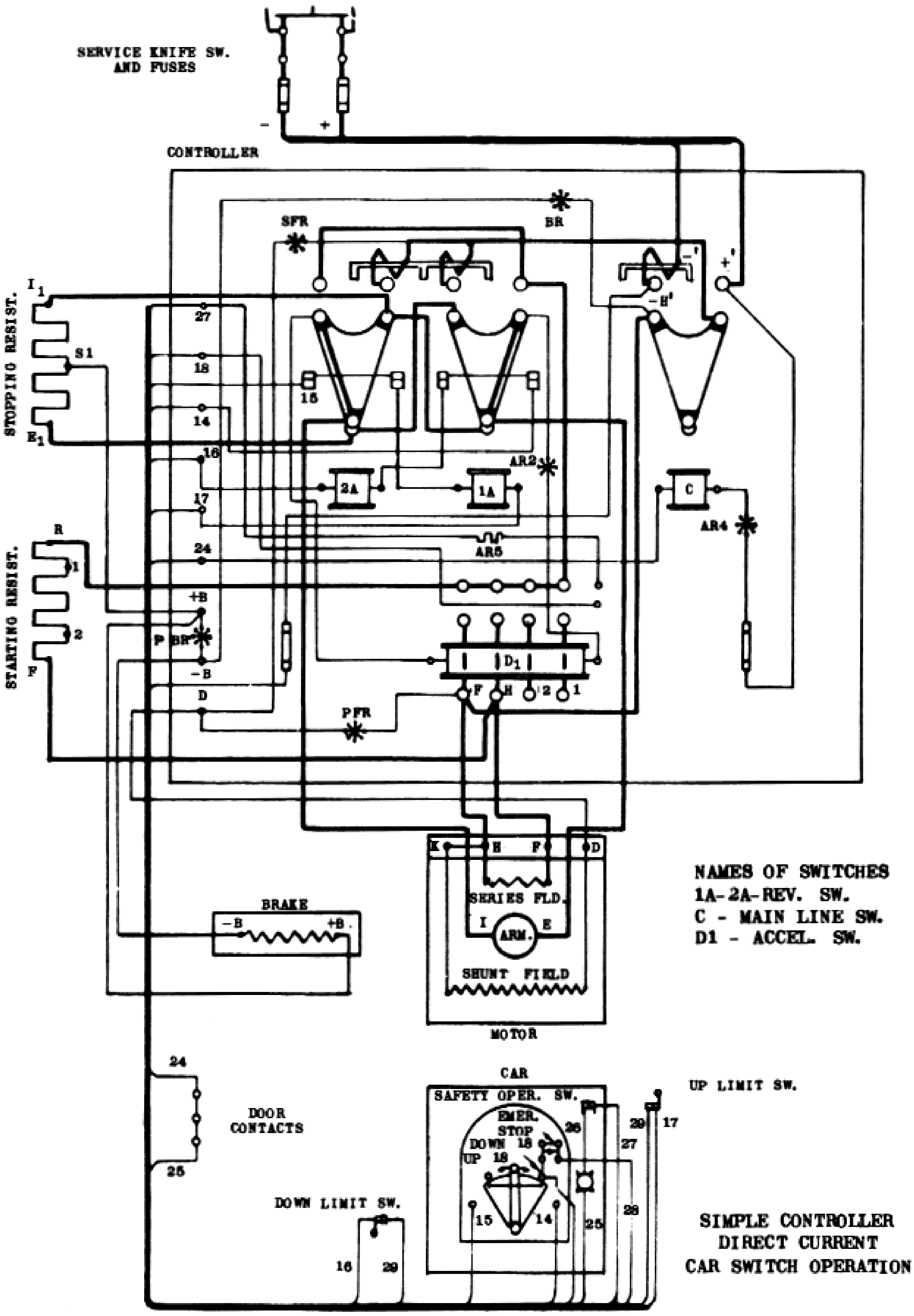
7. As a rule, they are marked-up to include any non-standard variables that may be specified for a contract.

8. The wire groups may or may not correspond to the arrangement indicated on the conduit layout. Where this condition occurs, follow the data outlined in the conduit layout, because this drawing is made specifically for the elevator being installed.

9. On some W.D.'s, the controller motor and brake are symbolized by an open square or rectangle. The wiring, however, is shown in the same general manner as illustrated in our example.

10. Light and alarm-bell wiring is often omitted from field wiring diagrams.

11. All "wires" are named or numbered at each end, to facilitate identification. For example, note that wire #14 terminates at both the controller and at the car switch in the attached W.D.



ELEMENTARY TYPE OF FIELD WIRING DIAGRAM

12. W.D.'s should be used in conjunction with straight wiring diagrams (see chapter 4 – c4).

CHAPTER 4
Section -c4

DRAWINGS AND MISCELLANEOUS PAPERS

Straight Wiring Diagrams

1. Straight line field wiring diagrams for elevators are the true circuit diagrams.

2. Whereas the draftsman may attempt to symbolize the physical appearance and location of elevator parts when he designs a W.D., he ignores these points when he makes up a "straight."

3. Because of this we may find, on a "straight," a symbol for a part of the hoistway equipment beside one for the controller with a hoistway part immediately beyond that.

4. Let us look at diagram *1 in this section, for an example.

5. We see that it is a "straight" for a simple, D.C. powered elevator and is for the same elevator as the W.D. in section -c3 of this chapter. It is divided into two sections. The upper section is of the "operating" circuits and the lower, printed with heavier lines, is of the "power circuits." At the upper left-hand corner is a symbol for one blade of the service or "line" switch. Just below it is a main fuse, usually located adjacent to the service switch. A plus (+) sign indicates that this is the positive side of the line.

6. A fuse is attached to this positive wire. This is a controller fuse and is shown on the W.D. (chapter 4 -c3) as a vertically mounted fuse at the lower right-hand corner of the controller panel.

7. Next in line along the same wire on the "straight" is a resistance "AR4" followed by a coil "C." These can be found on the W.D. also, just above the fuse.

8. From that point on, the simplicity of the "straight" becomes apparent. To the right of "C" coil are a series of circles representing hoistway door contacts. These are followed by the gate contact, which is on the car. All of these are in line, as if the wires and contacts were actually pulled out of their conduits and laid out in a straight line.

9. To trace the same circuit on the W.D. it is necessary to search from the "C" coil, across the board to "stud" *24, then down the heavy black line (conduit) to find the door contacts, where *24 again appears.

10. The wire goes through the door contacts, passing back into the heavy line as #25. Then it must again be traced down to the bottom right-hand corner of the W.D., and into the group of car-switch wires where it is again found as #25.

11. By this short comparison, the advantage of the "straight" over the W.D. for checking hoistway circuit faults or continuity is clearly shown.

12. Also, the straight is the diagram most generally used by field engineers and inspectors for adjusting. The exact relationship between the accelerating switches and the starting resistance, for instance, can be seen at a glance.

13. Trace out the same circuits on the W.D. and note the comparative complexity in following the circuit. (The actual connections between 1 & 2, on the resistance were left out because the print was becoming too complicated.)

14. It is, therefore, recommended that all mechanics learn to read straight wiring diagrams. They should become acquainted with the wiring symbols of their companies and learn what they represent.

15. Begin tracing a circuit at one supply line, follow it through until an "open" contact appears.

16. Find the coil for that contact (as "C" contact and "C" coil) and trace the circuit needed to close it. Then the contact will close and you may continue on the original circuit to its completion.

17. Whether the mechanic maintains, repairs or installs elevators, his work is simplified if he can read a "straight."

18. Modern single-speed elevators are usually operated from an A.C. power supply. In order to obtain the benefits of D.C. switch and brake-coil control, the switch, relay and brake-coil circuits are often supplied from a dry-plate rectifier, which "phases out" the A.C. circuit to provide a modified D.C. supply.

19. Diagram #2 illustrates this type of elevator control.

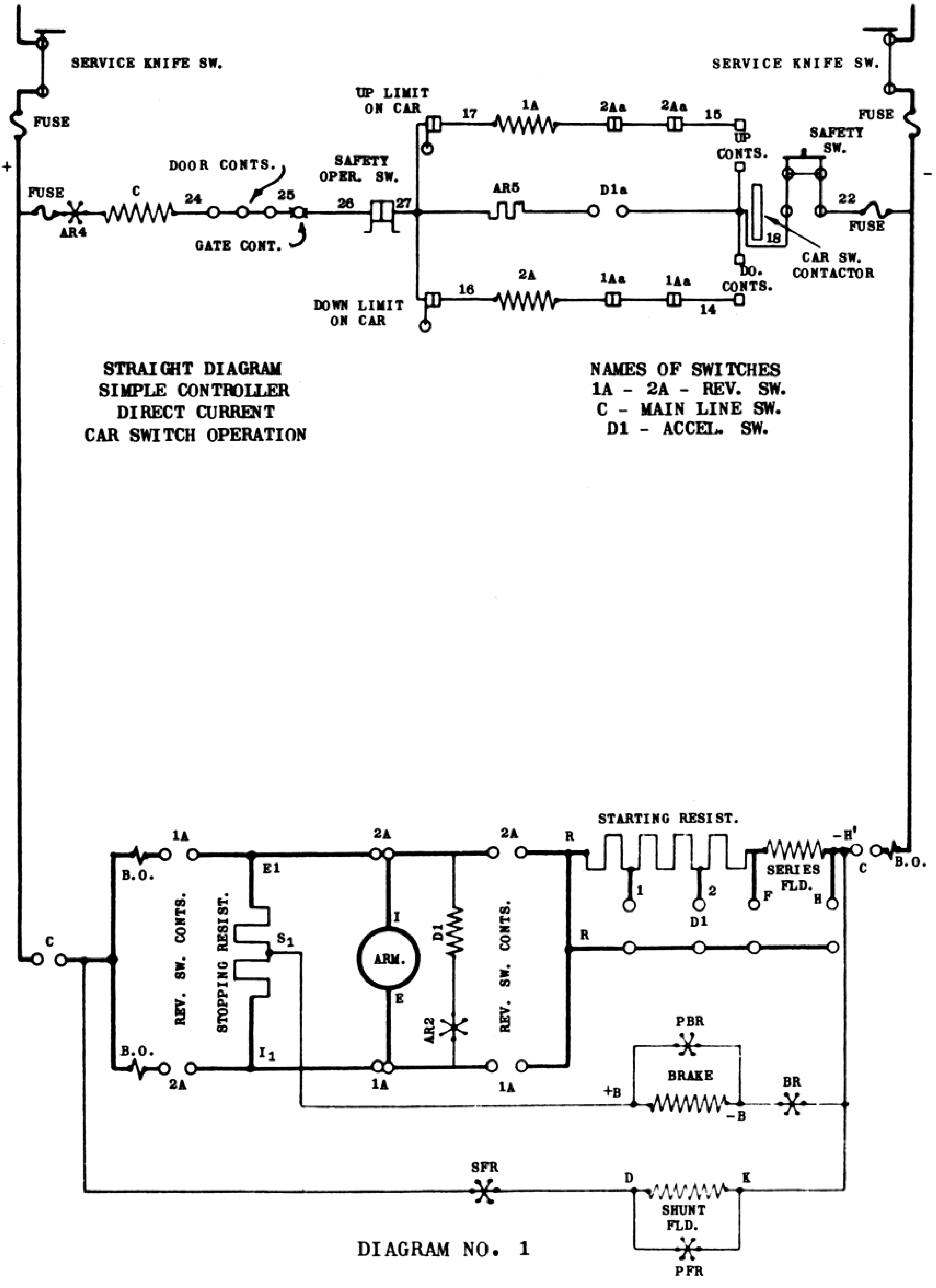


DIAGRAM NO. 1

STRAIGHT LINE WIRING DIAGRAM FOR D.C. ELEVATOR

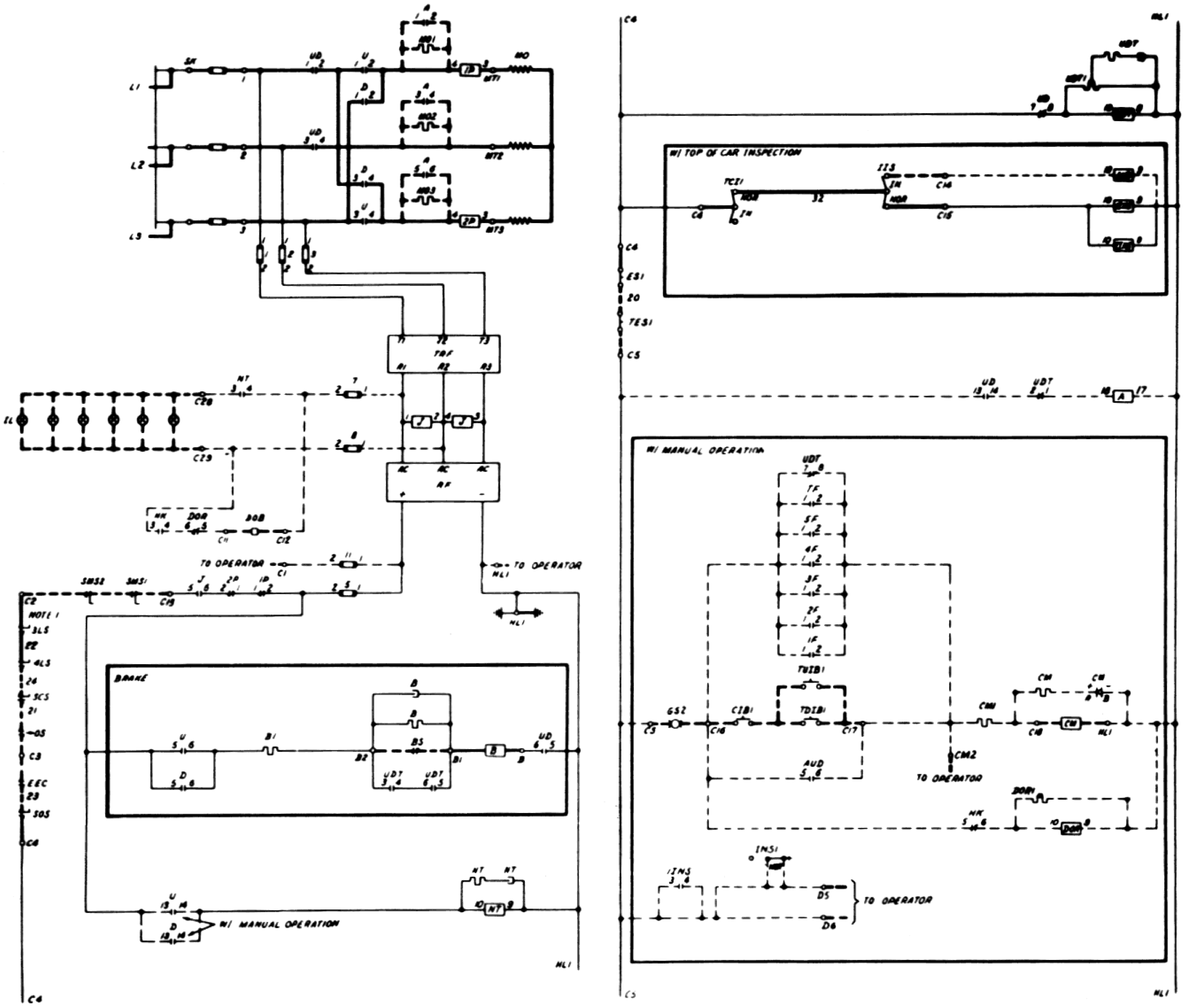


DIAGRAM NO. 2

STRAIGHT LINE WIRING DIAGRAM FOR A.C. ELEVATOR

CHAPTER 4
Section -dl

DRAWINGS AND MISCELLANEOUS PAPERS

Standards and Tables

1. An unbiased analysis indicates that the American automobile industry has done much to improve the economic and social lives of all peoples. This marked influence probably had its birth in an exhibitionist ''stunt'' put on in Europe by a United States automobile manufacturer about the turn of the century.

2. At that time the few automobiles manufactured were mostly hand finished. The American manufacturer shipped a number of ''stock'' autos to the exhibit. (We are not sure of the number but whether ten or a hundred, the effect was the same.) Competent mechanics dis-assembled the greater parts of the cars, threw the parts into a heap and then reassembled the automobiles, started the engines and drove each away! This demonstrated to a skeptical audience the practicability of standardization applied to machine finished assemblies.

3. Essentially all automobile companies manufacture to close machine standards today and much of the general manufacturing industry also does. All of us benefit since mass production results in uniform quality at minimum prices.

4. Those of us who assemble equipment also benefit. If we ask a helper for a 5/8'' x 3'' bolt, we expect and get one that is like a thousand others. Our tools fit the bolt heads and nuts, and we feel confident that once we complete a job properly the quality of material will reduce to a minimum the possibility of failure under service. This standardization is increasing but is not by any means universal. One of the more important phases under international study is the reconciliation between metric dimensions, inch-foot-yard dimensions and other improvised systems of linear measurement such as Japan's ''shaku'' unit. Scientific measurements of all kinds have been metric for years. However, while governmental authorities generally concede the logic and desirability of international acceptance of the decimal metric system, commercial adaptation of it will be slow because of the expenses of conversion. Much of this expense will be due to the need to maintain existing equipment after new materials are manufactured to metric dimensions. The increasing per cent of overseas sales of European goods made to metric dimensions will undoubtedly expedite general acceptance of that system as the international commercial standard.

5. One of the beneficial results of even our present incomplete standards system is the fact that we can tabulate information for common use of engineer, draftsman, manufacturer, installation mechanic and service man. Simple examples are attached hereto. The benefits of their use will increase as standardization is extended.

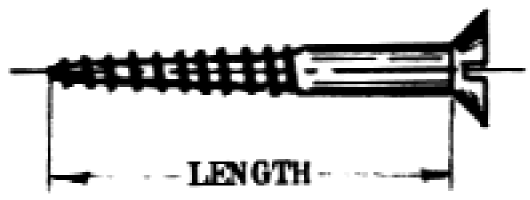
THREAD DIMENSIONS AND TAP DRILL SIZES

Nominal Size	Outside Diameter, Inches	Pitch Diameter, Inches	Root Diameter, Inches	Tap Drill	Decimal Equivalent of Tap Drill
0-80	.0600	.0519	.0438	3/64	.0469
1-64	.0730	.0629	.0527	1/16	.0625
72	.0730	.0640	.0550	1/16	.0625
2-56	.0860	.0744	.0628	5/64	.0781
64	.0860	.0759	.0657	5/64	.0781
3-48	.0990	.0855	.0719	5/64	.0781
56	.0990	.0874	.0758	3/32	.0938
4-40	.1120	.0958	.0795	3/32	.0938
48	.1120	.0985	.0849	3/32	.0938
5-40	.1250	.1088	.0925	7/64	.1094
44	.1250	.1102	.0955	7/64	.1094
6-32	.1380	.1177	.0974	7/64	.1094
40	.1380	.1218	.1055	1/8	.1250
8-32	.1640	.1437	.1234	9/64	.1406
36	.1640	.1460	.1279	9/64	.1406
10-24	.1900	.1629	.1359	5/32	.1562
32	.1900	.1697	.1494	11/64	.1719
12-24	.2160	.1889	.1619	3/16	.1875
28	.2160	.1928	.1696	3/16	.1875
1/4-20	.2500	.2175	.1850	13/64	.2031
28	.2500	.2268	.2036	7/32	.2188
5/16-18	.3125	.2764	.2403	17/64	.2656
24	.3125	.2854	.2584	9/32	.2812
3/8-16	.3750	.3344	.2938	5/16	.3125
24	.3750	.3479	.3209	11/32	.3438
7/16-14	.4375	.3911	.3447	3/8	.3750
20	.4375	.4050	.3726	25/64	.3906
1/2-13	.5000	.4501	.4001	27/64	.4219
20	.5000	.4675	.4351	29/64	.4531
9/16-12	.5625	.5084	.4542	31/64	.4844
18	.5625	.5264	.4903	33/64	.5156
5/8-11	.6250	.5660	.5069	17/32	.5312
18	.6250	.5889	.5528	37/64	.5781
3/4-10	.7500	.6850	.6201	21/32	.6562
16	.7500	.7094	.6688	11/16	.6875

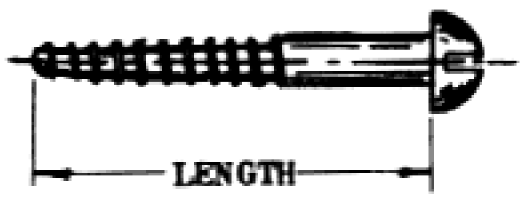
TABLE NO. 1

GAUGE NO.	THREADS PER INCH	DIA. APPROX. FRACTION	DRILL OR AUGER BIT			
			CL. HOLE	PILOT HOLE		C'SK. HOLE
				HARD WOOD	SOFT WOOD	
0	32	1/16"	1/16"	–	–	–
1	28	5/64"	3/32"	–	–	–
2	26	5/64"	3/32"	1/16"	–	3/16"
3	24	3/32"	1/8"	5/64"	1/16"	1/4"
4	22	7/64"	1/8"	3/32"	5/64"	1/4"
5	20	1/8"	1/8"	3/32"	5/64"	1/4"
6	18	9/64"	5/32"	7/64"	3/32"	5/16"
7	16	5/32"	5/32"	1/8"	7/64"	5/16"
8	15	5/32"	3/16"	9/64"	1/8"	3/8"
9	14	11/64"	3/16"	5/32"	1/8"	3/8"
10	13	3/16"	3/16"	11/64"	9/64"	3/8"
11	12	13/64"	7/32"	11/64"	9/64"	7/16"
12	11	7/32"	7/32"	3/16"	5/32"	7/16"
14	10	15/64"	1/4"	13/64"	11/64"	1/2"
16	9	17/64"	9/32"	15/64"	13/64"	9/16"
18	8	19/64"	5/16"	17/64"	15/64"	5/8"
20	8	21/64"	11/32"	9/32"	1/4"	11/16"
24	7	3/8"	3/8"	21/64"	19/64"	3/4"

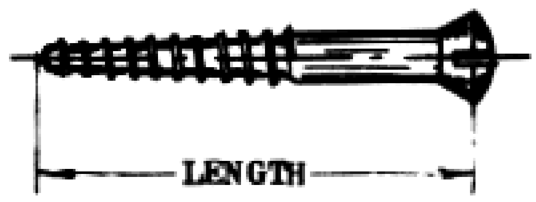
WOOD SCREWS



FLAT HEAD



ROUND HEAD



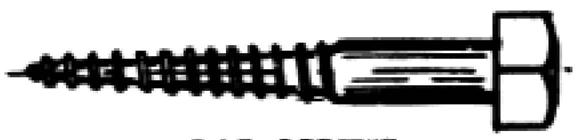
OVAL HEAD

SIZE	LGTH.	DIA. INCH APPROX.	APPROX. NO. ONE LB.
2d	1"	5/64"	900
3d	1-1/4"	5/64"	550
4d	1-1/2"	3/32"	300
5d	1-3/4"	3/32"	275
6d	2"	7/64"	175
7d	2-1/4"	7/64"	150
8d	2-1/2"	1/8"	100
9d	2-3/4"	1/8"	100
10d	3"	5/32"	70
12d	3-1/4"	5/32"	60
16d	3-1/2"	5/32"	50
20d	4"	3/16"	30
30d	4-1/2"	13/64"	25
40d	5"	7/32"	20
50d	5-1/2"	1/4"	15
60d	6"	17/64"	10

COMMON NAILS

DIA.	PILOT HOLE	
	HARD WOOD	SOFT WOOD
1/4"	3/16"	5/32"
5/16"	1/4"	7/32"
3/8"	5/16"	9/32"
7/16"	3/8"	11/32"
1/2"	7/16"	3/8"
9/16"	1/2"	7/16"

LAG SCREWS



LAG SCREWS

SIZE	LENGTH	APPROX. NO. ONE LB.
5d	1-3/4"	250
6d	2"	180
7d	2-1/4"	150
8d	2-1/2"	100
9d	2-3/4"	90
10d	3"	75

FLOORING NAILS

COMMON NAILS

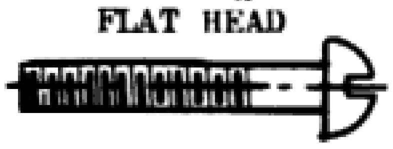
FLOORING NAILS

TABLE NO. 2

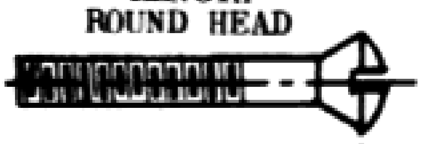
DIA.	THDS. PER IN.		TAP DRILL			
	COARSE NC	FINE NF	NC	APPROX. FRACTION	NF	APPROX. FRACTION
No. 2	56	64	#50	1/16"	#50	1/16"
No. 3	48	56	#47	5/64"	#45	5/64"
No. 4	40	48	#43	3/32"	#42	3/32"
No. 5	40	44	#38	3/32"	#37	7/64"
No. 6	32	40	#36	7/64"	#33	7/64"
No. 8	32	36	#29	9/64"	#29	9/64"
No.10	24	32	#25	5/32"	#21	5/32"
No.12	24	28	#16	11/64"	#14	3/16"
1/4 in.	20	28	#7	13/64"	#3	7/32"
5/16 in.	18	24	F	1/4 "	#1	17/64"
3/8 in.	16	24	5/16"	5/16"	Q	21/64"

MACHINE SCREWS

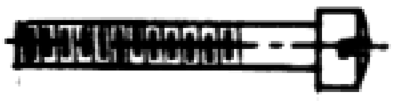
LENGTH
FLAT HEAD



LENGTH
ROUND HEAD



LENGTH
OVAL HEAD



LENGTH
FILLISTER HEAD

DIA.	THDS. PER IN.		TAP DRILL			
	COARSE NC	FINE NF	NC	APPROX. FRACTION	NF	APPROX. FRACTION
1/4 in.	20	28	#7	13/64"	#3	7/32"
5/16 in.	18	24	F	1/4 "	#1	17/64"
3/8 in.	16	24	5/16"		Q	21/64"
7/16 in.	14	20	U	3/8"	25/64"	
1/2 in.	13	20	27/64"		29/64"	
9/16 in.	12	18	31/64"		33/64"	
5/8 in.	11	18	17/32"		37/64"	
3/4 in.	10	16	21/32"		11/16"	

CAP SCREWS

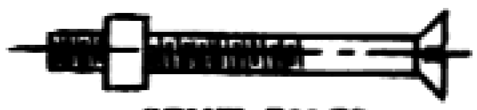
LENGTH
CAP SCREWS

DIA.	THREADS PER INCH
1/8 in.	40
5/32 in.	32
3/16 in.	24
1/4 in.	20
5/16 in.	18
3/8 in.	16

STOVE BOLTS

DIA.	THREADS PER INCH
3/16 in.	24
1/4 in.	20
5/16 in.	18
3/8 in.	16
7/16 in.	14
1/2 in.	13

CARRIAGE BOLTS



STOVE BOLTS

STOVE BOLTS

CARRIAGE BOLTS

DIA.	THDS. PER IN.	
	COARSE NC	FINE NF
1/4 in.	20	28
5/16 in.	18	24
3/8 in.	16	24
1/2 in.	13	20

DIA.	THDS. PER IN.	
	COARSE NC	FINE NF
9/16 in.	12	18
5/8 in.	11	18
3/4 in.	10	16
7/8 in.	9	14
1 in.	8	14

MACHINE BOLTS

LENGTH
MACHINE BOLTS

TABLE NO. 3

STEEL MILL STOCK

SHAPE	SYMBOL	WEIGHTS PER FOOT (IN POUNDS)					
		4"	6"	8"	10"	12"	15"
CHANNEL		5.4	8.2	11.5	15.3	20.7	33.9
SHIP CHANNEL		13.8	12.0	18.7	21.9	30.9	50.0
"I" BEAM		7.7	12.5	18.4	25.4	31.8	42.9
"H" BEAM		13.0	15.5	17.0	21.0	27.0	-
ANGLE		6.6	12.5	26.4	-	-	-

TABLE NO. 4

CONTENTS

CHAPTER 5

CHAPTER 5
Section -a1

GUIDE RAILS

General

Elevator Installation Is Based On Guide Rail Locations

1. Rule 200.1 in Section 200, of the 1960 edition of the American Standard Safety Code for Elevators states that "passenger and freight elevators shall be provided with car and counterweight guide rails." Further definition determines that the rails shall be of open hearth steel and have specific weights per foot as well as other features of design and manufacture.

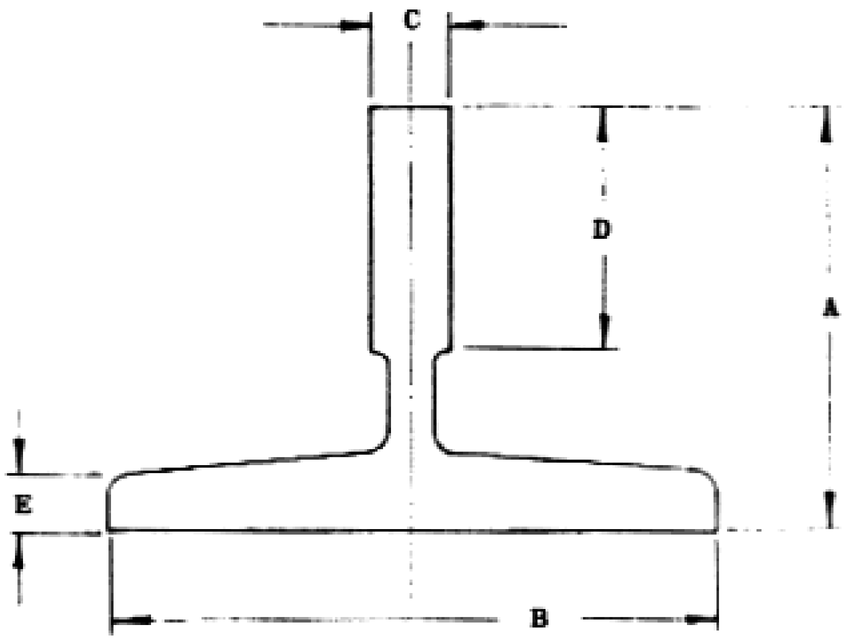
2. These rulings are subject to some well defined exceptions but for purposes of introduction of the subject to new elevator constructors we can conclude that in the United States and Canada, guide rails are generally of steel.

3. Guide rails are normally "T" sections. The riding surfaces are finished by planing or milling, with planing being the preferred method. Rail ends are milled with matching tongues and grooves in the blade sections. They are joined by steel fishplates and each end of each rail must have a minimum of four bolts to the fishplates. The backs of the guide rails and the fishplates themselves are milled at the matching surfaces. Thickness of plates and sizes of bolts are specified by the code in relation to the size of the rail on which they are to be used.

4. Rails are secured to the brackets by means of clips, which are divided into two basic groups; forged or formed. They can be of steel or steel combined with other metals. Due to the fact that we often install elevators in buildings at the time when the structures are not completed, there is a good chance that building compression could exert pressure on the guide rails and distort them. This is the chief reason that clips are used to secure the rails rather than through bolts.

5. Guide rail brackets can be formed from various steel shapes. The later sections of this chapter will describe their shapes and the methods of installing them. Spacing of brackets is strictly spelled out by the "Code." Building supports for rail brackets are usually designed and installed by the building architect, structural engineer and contractor.

6. It is interesting to note that some of the greatest differences in standards between American and European elevators exist in the area of guide rails and their supports. Light duty European elevators often use unfinished, small section, commercial "T" steels for rails. Many elevators are still being equipped with wire or wire-rope guides for the counterweights instead of "T" section rails. These wire guided units require comparatively deep hoistways to allow for "sway" of the counterweight. The tops of the wires are shackled to the overhead concrete (or steel, if used) and secured to the pit floor, by means of turnbuckles bracketed to



NOMINAL WEIGHT IN POUNDS PER FOOT	NOMINAL DIMENSIONS					FISH PLATE		MINIMUM DIAMETER CLIP AND BRACKET BOLT.
	A	B	C	D	E	MINIMUM THICKNESS	MINIMUM BOLT DIAMETER	
8.0	2-7/16	3-1/2	5/8	1-1/4	5/16	9/16	1/2	1/2
15.0	3-1/2	5	5/8	1-31/32	1/2	11/16	5/8	5/8
18.5	4-1/4	5-1/2	3/4	1-31/32	1/2	13/16	3/4	5/8
22.5	4	5-1/2	1-1/8	2	9/16	13/16	3/4	3/4
30.0	5	5-1/2	1-1/4	2-1/4	11/16	15/16	3/4	3/4

ALL DIMENSIONS IN INCHES

Guide Rail Characteristics

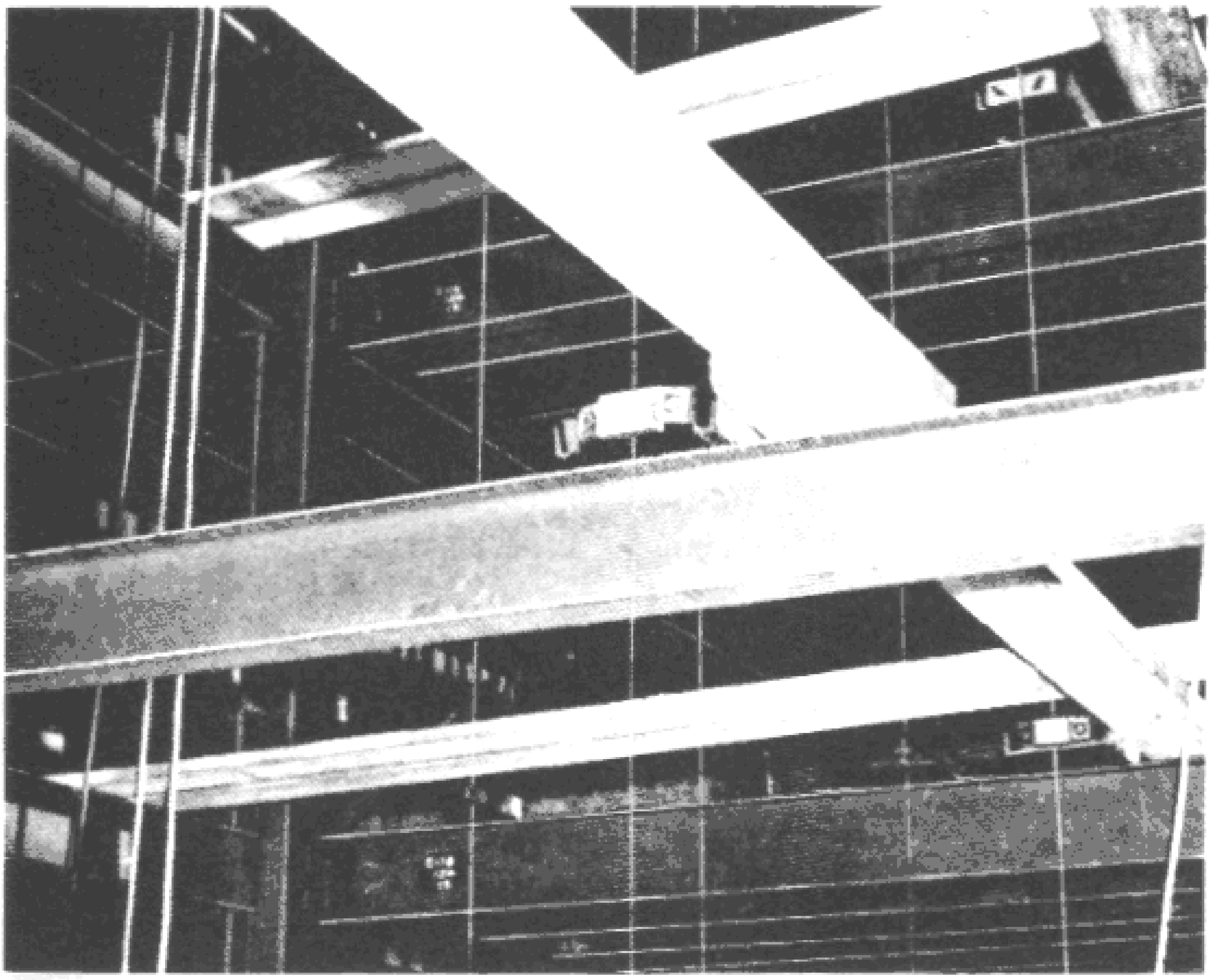
the concrete pit floor. Naturally the counterweights are quiet in operation and cheap to install. They do waste space. Incidentally, wire-rope guides were used by at least one United States firm years ago.

7. The appended table includes abridged information taken from the A.S.A. 1960 code.

CHAPTER 5
Section -b1

GUIDE RAILS

Plumbing Hoistways – General



Plumb Lines Dropped From Overhead

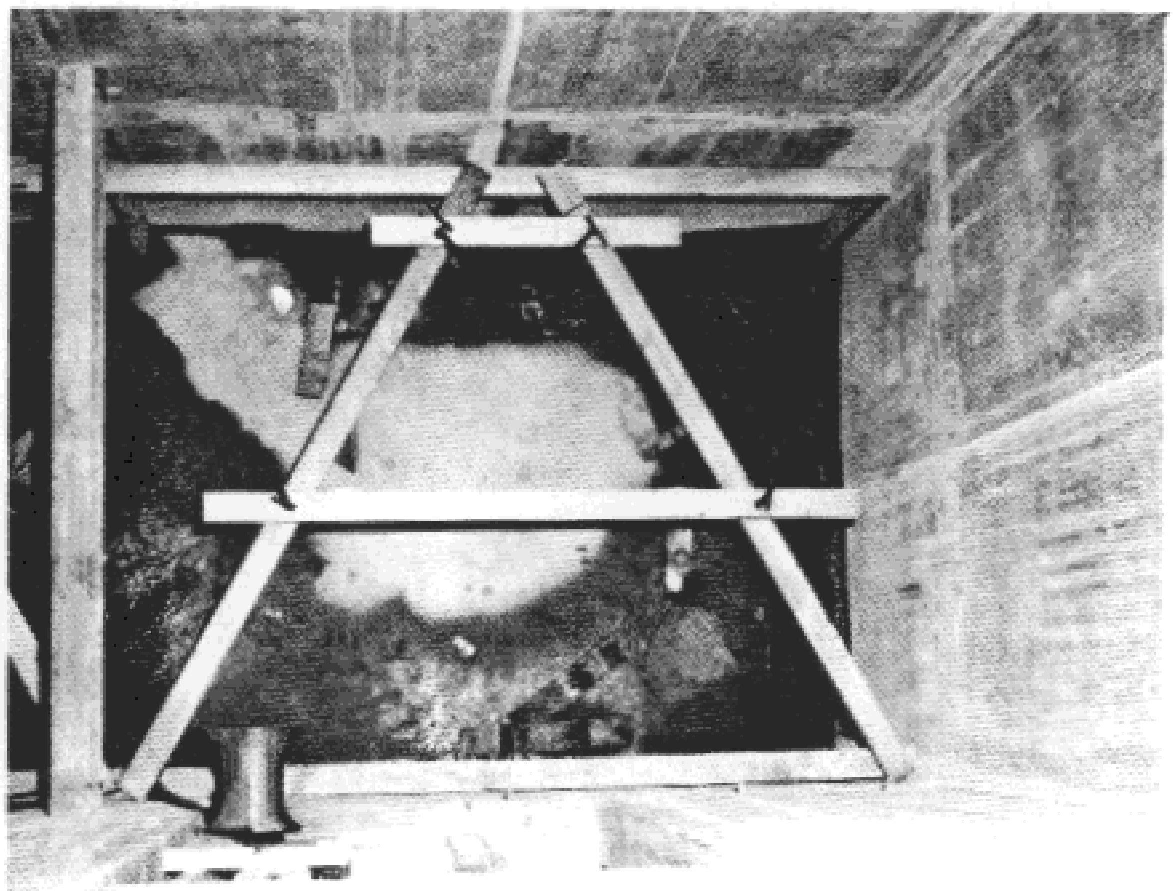
1. The lines set when plumbing an elevator hoistway, are the base on which the elevator is assembled. The primary purpose of dropping these lines is to determine whether or not the hoistway will accommodate the elevator in all three dimensions, i.e., front-to-back, postwise (sideways) and vertically in a plumb line. A secondary, but equally important reason for dropping the lines is to establish the location of the guide-rail centers. These rail centers form the basic working lines of the entire installation. The third reason is obviously to locate the elevator equipment properly in relation to the building structure.

2. It is very necessary, therefore, to plumb the hoistway with the greatest possible care. After the lines are dropped and steadied, they must be secured at top and bottom. Frequent inspections of the entire lengths of the lines should be made to be sure that nothing has disturbed the plumb lead or drop of the lines. This is very important, because often a mechanic or another trade, working at some point adjacent to the hoistway, accidentally disturbs a plumb line by laying a scaffold, plank, or some other object against it. If this were not observed, it might make it necessary to reset an entire line of guide-rail brackets.

3. The same elementary rules may be applied to plumbing any kind of an elevator hoistway. They are:

- **a.** Secure the plumb lines at top and bottom as soon as they are established.
- **b.** Keep the lines clear of any obstructions at all times.

4. In writing this chapter no attempt is being made to discredit methods of plumbing hoistways that are not mentioned herein. There are many approved and satisfactory ways of doing this work. This book only sets forth a few of the basic, long established means of plumbing hoistways, because it is believed that they illustrate the problem clearly for inexperienced men.



Template Will Be Adjusted To The Lines After They Are Dropped To The Pit

CHAPTER 5
Section -b2

GUIDE RAILS

Plumbing Hoistways – Steel Structures, One Elevator

Suggested:

Materials –
  a. wire nails, 3''

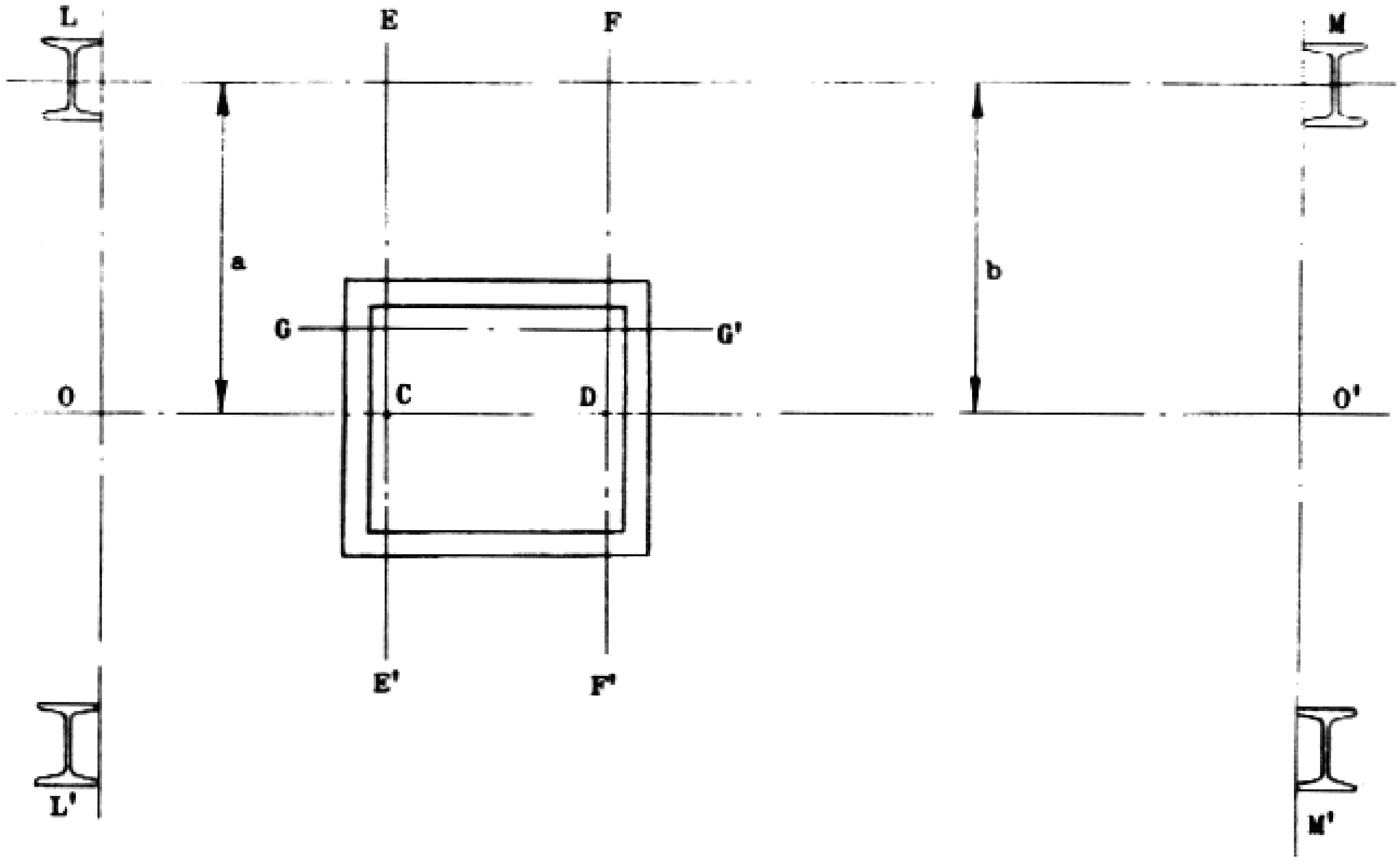
Tools –
  a. hand tool kit
  • 22 gauge annealed iron wire
  c. planed wood timbers (2'' x 4'' or larger)

1. The initial step in the work of plumbing an elevator hoistway in a steel frame building is to locate the center lines of the building columns, which are shown as points of origin on the final layout. Generally, these columns are numbered on the layouts, such as ''Cl,'' ''C2,'' etc., and all hoistway dimensions are taken either directly or indirectly from the centers of some particular set of them. The position of these points should be confirmed by the building construction superintendent before work is begun. (As noted in earlier chapters, modern ''panel'' construction of buildings introduced the practice of using center lines of corridors for indexing building equipment locations. In such buildings the corridor center lines would be used by us instead of column centers.)

2. It is common practice to always take these measurements from the center lines of the building columns, because, while the outside dimensions of the upright member may become smaller as the building height increases, the center lines of the columns always remain the same.

3. When plumbing an elevator hoistway, the terms ''drop a plumb'' or ''dropping lines'' are used. These are formed by the suspension of a heavy weight, usually at least 25 pounds, on a fine gauge iron wire. The plumb line extends from the top to the bottom of the hoistway in low rise installations, and for about ten floors at a time in the higher ones. Rail installation practices vary considerably, not only between companies but from one area to another. Job conditions also impose variations. For example, mechanics often use soft annealed wire for low-rise plumb lines. On high rise open steel jobs the same men might use piano wire and suspend a very heavy weight in a tub of water to reduce the movement caused by wind effect on the wire.

4. With sketch #1 as an illustration and assuming columns L and M as the locating points, we will, with a hypothetical case, describe an approved system of plumbing the hoistway. This description will follow the old standard routine of locating guide rail points from building column centers.



Sketch #1

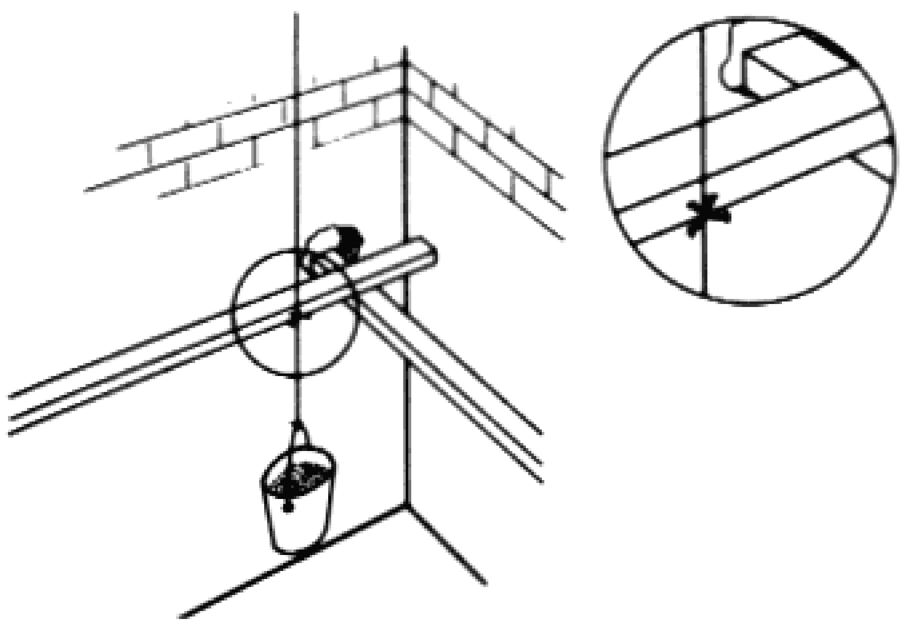
5. Referring to the sketch, lines are run from the flange edges of column L to column L', and from M to M'. As, in this case, the columns are equal in size, the flanges are also equal and may be used. (If the pairs of columns vary in size, make a mark on the column center and measure directly from it.)

6. On the lines L-L' and M-M', mark off the distance given on the final layout as the spacing between the centers of the building columns and the center of the guide rails. Mark the line. Name the points, 0 and 0'.

7. Extend a line between 0 and 0'. Mark the hoistway beams where this line crosses them. Measure from 0 to C and from 0' to D to establish the guide rail centers.

8. Set one of the planed timbers across the hoistway so a straight edge is on the marks of the guide centers. Secure this timber firmly in place along C-D.

9. Place two more planed timbers, as indicated at E-E' and F-F' on the sketch, resting on top of C-D and square to it. Nail E-E' and F-F' in place on C-D, spacing them so they are 1-1/4'' less than the actual distance between rail bracket faces, and so that each is 5/8'' from the face of its respective bracket and the correct distance from L-L' and M-M' as noted on the final layout. Secure them on the front and rear beams of the hoistway.



Sketch #2

10. Drop two lines on E-E' and two on F-F'. Space these lines to coincide with the guide-rail bracket bolt-hole centers. These lines should be checked to ascertain their proper distance from the column centers. (For example, in this case, distances O-C and O'-D should be checked.)

11. Go to the pit and place timbers (not necessarily planed) across the hoistway below E-E' and F-F'. Secure these so that an edge of one barely touches the plumb line of E-E' while the other is at the lines of F-F'.

12. Clinch two nails over each wire in a manner that permits the lines to move vertically but not horizontally (see sketch #2).

13. The center lines of the main rail bracket bolt holes are thus definitely established.

14. In this case we assume that a U-type counterweight bracket is to be used, therefore, go to the top of the hoistway and place a planed timber across E-E' and F-F' at the approximate position of the counterweight. Square this up with E-E' and F-F' and set it 1/2'' from the face of the counterweight bracket position. Drop plumb lines in the center of each brakcet bolt position, then go to the pit and secure these lines with a timber in a manner similar to that used for E-E'.

15. Inspect the hoistway clearance to the lines at all floors. If necessary, move all lines as a unit to adjust the rail layout positions to the prevailing field conditions. If any change is required in a front-to-back direction this should be brought to the attention of both the elevator construction superintendent and the building construction chief, because such deviation from the layout will affect the hoistway door and front arrangement. This, in turn, can effect alignment of other building equipment or features in the corridors throughout the building.

16. Several important factors may have an effect on the work of plumbing a hoistway. Although the ideal condition is one in which the hoistway is perfectly plumb and square for its entire length, this seldom exists. As a result it is advisable to:

a) Check the square of the hoistway at key (or sometimes all) floors. This is done by measuring diagonally across the opposite corners with a steel tape. If the hoistway is out of square, this check will show it up immediately. In such cases a check is made at the various floors, and the plumb lines adjusted to the best possible average.

b) Another precaution is to check for a condition that is, also, all too common. That is, that the front lines of the hoistways are often not exactly according to plan. If the outer wall finish is to be pre-cut marble or wood paneling, it is advisable to adjust your plumb line to accommodate the field conditions. This, naturally, holds only if it involves no alterations to the existing elevator material. Arrangements for any major changes should be handled by your field superintendent and office.

c) Check the alignment of the entire hoistway. Many times it is impossible to set rails plumb because of the construction of the hoistway or framing. Though not desirable, it is permissible, in such instances, to slant the rails to conform to the hoistway, striking an average to most floors. The important thing is to have the main rails and the counterweight rails straight and as square and parallel with their opposites as it is possible to make them. In other words, if it is necessary to ''slant'' the main and counterweight rails, both rails of each pair must be pulled out or ''slanted'' the same amount, in the same direction.

17. After these lines are in position and secured, the positions of all guide rail bracket bolt center lines are exactly established. The vertical spacing can then be marked out and holes burned, cut or drilled. When the brackets are being installed, these same lines can be used for squaring them.

18. Any other measurements needed in the erection of the elevator can be derived from these established lines.

19. It is common practice in some areas and with some companies to use templates as a base for dropping plumb lines in hoistways on all of their installations. This is sound practice because the templates are prepared to conform exactly with the layout positions for all four rails. This reduces the chance of error that might occur if one of the planed planks should move in relation to the other.

20. The templates are often prepared in advance and shipped to the jobsite with all line positions carefully marked out.

21. Section -b5 of this chapter reviews the preparation and use of templates as related to concrete structures. The same information can be utilized for steel or brick construction also.

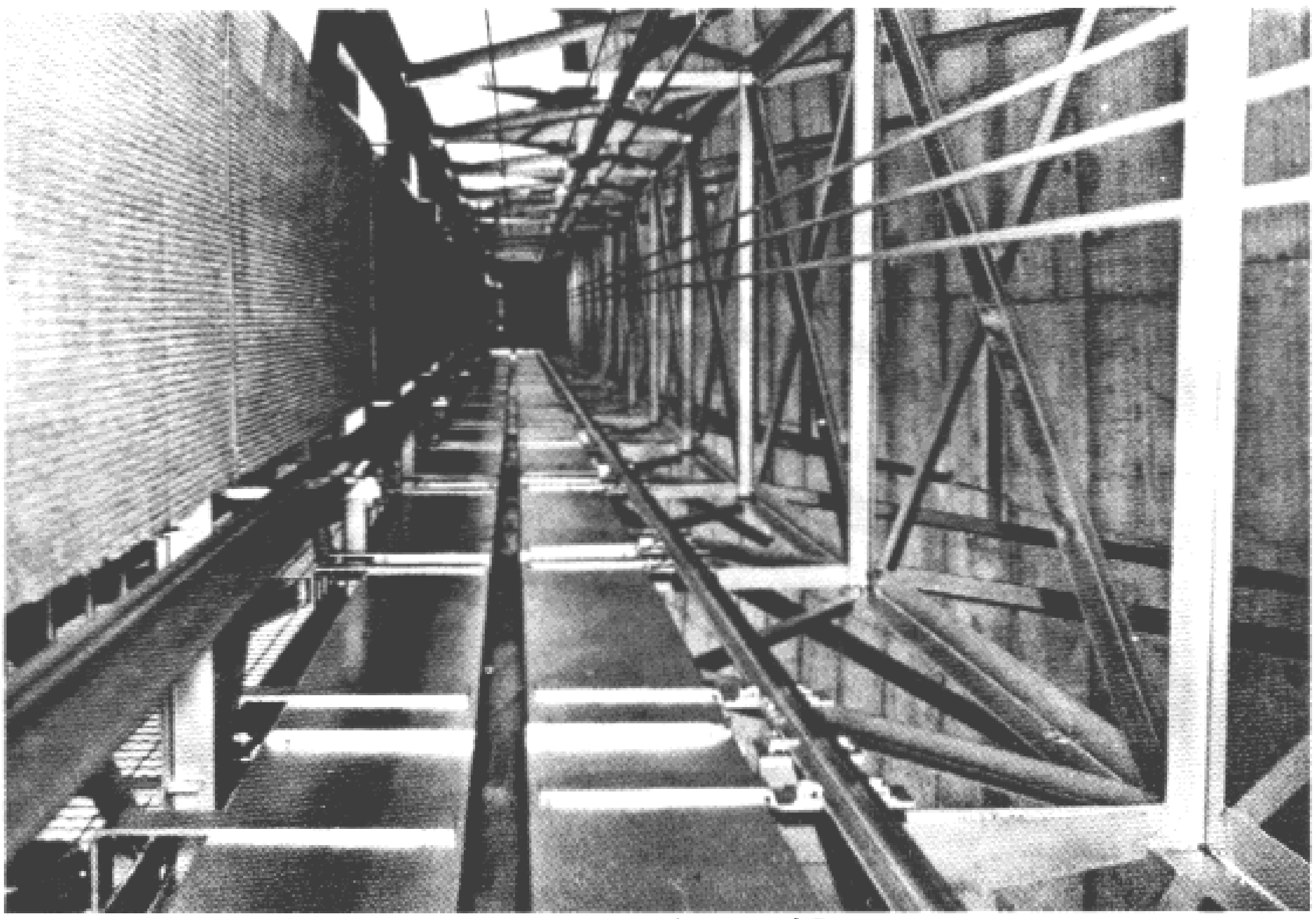
GUIDE RAILS

Plumbing Hoistways – Steel Structures, Elevators in Banks

Suggested:

Materials –
a. nails

Tools –
a. *22 gauge annealed wire
b. weights
c. planed timbers
d. hand tools



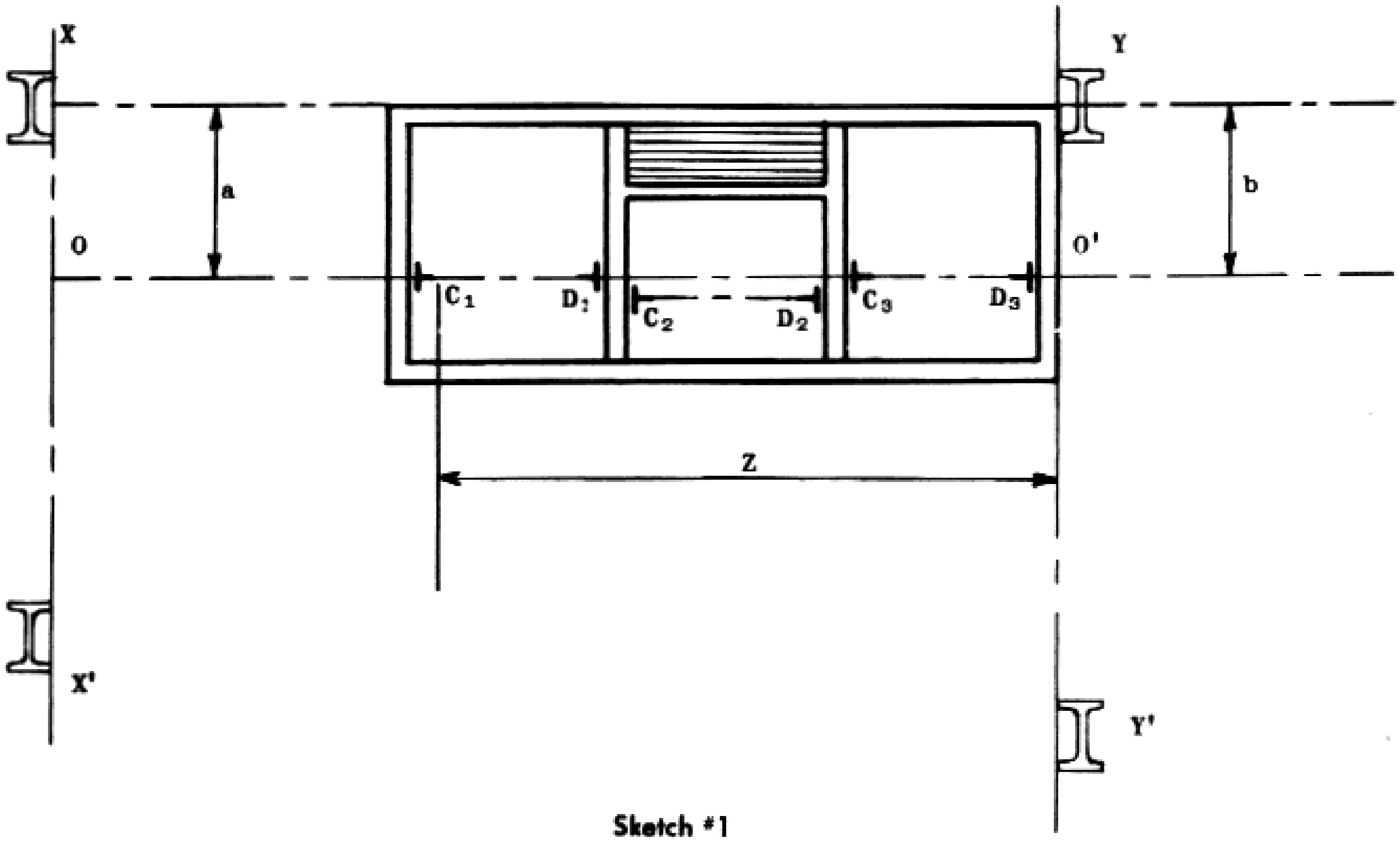
Elevator Installed In Steel Tower

1. The general method and intent of plumbing hoistways for elevators is the same for any type. It does not matter if they are single installations or are in a "bank." Locating the elevator equipment in proper relation to the other parts of the building structure is always a primary object of plumbing. If, however, elevators are installed in groups (or "banks"), they must be carefully aligned with each other as well as with building steel. Therefore, an illustration and description of aligning such equipment is given in this part of the text and in sketch *1.

2. Referring to the sketch: The lines X-X' and Y-Y' are established in a manner similar to that used for a single car installation. From these, lines 0-0' can be located with the help of measurements "a" and "b."

3. Guide rail center or rail back points, C1, C2, C3,– D1, D2, D3, etc., can be determined from O-O' with the aid of dimension Z as a check. This can always be obtained from the final layouts.

4. After this is done, each car can be handled as a separate elevator. However, care must be used, and a frequent check made of the lines, to be sure the elevator entrances remain in proper alignment with each other at all landings.



Sketch #1

CHAPTER 5
Section -b4

GUIDE RAILS

Plumbing Hoistway – Steel Structures, Corner-Post Elevators

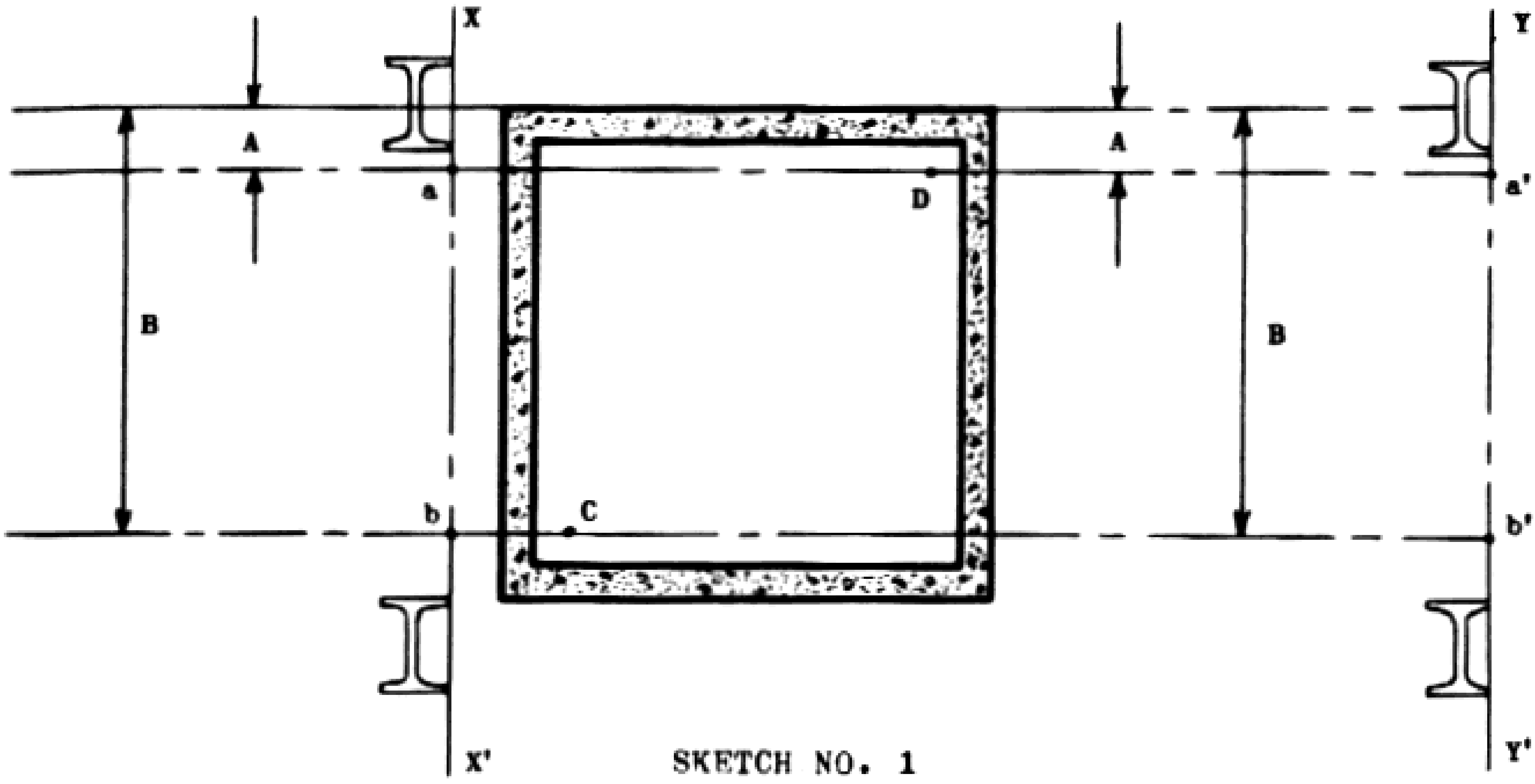
Suggested:

Materials –	Tools –
a. nails	a. #22 gauge annealed iron wire
	b. hand kit
	c. planed timbers

1. Without a doubt the installation of a corner-post elevator presents more problems than similar operations on side-post cars. Despite this, dropping the lines for such

an elevator is quite simple, whether the job is in a steel structure or in one built of some other material. However, the fact that building hoistways are frequently both out of plumb and out of square complicates corner-post elevator installation. Some companies supply field men with a supplementary sketch to the layout. At least one provides special plumbing points on this so called "foreman's sketch." We recommend that templates be used at top and bottom for plumbing hoistways for corner-post elevator installation.

2. Proceeding along the same general lines as for a side-post car in a single hoistway, refer to sketch.



SKETCH NO. 1

3. The lines X-X' and Y-Y' are established as on other types of installations. On these lines mark off distances A and B. These are noted on the final layout as the distances from column centers to guides.

4. Extend secondary lines between a-a' and between b-b'.

5. On line a-a' measure distance from Y-Y' to center of guide rail D.

6. On line b-b' measure distance from Y-Y' to center of guide rail C. (These distances can be obtained from the final layout.)

7. A timber is usually laid across the hoistway from C to D. If this is impractical, because of the hoistway size, use a wire line. (The timber or plank should have one straight edge or be chalk-lined.)

8. Measure from C to determine the center of the guide rail bracket face. Set a planed board across the corner of the hoistway at 90° to the C-D center line near the position of the bracket face.

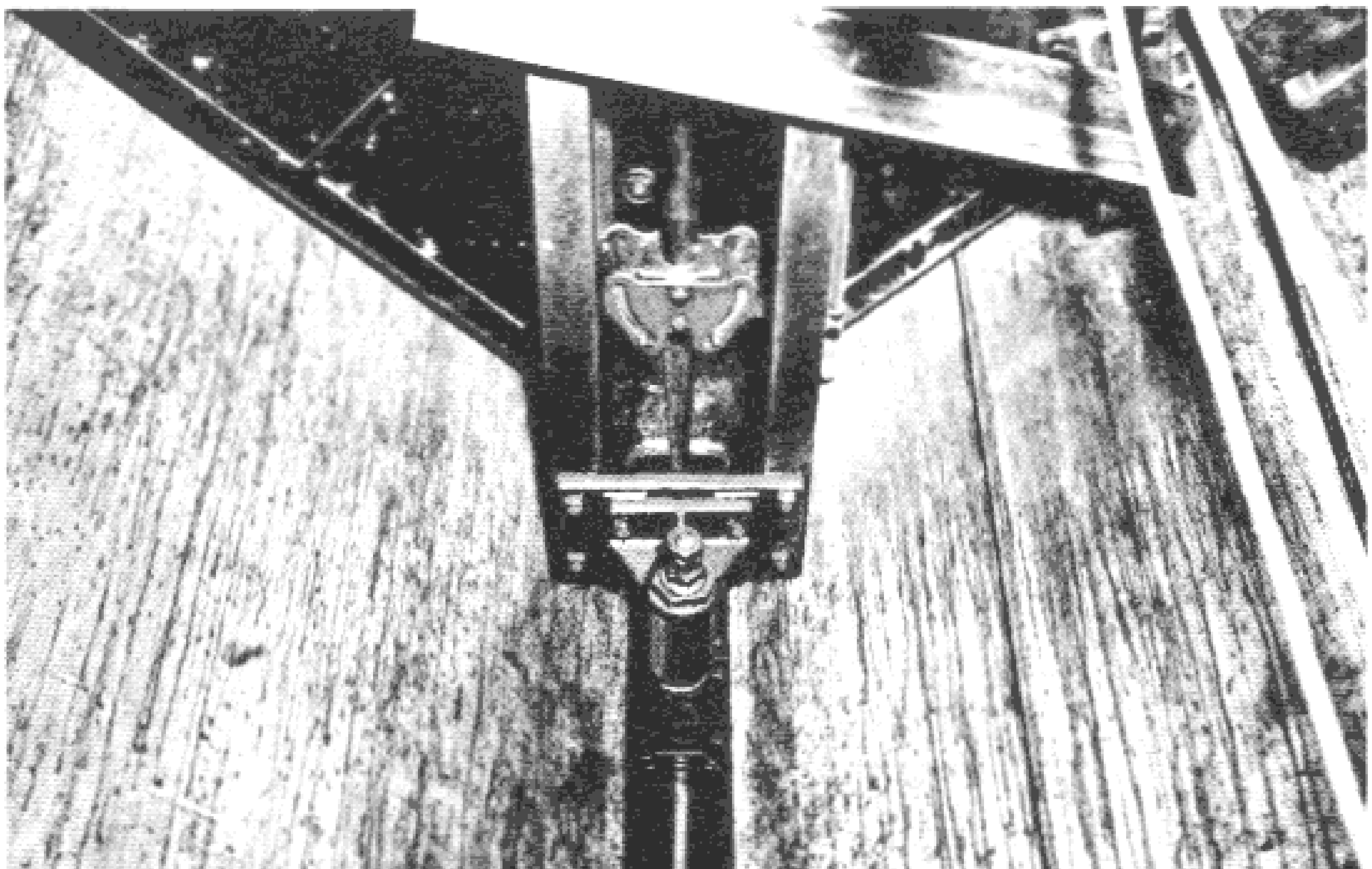
9. Repeat this at D.

10. The two boards will be used to anchor lines or "targets" for setting brackets. The exact position of the lines at C and D varies to some extent with different men and the various companies. It is quite common to set the lines 1/2" in front of each bracket face, or a spacing between lines of D.B.G. less 1".

11. Secure these lines at the top and bottom in a manner similar to that used for side-post cars. If adjustments are made on the lines, move the top and bottom equally.

12. When these lines are carefully secured in position, the bracket faces can be squared to the rail and to each other. All additional working lines required can be determined from these original ones.

13. The corner-post elevator was designed to fill certain needs in a time when elevators were less common than today. They have several serious disadvantages such as the difficulty of arranging power operated doors and keeping them smooth in action. A study of a corner-post layout will make installation and operating problems obvious. These difficulties extend from initial bracket work to door interference and lack of space for items such as traveling cables, selector drive tapes, conduit and even counterweights themselves. Machine rooms are often cluttered, too.



Typical Corner-Post Arrangement

14. Fortunately, as architects, owners and our sales and layout men gain in knowledge and ingenuity they seem to find solutions to corridor access problems other than by use of corner-post elevators. The type is less common than it was some years ago.

CHAPTER 5
Section -b5

GUIDE RAILS

Plumbing Hoistways – Concrete Structures, One Elevator

Suggested:

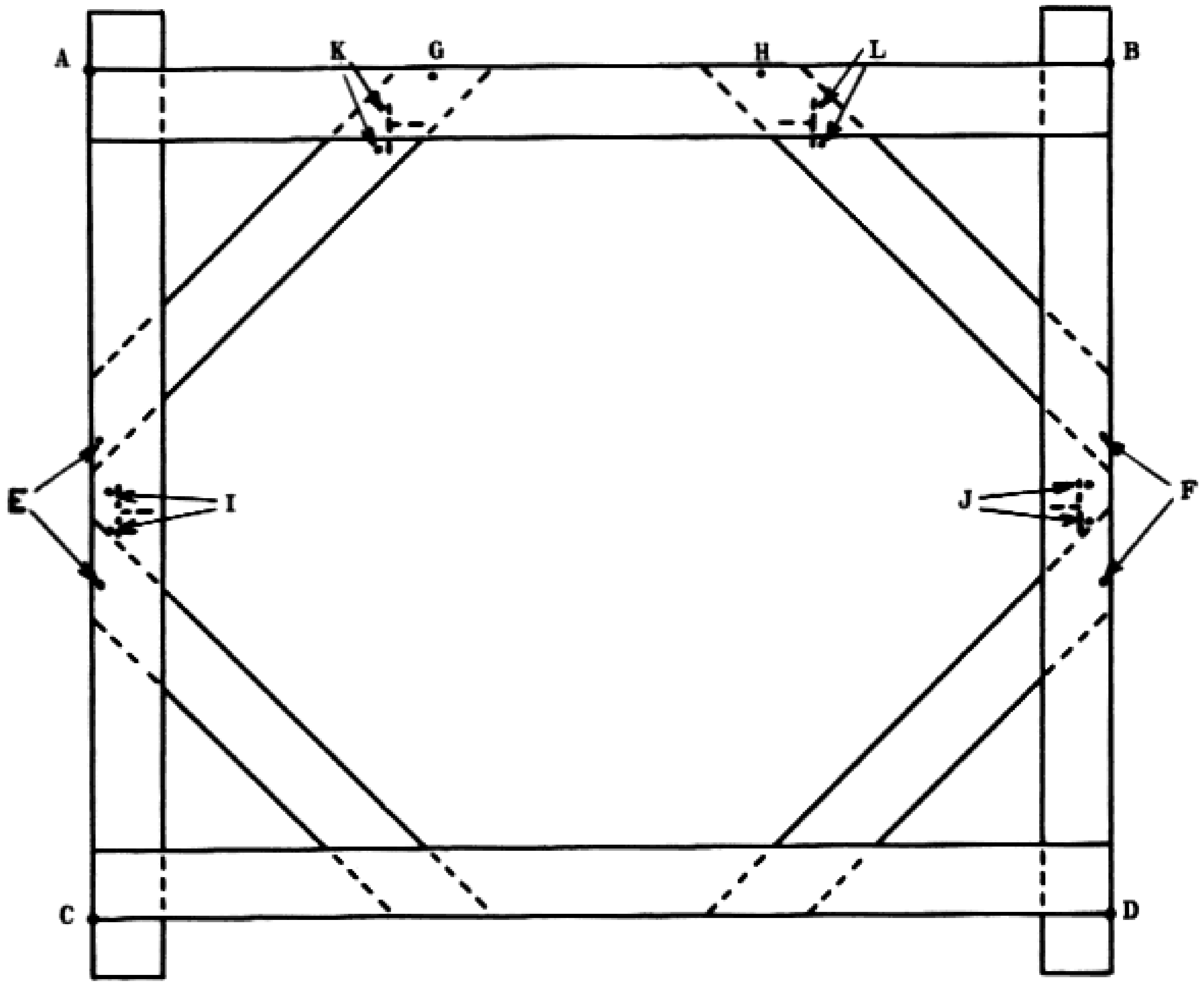
Materials —	Tools –
a. wood for template (7/8'' x 6'' planed true	a. hand kit
b. cement	b. wood saws
c. sand	c. *22 gauge annualed iron wire
d. nails	d. rough wood timbers
e. wood screws	e. wood blocks

1. It is preferable to use a template when checking the plumb of a hoistway in a concrete structure. Types of templates differ in most localities, but the theory of their use is similar. A type that will establish all the important hoistway lines is the most practical. The important lines are the four ''corner'' lines that determine the clear hoistway size and the lines for car and counterweight rails. As a rule, templates can be built to the exact clear hoistway size, since the rough hoistway is generally one inch larger (all around), than the finished hoistway in concrete structures. When the work is about done, a cement plaster finish is troweled onto the rough wall. When clearance is too small to permit a full size template, set all lines one inch inside of the clear hoistway dimensions.

2. Two templates are always used; one is set at the top of the hoistway and the other near the bottom. Plumb lines are dropped from the top. The hoistway is checked for clearances to those lines. If necessary to suit field conditions, the template is shifted to get clearances to the lines. The bottom template is then installed a few feet above the pit floor. It is set in place without disturbing the plumb lines which are then secured to the template.

3. Obtain clear, straight wood about 7/8'' x 6'' to build the template. Make a chalk line along one edge of each board and plane it to this line. Be sure to clear space on the floor large enough for easy working. Place the boards on the floor in the form on a rectangle. For example, see sketch *1. Set the template up so that points A, B, C, and D, are the exact ''clear'' hoistway dimensions. Square the corners carefully, and fasten them with wood screws. Cross brace the corners. In our example, notice that the rear braces are in the position of the layout where the counterweight lines fall.

4. Mark the points A, B, C, and D, very carefully on the template. These points are the four corners of the clear hoistway dimensions. A different shape of template must be built, if there is a hoistway column, or if the hoistway is irregular for any other reason. Also, more plumb lines will be required at locating points. The



Sketch *1

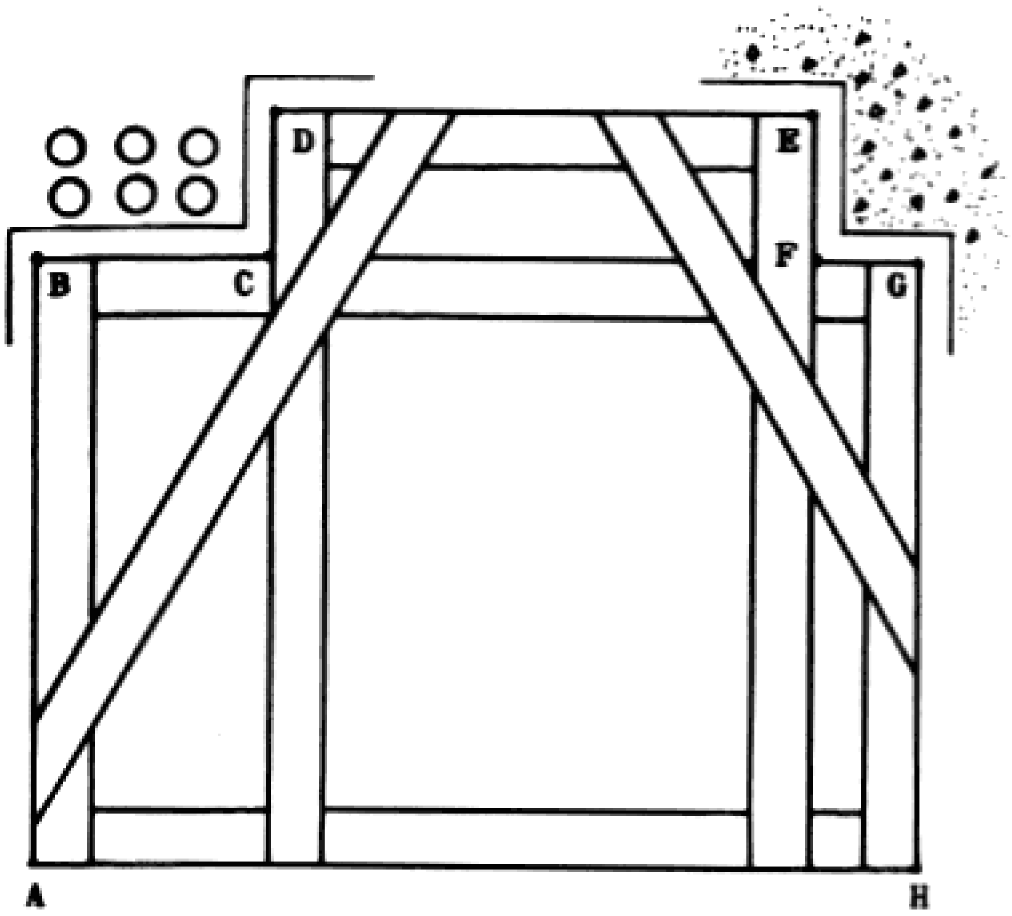
construction of the template will be a bit more difficult but the general principle will be the same. A type of template for irregular hoistways is shown in sketch *2.

5. As an example of how the templates are used, refer to sketch *1. Once the clear hoistways points are set up, mark the locations of car and counterweight guide-rail centers on the wood; drill 1/16'' holes through the boards at each point marked. Repeat this procedure for guide-rail bracket clip and support bolts.

6. Build another template, making it a duplicate of the original.

7. Place two 4'' x 4'' timbers across the hoistway near the overhead to support the template. Block the timbers level with each other and fasten them. Place the template on the timbers and drop a plumb line at each point of the clear hoistway marks (A, B, C, D).

8. After the plumb lines are hanging free and almost to the pit, check them for the entire length of the hoistway. If necessary, shift the template slightly to obtain clearances, but keep the front parallel with the front finished wall line. Hoistway walls should never be inside the ''clear lines.'' Reset the template if this condition occurs.



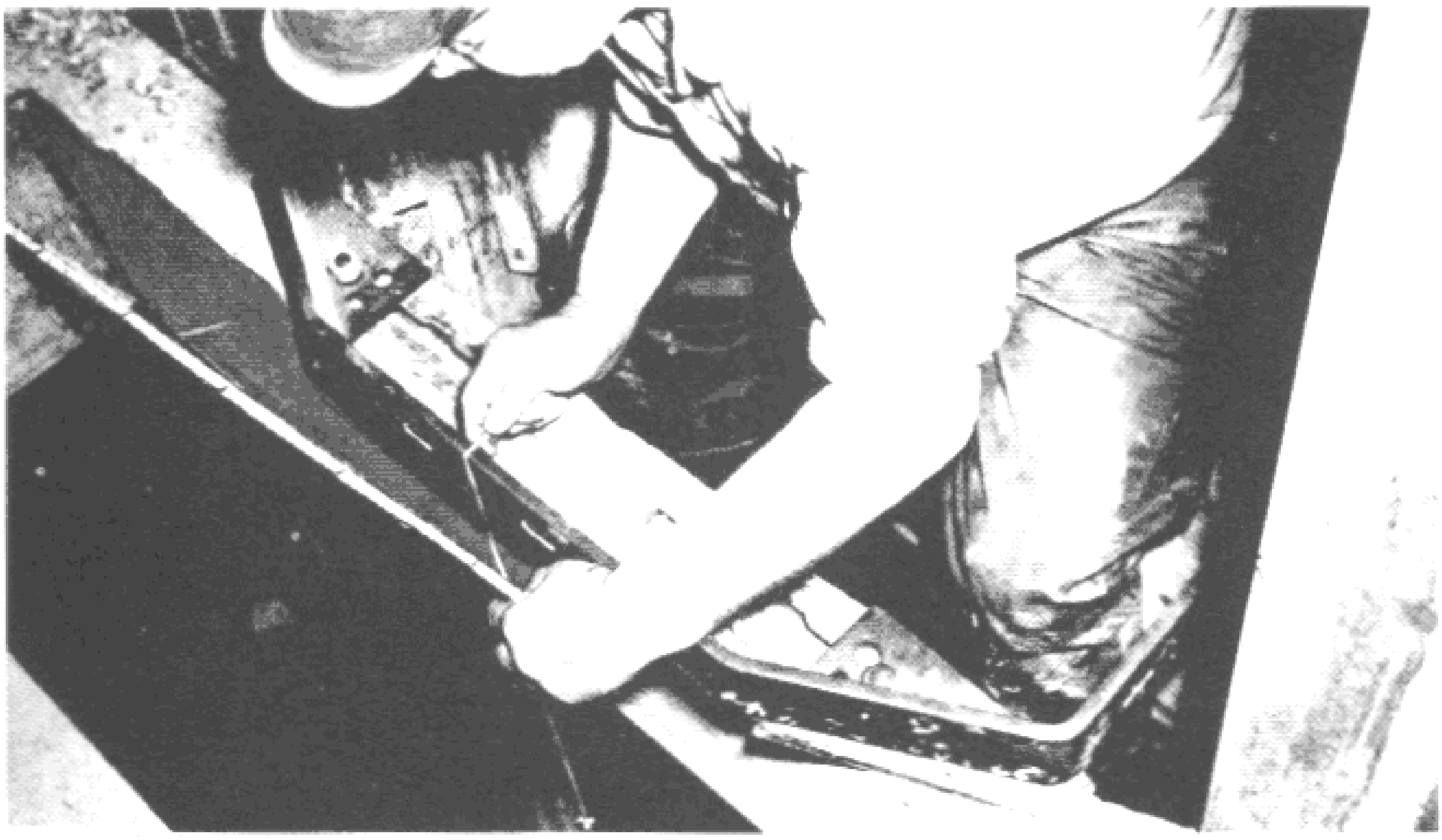
LINES DROPPED AT ALL POINTS "A" TO "H" WILL INDICATE CLEAR HOISTWAY LINES.

SKETCH NO. 2

9. After all lines are clear of the walls and square with the front, nail the top template to its supporting timbers.

10. Install the second template on timbers a few feet above the pit floor. (The exact amount would depend on job conditions but the template must be clear of the bottom bracket position.) Line it up carefully with the plumb wires and nail it in place. Clinch two nails over each wire. This will permit the wires to move vertically but not horizontally.

11. A man who is not experienced in concrete jobs, could extend wire plumb lines between corresponding points, E, F, G, and H of the top and bottom templates. Doing this would locate all guide-rail bracket bolt-holes in line vertically.



Bracket Used To Locate Plumb Line

12. When the guide-rail bracket supports are vertically located, lines E, F, G, and H can be shifted to I, J, K, and L, so they can be used to square the brackets when they are installed.

13. Be sure that all the guide-rail brackets are installed before removing the templates. Naturally, the bracket lines must be removed before guide rails are installed.

CHATPER 5
Section -c1

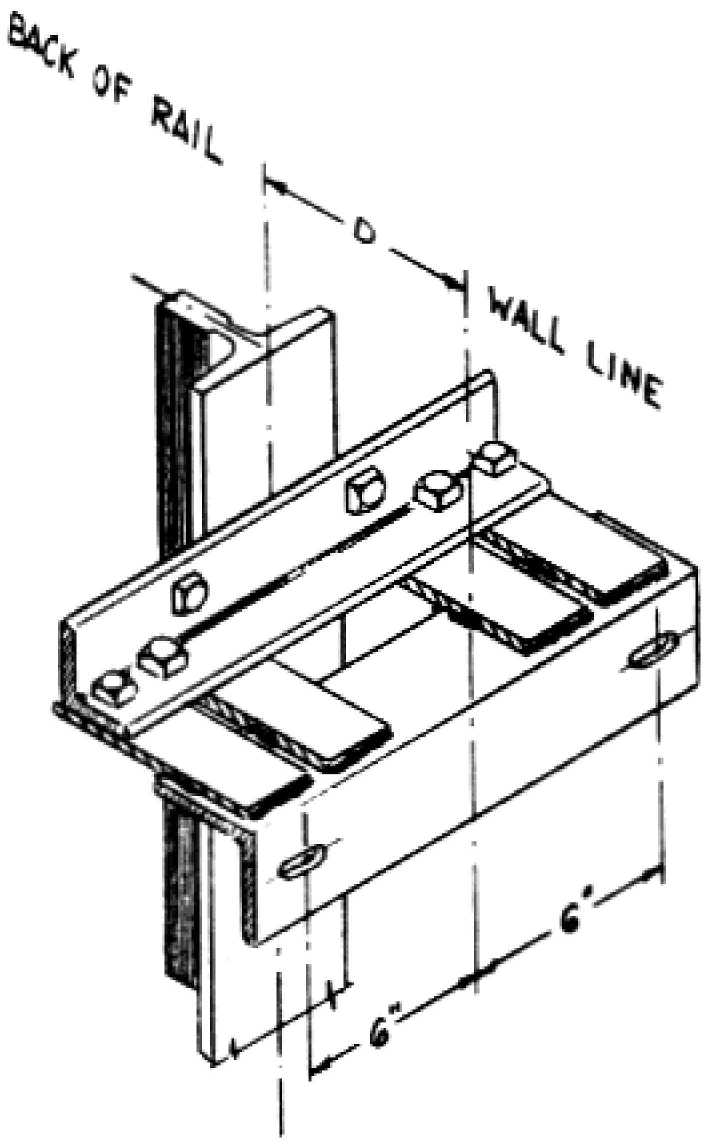
GUIDE RAILS

Bracket Fastenings – General

1. Just as a smooth riding elevator depends to a great extent on a good rail installation, so good rails depend on a satisfactory bracket job.

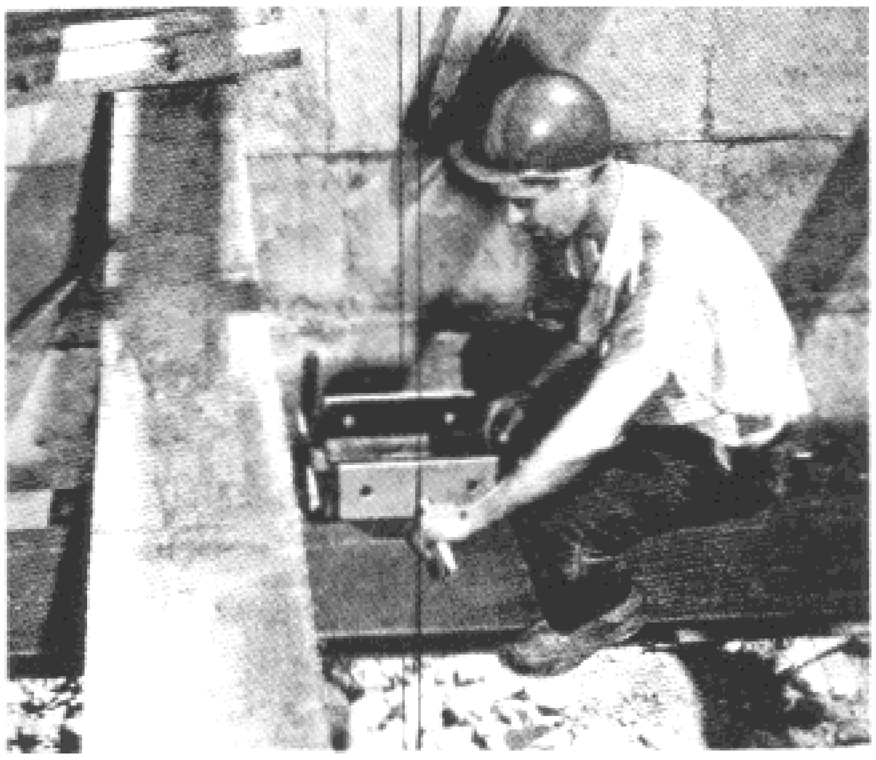
2. Although most companies use a conventional type of bracket, some have special types peculiar to themselves.

3. As an example of this, the Westinghouse Electric Corporation uses horizontal slots in the faces of its guide-rail brackets. This permits adjustment of rail alignment and utilization of the same bracket size and types for different rail types. Otis Elevator Company has developed a "V" slotted bracket. Other companies also have variations.



SKETCH NO. 1

4. The Haughton Elevator Company (and some others) manufactures a special combination bracket that supports one main and one counterweight rail. This type of bracket is quite popular with European and Asiatic Companies. One of the Montgomery Elevator Company's standard brackets is fabricated of two commercial angles and four short sections of flat iron. The flats are welded to the lower, or "shelf" angle to form slots in which the upper or "clip angle" bolts can be slid postwise for adjustment. The anchor bolt



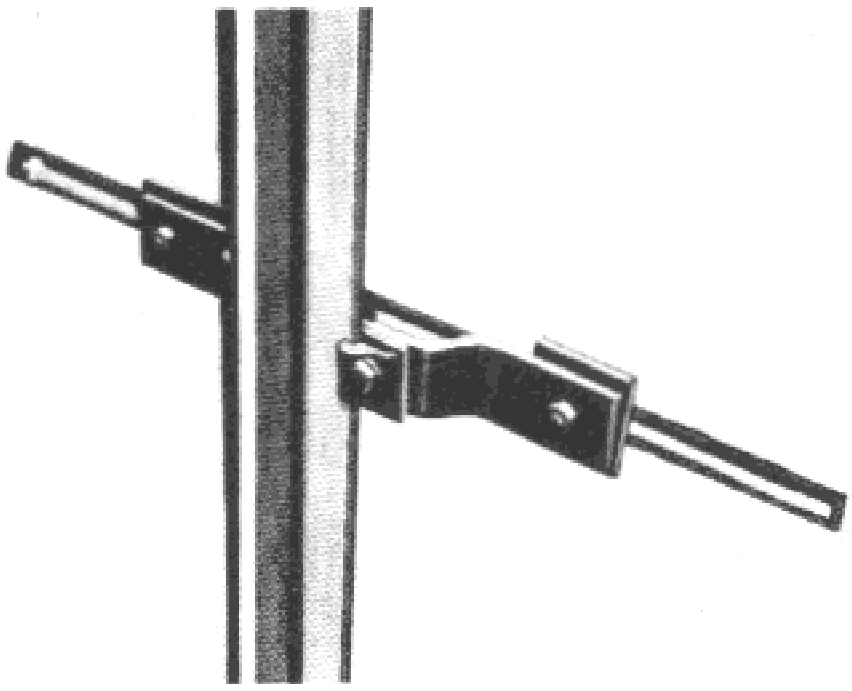
Bracket Being Installed On Steel

holes of the shelf angle are slotted. This provides two-way adjustment and like most shelf and clip angle brackets, reduces shimming to a minimum. Sketch *1 illustrates this type of bracket.

5. There are many contracts, especially those for installations in older buildings, that require nonstandard bracket types.

6. However, installation methods follow the same general rules, and will be described more fully in other sections of this chapter.

7. Guide rail brackets are fastened to the building structure. These bearing points, whether steel beams or masonry walls, are supplied and installed by the building contractor. If they are not, the mechanic should consult his superintendent because they are not usually part of the elevator contract. Such supports should not be installed by the elevator mechanic without authorization.



Insert Used To Secure A Bracket

8. Normally, the construction mechanic checks the sizes, types and vertical spacing of the beams or bracket supports against their respective dimensions as indicated on the final layout. If there are any major differences, these should be pointed out to the superintendent. He should approve any changes of this nature, before the work is done.

9. Examine beams for level both in postwise and front-to-back directions. Steel shims can be used to level the brackets when they are installed, but they must be bent over so they cannot fall out, if the bolts become loose.

10. In low rise jobs, the general plumb location of beams, or other bracket supports, is checked by lines dropped from the top to the bottom of the hoistway. For high rise, the lines are dropped ten floors at a time. Descriptions of several methods of making these surveys are given in chapter 5-b.

11. Many types of fastenings are used on bracket supports. Details of them are given in this chapter, beginning with the suffix -c2.

CHAPTER 5
Section -c2

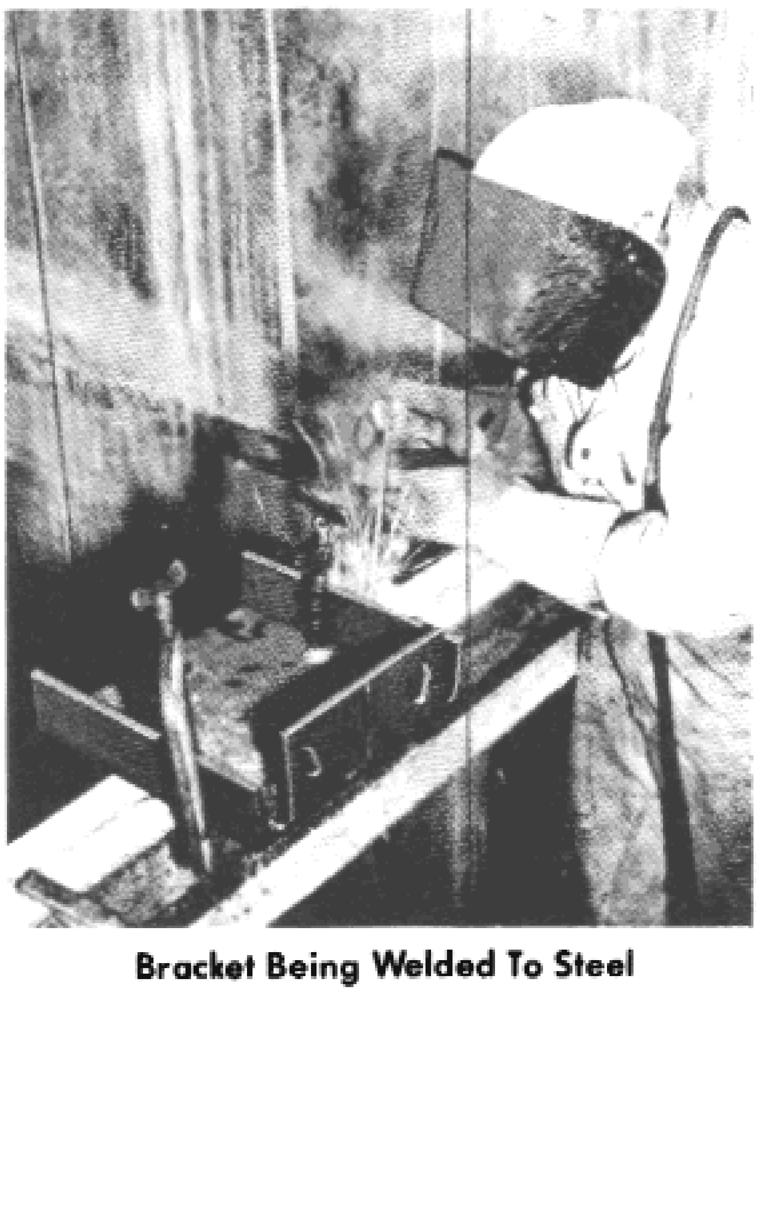
GUIDE RAILS

Bracket Fastenings – Steel Structures

Suggested:

Materials –	Tools –
a. 5/8'' bolts	a. wrenches
b. cut washers	b. hammer
c. steel shims (packing)	c. level
	d. 6' rule
	e. ratchet or electric drill and twist drills, a punch, or burning outfit
	f. ''drift pins''

1. Usually brackets are welded or bolted directly to the separating or hoistway beams on steel buildings. Although welding is a good, practical means of securing brackets to steel beams or other shapes, the work must be properly done. Most governing building code authorities require that men who do structural welding be licensed. This requires training and testing of the men. Usually welder's schools are set up for this purpose. Incidentally, there are a number of good books available on welding. Two of which we believe to be good are Lincoln Electric Company's ''New Lessons in Arc Welding'' and Delmar Publishing Company's, ''Basic Arc Welding.'' Both are excellently prepared books and inexpensive. Delmar's is set up in the ''Unit'' form like the New York State Monographs used for some years by N.E.M.I. groups.



Bracket Being Welded To Steel

2. The support bolt holes in those structural parts, to which the bracket is to be bolted, are drilled in one of several ways. On large installations, a punch is probably the most efficient. Many types of punches are available. Some specifications require that all holes be drilled. Electric drills are used in such cases. If the brackets are mounted to the webs of beams, the holes must either be drilled or burned.

3. Burning outfits are efficient, but when they are used the construction foreman should be cautioned to see that the holes are burned round and slightly less than the correct sizes. Burned holes are always slightly ragged. The holes, therefore, should be shaped to size with a "drift" while the iron is still hot. In addition, the burrs must be cleaned off the surface of the iron with a sharp coal chisel. Some builders, engineers and architects "specs" do not permit burning of steel on their structures. Occasionally city fire or other regulations prohibit it. Because of this, it is important to check job and local regulations before burning or even calling for burning equipment to be sent to the jobsite.

4. Whenever holes are burned, use washers under the bolt head and nut.

CHAPTER 5
Section -c3

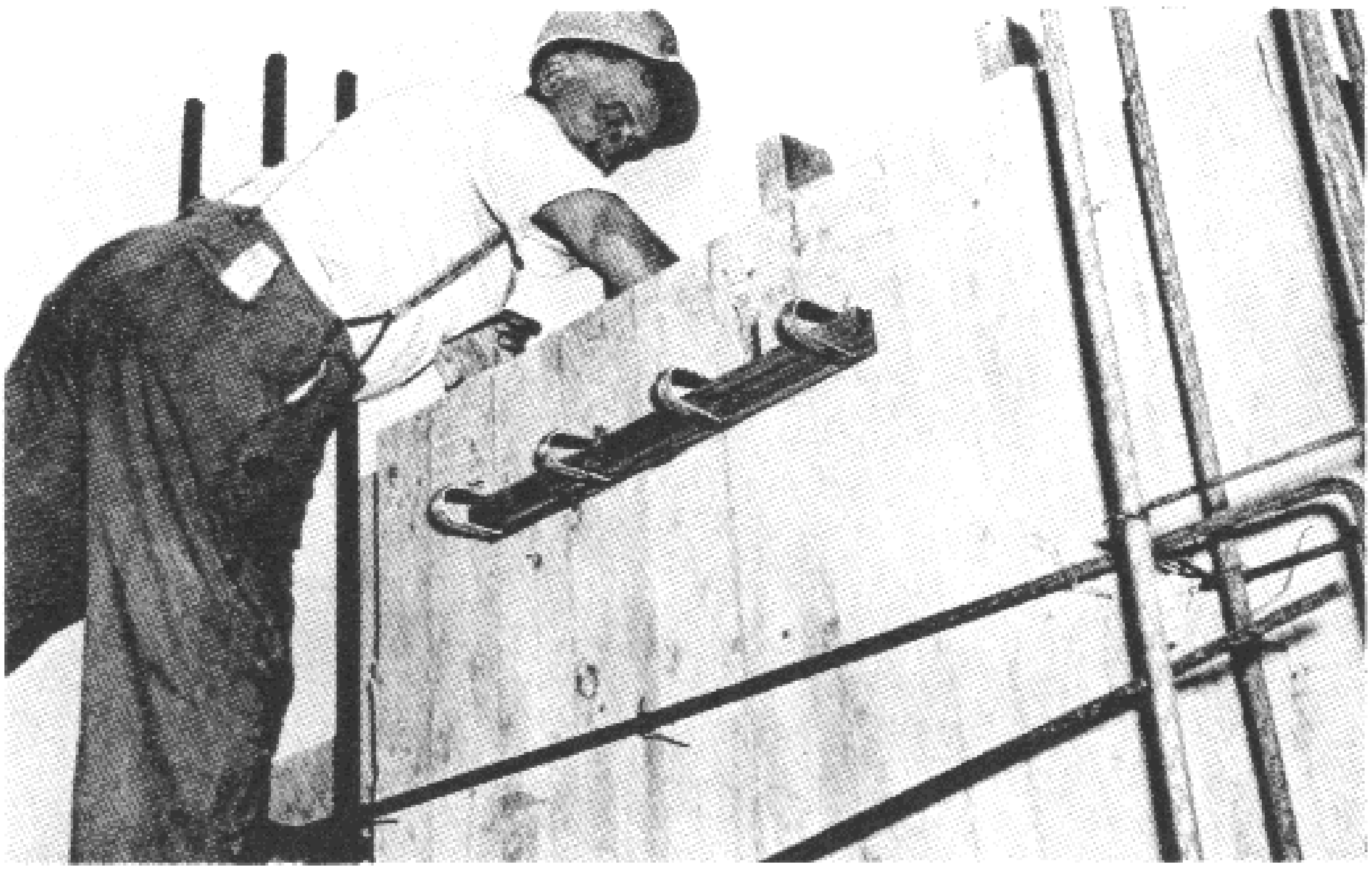
GUIDE RAILS

Bracket Fastenings — Concrete Structures, Steel Inserts

Suggested:

Materials –
- a. steel inserts for concrete
- b. steel insert bolts
- c. 5/8" cut washers

Tools –
- a. 24" level
- b. brace and 5/8" wood bit
- c. hammer
- d. 6' rule
- e. rough wood straightedge



Insert Being Installed Inside Concrete Form

1. The problem of providing supports for rail bracket bolts in concrete is handled in several ways by the various companies. One way that has proven practical, is to have the mechanic install inserts into the wood forms, before the concrete is poured.

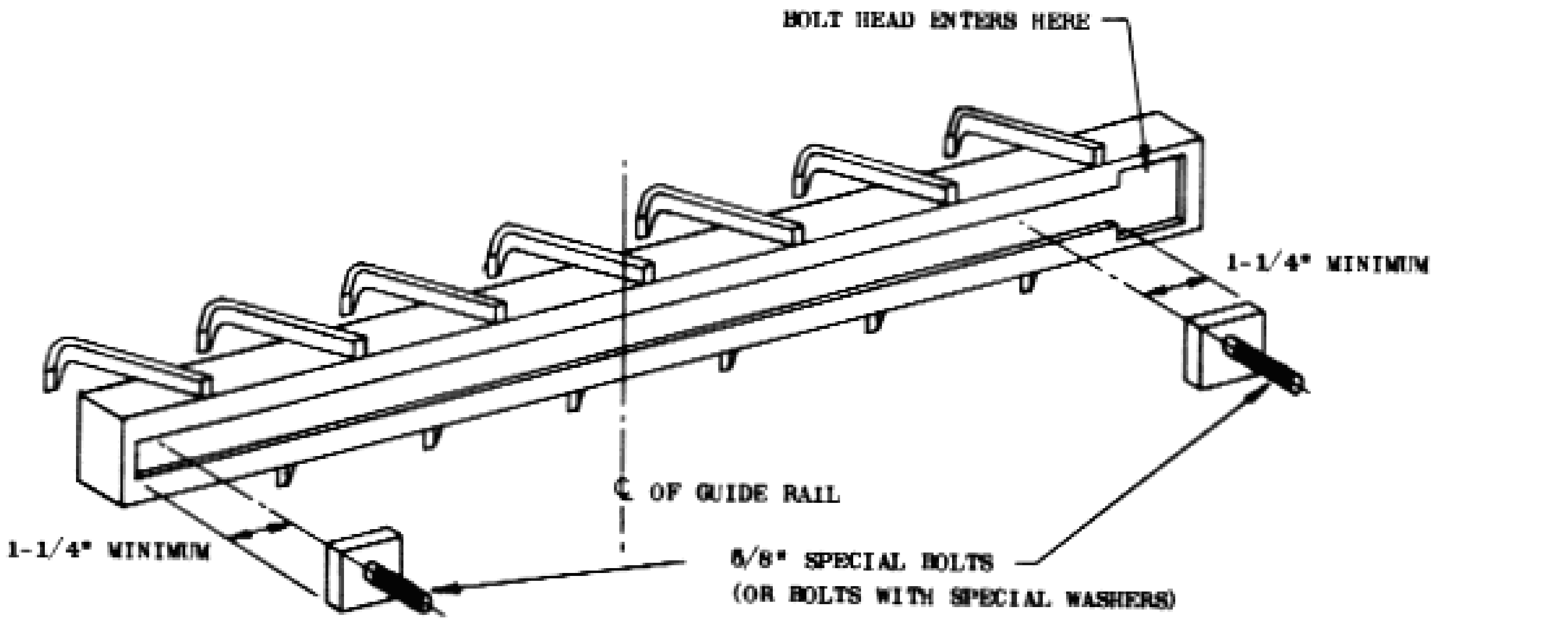
2. Good inserts, when properly installed, assure an extremely satisfactory bracket support. Among them are some manufactured of special steel, capable of withstanding loads of about 2,000 pounds per lineal foot, when imbedded in average good concrete.

3. The system of using inserts for fastenings requires planning in the initial steps of building. The inserts must be set at each bracket level before the concrete is poured. When the construction of the building has reached the stage where the hoistway forms are being built at the lowest landing, the inserts for that landing have to be installed.

4. The hoistway dimensions are compared with the plan-view of the final layout. Then, if they check, the approximate location of the main and counterweight guide-rail brackets are determined and laid out. The approximate location of the bracket bolts are marked. These bolts should be equidistant from the guide-rail center lines. Holes, 5/8'' diameter, should be drilled through the wood forms at the points marked. A level and wood straightedge can be used to establish level marks for all of the brackets at the landing. Be sure to allow for the thickness of the wood used in the forms, when marking bolt hole locations.

5. From outside the hoistway, place the individual inserts for each bracket in their correct locations as established by the bolt holes.

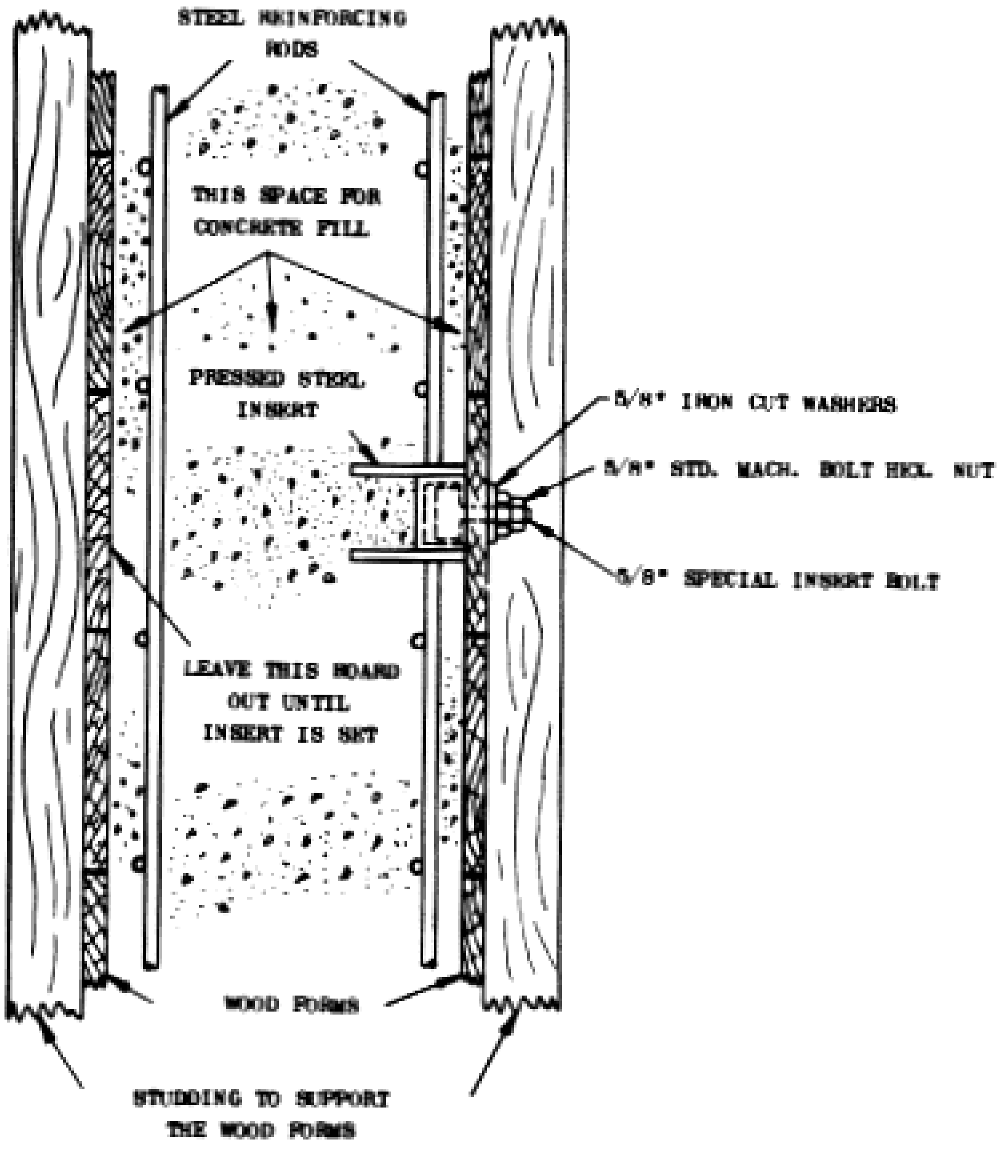
A LONG INSERT AS USED FOR BOTH BRACKET BOLTS



LOCATE THE INSERT ON THE WOOD FORM SO THE ℄ OF THE GUIDE RAIL IS AT THE APPROXIMATE CENTER OF THE SLOT.

Sketch #1

6. It would be well to examine an insert and note its construction features. The face is slotted to receive the bolt heads. The insert is designed so that the concrete will grip the "arms" or extrusions. Certain inserts require a special bolt for elevator work. The head is oversize in all dimensions and is designed not only for strength, but also to prevent the bolt from turning. Standard machine bolts should not be used in this type of insert because the head might turn. However, the manufacturers of inserts do have adaptor washers which permit the use of our standard bolts, if this is preferable.



Sketch #2

7. In order to mount the insert on the hoistway side of the wood form, it is necessary to have the carpenter leave a board off the outer wall of the form at each landing, or to install the insert when the concrete forms have just reached the bracket level. Where a board is left out temporarily, it can be filled in after the insert has been set. The general arrangement of the insert in the form is illustrated in sketch #2.

8. To install the insert, first, set two bolts in the slot of the insert. Place them in the approximate positions of the holes previously drilled in the form. Next, pack paper into the remainder of the slot. Where the wood form is at all rough, the paper will prevent concrete from running into the slot and destroying the utility of the insert. Hold the insert in position with the bolts extending through the wood form. Send the helper into the hoistway to install the washers and nuts onto the bolts. Make the bolts up snug. Level the insert, then, tighten the nuts securely. Remember that the concrete workers will pour and tamp the mixture over the insert; therefore, a good, strong fastening must be made on each.

9. After the inserts are installed for each landing, it is necessary to wait until the carpenters have extended the forms to the next bracket location. As a rule men are not kept on a construction job of this type, at this stage of the work unless it is a large contract. Therefore, the superintendent or foreman must make frequent visits to the jobsite, so as to keep close watch on the work of the carpenters. In this way, he can be sure that they do not build the forms beyond the desired bracket location.

10. The practice of installing only one long "insert" for each bracket, is suggested. This automatically assures that both bracket bolts are in the same parallel plane. The maximum distance for possible bracket adjustments is guaranteed in this manner too. Also, it requires a bit less labor, and tends to eliminate troubles resulting from short inserts tipping during the pouring.

11. Where the span of the counterweight D.B.G. is over 42", two inserts should be used.

12. Some mechanics weld a piece of 3/8" reinforcing rod to the backs of two one-foot inserts, setting them at the proper distance to receive the bolts for long counterweight brackets. This is a practical arrangement and it has the advantage of preventing the short inserts from tipping.

13. There is no question as to when a strain may be put on the insert. As soon as the concrete foreman has the carpenters remove the forms, the inserts may be used.

CHAPTER 5
Section -c4

GUIDE RAILS

Bracket Fastenings – Concrete Structures, Malleable Inserts

Suggested:

Materials:
- a. malleable inserts
- b. 5/8" insert bolts
- c. nails
- d. washers

Tools –
- a. 24" level
- b. brace and 5/8" wood bit
- c. hammer
- d. 6' rule
- e. wood strip for use as rough straightedge

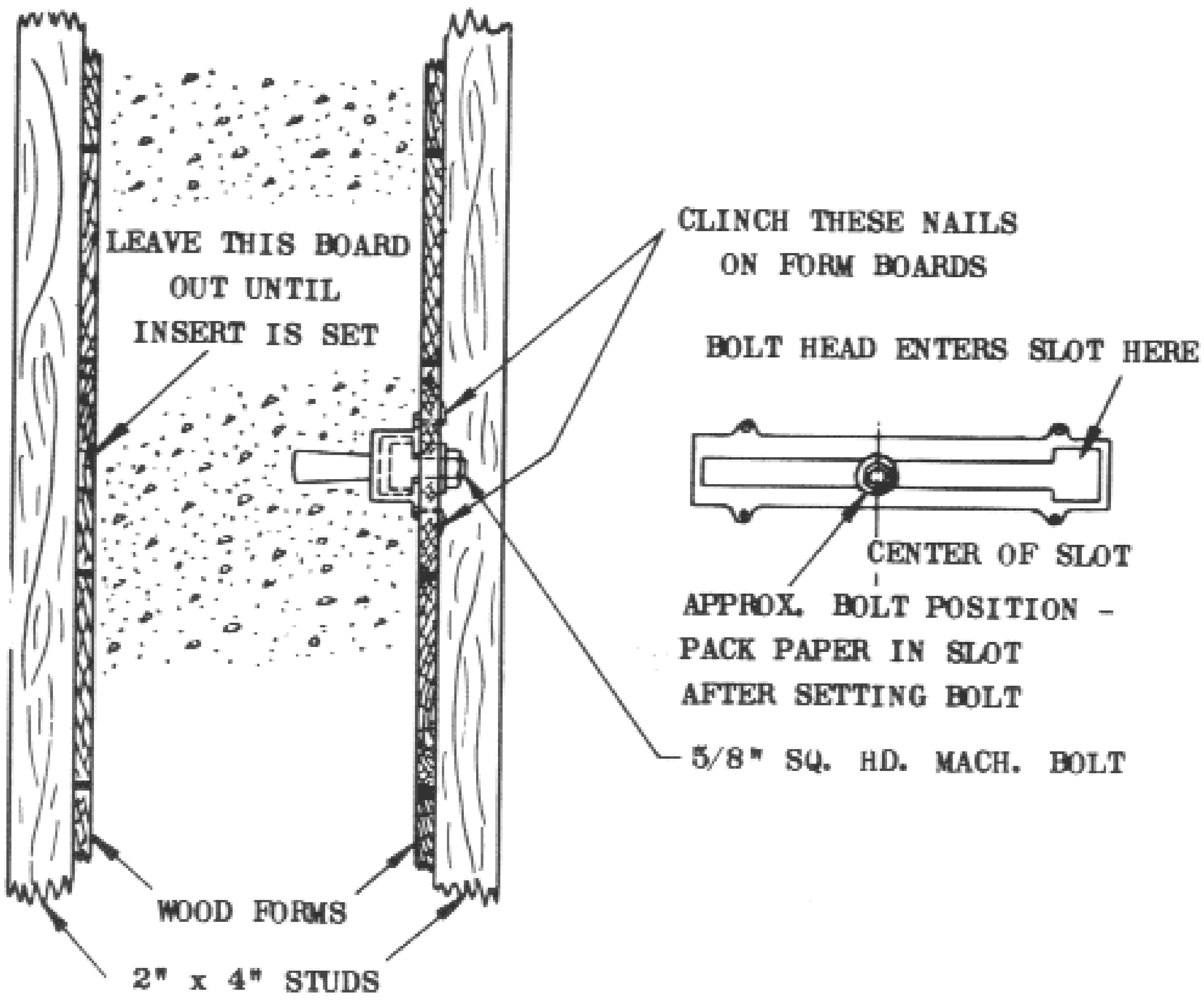
1. Some companies prefer their own designs of inserts to the commercial articles. These special types, often malleable iron, are installed in the same general manner as described for the steel inserts.

2. They are frequently made in short lengths, however, to facilitate inventory or stock handling. In cases where these inserts are short, one is needed for each bracket bolt. Also, because of this, there is a tendency for the insert to turn when the concrete is poured around it. To avoid this, holes are often cast in the insert, so that it can be nailed to the carpenter's wooden forms, after it has been bolted in its proper position. Refer to sketch #1.

3. These inserts are centered on each rail bracket bolt, instead of being centered on the guide rail, and are then bolted securely. They are then nailed so they will not pivot on the bolt during the pouring of the concrete mix.

4. After the carpenters remove the wood forms from the hoistway, cut the nail ends flush with the hoistway wall, so they cannot damage traveling cables or other equipment.

5. One Asiatic firm now makes its own inserts from angle and flat iron shapes. The parts are welded to form a satisfactory, inexpensive fastening anchor.



Sketch #1

CHAPTER 5
Section -c5

GUIDE RAILS

Bracket Fastenings — Concrete Structures, Self-Drilling Anchors

Suggested:

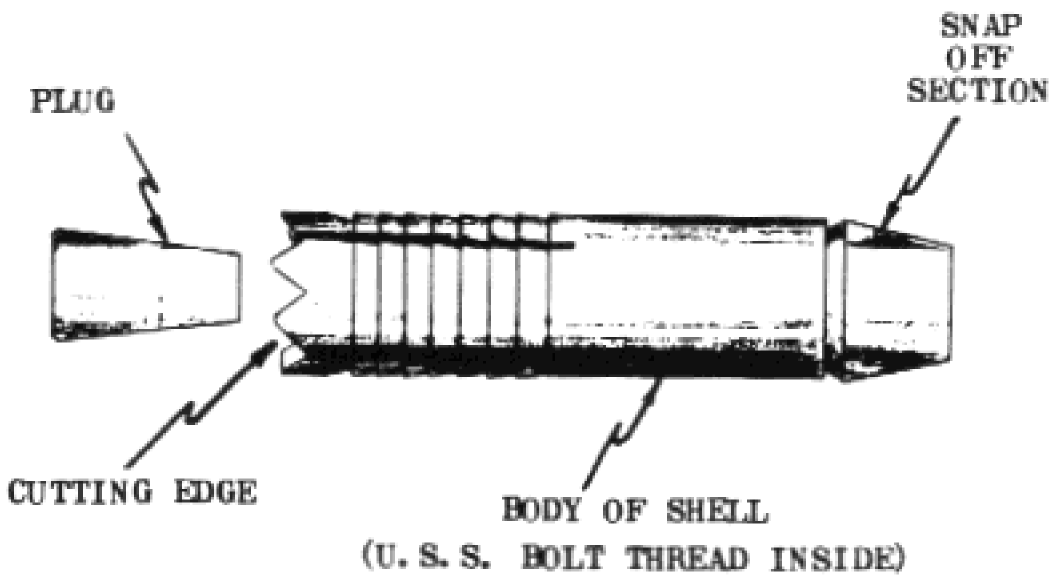
Materials –
- a. self-drilling anchors and plugs
- b. specified bolts
- c. rail brackets

Tools –
- a. 2'' capacity electric hammer
- b. chuck to suit hammer and anchor
- c. handsetting tool for anchors
- d. 24'' level and 6' rule
- e. hand tool kit
- f. extension cord

1. Although self-drilling anchors have been on the commercial market for some years, it has been only recently that they were generally accepted for elevator guide-rail bracket fastenings. However, today they are being used on a world wide basis and offer certain advantages, particularly on contracts out of town or those where the elevator layout is prepared after the structure has been poured.

2. The self-drilling anchor is formed into a steel tube that is equipped with pointed cutting edges that are tempered under a patented heat-control process. Its hollow center is tapped for standard bolt threads.

3. Being equipped with a cutting edge and an internal thread the self-drilling anchor performs both the function of a tool and that of an anchor.



Sketch #1

4. The anchor can be driven into normal concrete by either a hand hammer or power driving tools. Once the anchor has been driven to form the hole in the concrete, it is removed. The dust is then removed from the hole by blowing through a small diameter rubber tube or some similar arrangement. Safety goggles should be used when performing this operation. The anchor is cleared of concrete powder and the steel tapered ''plug'' is inserted in the cutting end.

5. It is then re-installed into the concrete and is driven "home."

6. The hand-driven anchor of some brands has a flush outer end, while the power-driven type has a tapered, "snap-off" end that fits into the tapered chuck of the driver. The snap-off section is easily removed once the anchor is set and a surface flush with the wall is obtained with this type, essentially the same as with the other type.

7. Repeated tests have proved that under normal circumstances and using a 2" nominal capacity electric hammer, anchors for 5/8" U.S. standard bolts can be driven, cleaned, and set in two minutes average time.

8. These units have the following advantages over other forms of rail-bracket fastenings:

Installing Self-Drilling Anchor

a) They can be installed when and where wanted, then used immediately.

b) There is no extra expense for special tools, such as carbide tipped drills.

c) If anchor points break, the holes can be completed with another anchor, and then the broken one used as the fastener.

d) Minimum sized holes are required as related to bolt sizes.

e) They can be installed by hand or power.

f) Their initial cost compares favorable with that of other fastening anchors.

9. Their use will be described in a later section of this chapter.

CHAPTER 5
Section -c6

GUIDE RAILS

Bracket Fastenings – Concrete Structures, Expansion Shells

Suggested:

Materials –
- a. expansion shells with bolts

Tools –
- a. 2'' capacity electric hammer
- b. 1-1/8'' star drill points (or 1-1/8'' star drill and 2 lb. hammer)
- c. 24'' level
- d. 6' rule
- e. hand tool kit
- f. extension cord

1. Expansion shells are sometimes used in concrete (or brick) hoistways for guide-rail bracket bolt supports on light or medium duty elevators, but at present they are not highly recommended. Occasionally, hoistways are built before the elevator contract is awarded and expansion shells are a practical fastening in such cases. Self-drilling anchors are not recommended for use in brick structures. No expansion anchors of any type should be used to support guide-rail brackets for heavy capacity elevators, regardless of other considerations.

2. The shells are very simply (though not necessarily easily) installed. It is only necessary to star drill a 1-1/8'' hole (for a 5/8'' bolt expansion shell) into the wall to a depth equal to the length of the shell plus 1/8''. Chop the hole at an angle of 90 degrees to the flush wall.

3. The reason for chopping 1/8'' more than the shell length is that this will allow the concrete to be chipped, if it is necessary to set the bracket back of the wall line, to permit rail alignment.

4. After the hole is drilled into the wall, it is necessary to install a few cut washers on the bolt. Then start the bolt into the shell nut, catching about one thread of the bolt. Place the expansion shell in the hole, tap it in place, so it is bottomed inside the hole in the wall. Next tighten up on the bolt. When the bolt is tightened, the washers will bear on the concrete wall, and draw the nut forward. The shell housing is thus expanded and wedges the sides of the shell in the hole. The bolt can be loosened and taken out to allow the installation of a guide-rail bracket at any time.

CHAPTER 5
Section -c7

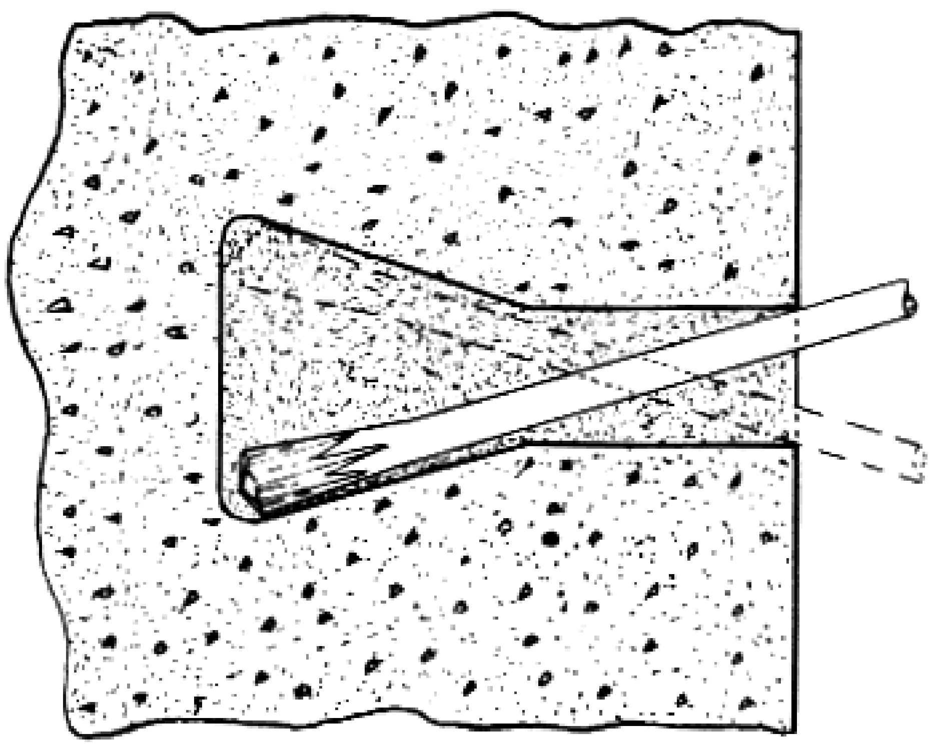
GUIDE RAILS

Bracket Fastenings — Concrete Structures, Bolts in Concrete

Suggested:

Materials –
- a. cement
- b. sand
- c. wooden board
- d. 5/8'' square-head machine bolts

Tools –
- a. 2 lb. hammer
- b. 1-1/8'' star drill



Sketch #1

1. Unfortunately, there cannot be any one standard system of fastening guide-rail brackets to concrete beams or walls. As a rule, the use of inserts or expansion shells or anchors is preferred for this purpose (see chapter 5 -c3 and 5 -c4). If, however, there is some reason to install a bolt into the concrete, without a shell or insert, we suggest the following system of doing the work.

2. Square head or hex. head bolts can be used for this work. The important point is to provide some means to prevent the bolt from turning after being grouted in. A simple arrangement is to have flat plates about 1/16'' thick drilled to suit the bolts used, then bent in a vise to follow the bolt head and form a ''lock.'' See sketch 2 for an example. Bolts of 5/8'' diameter should be minimum size when used in areas affected by the A.S.A. code.

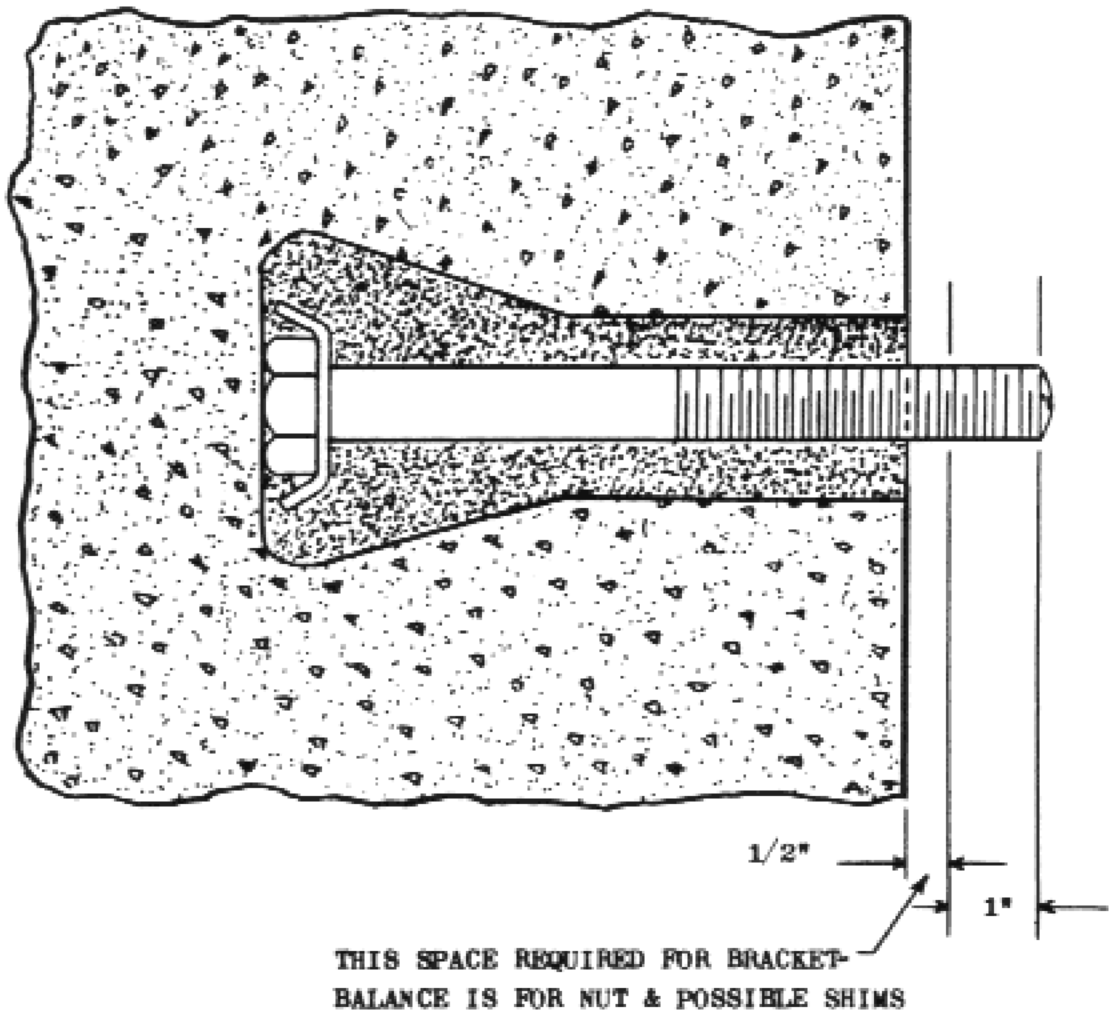
3. The bolt length will depend on the thickness of the concrete. However, bear in mind that for guide-rail brackets, the bolt head should never be less than four inches inside the wall or beam. It is seldom necessary to put it more than six inches inside the surface of the wall.

4. As an example, let us set the bolt 5 inches inside the wall. A bolt 6-1/2'' long would be required. Sketch #2 illustrates the way to determine this.

5. Assume that the location for the bolt has been established. Make a cross mark on the wall with soapstone or chalk, so the bolt can be centered later. Begin drilling

the hole. Make it about two inches deep, using a 1-1/8'' star drill. This far, it will be about 1-1/8'' in diameter. The bolt head will enter this size hole.

6. When the hole is 2'' deep, begin to widen (or bell) the hole until it is about 3'' wide in back and 4'' deep, as illustrated in sketch *2. Tilt the star drill while hammering to ''bell'' the hole.



Sketch *2

7. After the hole has been chopped, mix a mortar of about one part cement and three parts sand. Make a rather stiff mixture; dry mix this thoroughly, before adding water.

8. Set the bolt in the hole. Align it straight with the marks on the wall. Trowel the concrete into the hole and tap it in solidly with a small wood block to be sure the hole is filled. If the bolt has moved, square it up to the marks again and allow the concrete to set by supporting it with a small flat board for a few minutes.

9. Do not put any pressure on the bolt until it has set for at least 48 hours.

10. British Empire, European, African and Asiatic firms use the foregoing system quite widely except that the bolts are ''ragged'' or fish tail types. That is, straight bolt stock is threaded at one end and split, then spread, at the other. However, self-drilling anchors are being adapted in England, France, Hong Kong, the Phillippines and Latin America so the use of ''rag'' bolts is decreasing.

CHAPTER 5
Section -c8

GUIDE RAILS

Bracket Fastenings – Brick Structures, Steel Inserts

Suggested:

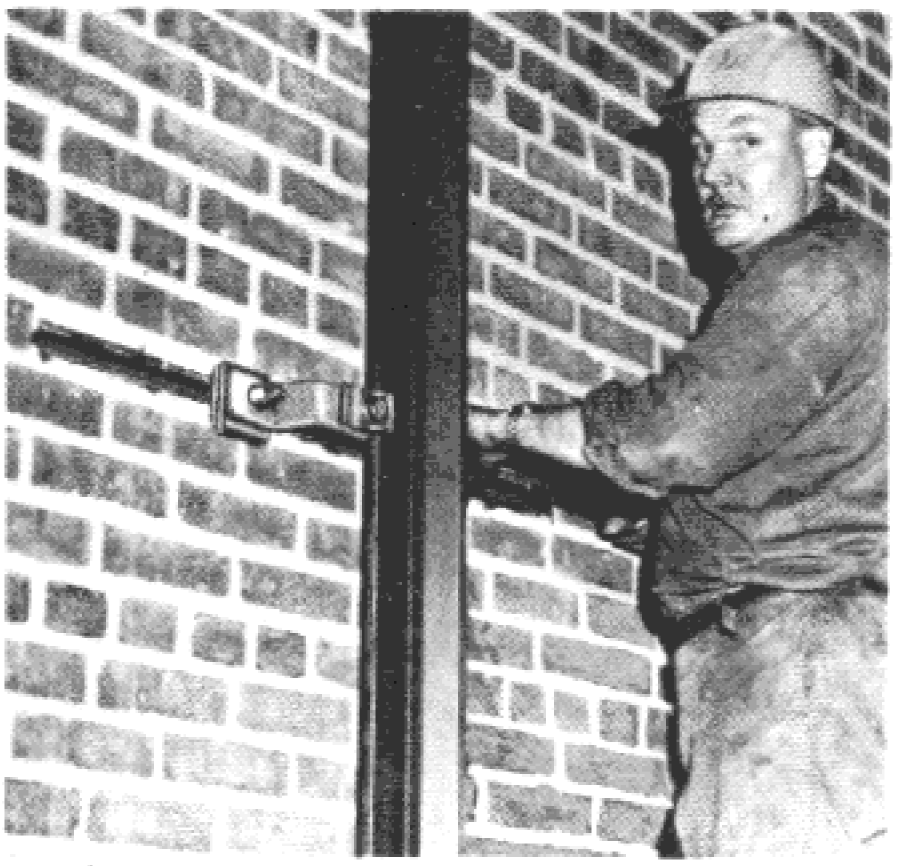
Materials –
a. steel inserts for brick

Tools –
a. none

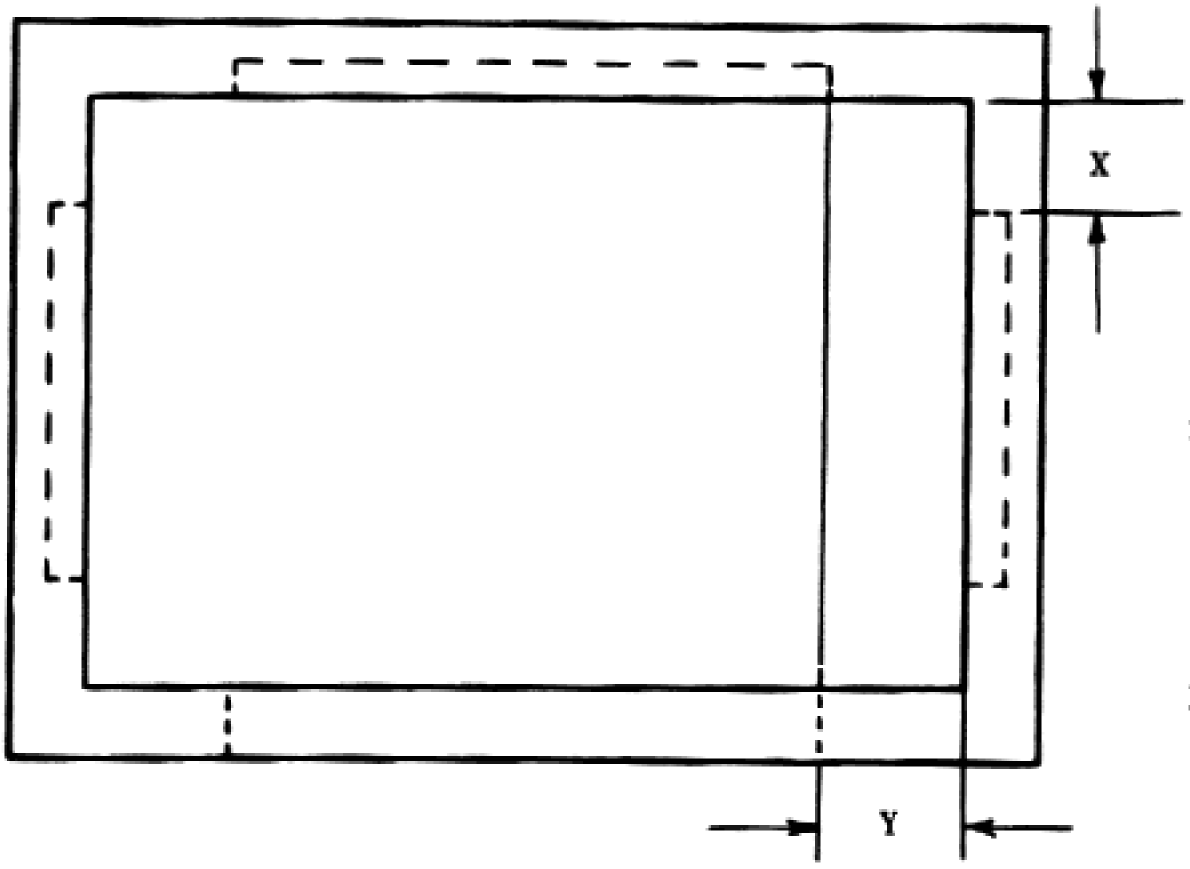
1. Since this type of insert is actually laid inside the bonding of walls, arrangements are generally made for the bricklayers to install them as they build the hoistway walls.

2. Note that inserts should not be used in hollow tile or terra-cotta walls.

3. It is advisable to set them 1/4'' inside the surface of brick walls. If the face is set back in this manner, it will allow space to cut if the hoistway walls are out of plumb, and it is necessary to set the bracket inside the wall line for rail alignment.



Chair Bracket Secured By Steel Insert



Sketch #1

DIMENSIONS "X" & "Y"
TO BE DETERMINED
BY FOREMAN
FROM FINAL LAYOUT AND
BUILDING CONDITIONS.

4. The photo illustrates how these brackets provide supports for bolts.

5. If a bricklayer is to set the inserts, a simple sketch with which to locate the inserts should be given to him. One similar to the sketch on the preceding page would suffice. The sketch is usually prepared by the layout draftsman.

6. The inserts can be used as soon as the hoistway wall is complete. If it appears that the mortar requires time to dry, consult your superintendent or get an O.K. from the bricklayer foreman, before proceeding with the work.

CHAPTER 5
Section -c9

GUIDE RAILS

Bracket Fastenings – Brick Structures, Through Bolts
– Wood Structures, Through or Lag Bolts (or Screws)

Suggested:

Materials –
- a. 5/8'' machine bolts for through bolts
- b. 1/4'' iron plate washers

Tools –
- a. electric hammer
- b. star drill points (or 5/8'' star drill and 2 lb. hammer)
- c. 5/8'' wrenches
- d. 5/8'' wood bit and brace or 11/16'' high speed twist drill and electric drill

1. Certain installations require through bolts to be used for guide-rail bracket support bolts. As an example, if the elevator contract was signed too late to have inserts installed in a brick building and the elevator was to be a 10,000 pound capacity freight car, shells might not be considered satisfactory.

2. In such installations, through bolts would probably be used to support the rail brackets.

3. Where through bolts were to be used the bolts would be installed in a manner similar to the following.

4. The bolt hole locations would be marked out. The mechanic would star drill 5/8'' holes through the brick wall and place 1/4'' iron plates, at least 3'' square, on the bolts. Then he would push them into the wall from the outside.

5. Where the outside wall was to have plaster finish he might have to recess the washer and bolt head until they were well inside the finished wall line.

6. Where brick walls are less than 8'' in thickness, they should not be used for fastening either main or counterweight guide-rail brackets.

7. There are some elevators still installed in wooden structures. This is especially true in isolated localities. The mill work involved in a job of this nature is similar in method to that described for brick structures. Through bolts with iron plate backing are the preferred fastening on this work also. If this is not possible, 5/8'' lag screws may be substituted, if the elevator duty is moderate. Such lags should not be less than 4-1/2'' long and 5/8'' diameter.

8. Where through bolts are used in millwright work, the erector would probably drill holes through the wooden bracket supports with a 5/8'' wood bit in a hand brace, or with an 11/16'' drill in an electric drill.

9. Where lag bolts are required, a 3/16'' hole should be drilled in the wood for a distance equal to the length of the lag, less the thickness of the guide-rail bracket stock and packing. The hole should be reamed to 3/8'' for about one half of its depth.

10. Grease or soap the lag screws, before screwing them into the wood.

CHAPTER 5
Section -d1

GUIDE RAILS

Setting Brackets — Channel Type

Suggested:

Materials —
- a. brackets
- b. bolts
- c. shim material
- d. sundries

Tools —
- a. hand tool kit
- b. punch, electric drill, or welder

1. The installation of guide-rail brackets is one of the most important steps in the erection of an elevator. Although it is not always impossible to align the guides if brackets are poorly installed, it certainly takes a lot of time and effort to correct the trouble. Therefore, it is advisable to put that time and effort into making the brackets as nearly right as possible, when they are being installed.

2. Before installing any brackets, study the final layout or the rail plan. Since the horizontal positions have been established, either by inserts or anchor bolt locations obtained from "targets" (or plumb lines) or by the actual positions of inserts, it is only necessary to determine the vertical locations. Brackets are to be spaced vertically as indicated on the final layout for each installation. The spacing of rail brackets for all rail weights is related to gross loads applied to the rails. Since traction and drum elevator cars are always equipped with safeties and generally the counterweights are not, it is common and accepted practice for the draftsman to establish rail bracket spacing based on the elevator car guide-rail loadings. However, there are specified limits to allowable spacing and these are outlined in Rule 200 of the Safety Code. Graph 200.4a(1) provides quick information to the draftsman, as does table 200.4c(1). It will be noted from these that an eight pound rail has a maximum 12'-0" bracket "pitch" or spacing when used for a car or for a counterweight with a safety, whereas the same rail can have as high as 16'-0" bracket pitch for a counterweight without a safety. It is permissible, therefore, to have an installation with say, 15# car guide-rails with brackets spaced 14'-0" apart and 8# counterweight rails with brackets at the same 14'-0" spacing for convenience in installations, provided there is no counterweight safety. However, if the counterweight was equipped with a safety, the maximum permissible bracket spacing would be 12'-0" or less, depending on the load. Some overseas countries, such as Japan, where frequent and serious earthquakes are prevalent, have much more stringent regulations on bracket spacing.

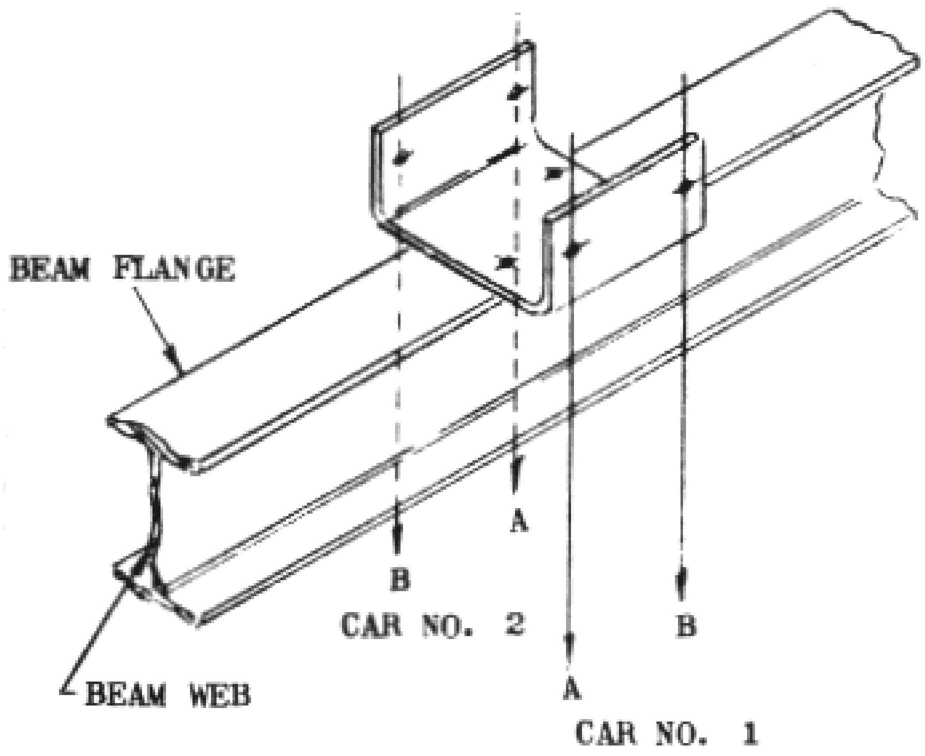
3. These points are given on the elevation of the layouts or rail plans. The bottom bracket is set about 4' above the pit floor in installations with spring buffers, and near the lowest terminal landing on oil buffer installations. Good practice dictates that a set of main guide brackets be installed about 18" below the lowest terminal landing. This tends to reduce excessive "side sway" or "float" while the car is loading or unloading.

4. The line of brackets is spaced upwards from the first one. A spacing 10' to 14' between brackets is generally accepted as sound engineering. The 8# rails require minimum bracket spacing because they do not have the inherent strength of the heavier rails.

5. The suggestion is made that no length of guide rail be installed without at least one supporting bracket. By this we mean that if an 8' length of rail is installed for spacing purposes anywhere between the lower and upper terminal landings, an intermediate bracket ought to be installed to support it. The specifier could include this bracket when ordering material, but, if it is omitted, the field man can order it. It can be installed after the rails are up. If a supporting beam is needed, it may be possible to convince the builder that he should install it for the sake of good construction. This point is equally important on main guides and on guides of counterweights equipped with safety devices.

6. Before beginning the work of installing the brackets, refer to section -b1, of this chapter. Inspect the bracket plumb lines to be sure they are clear.

7. If beams are to be fire proofed before brackets can be installed, it is desirable to place wood forms over the bracket locations.



"A" & "B" ARE PLUMB LINES FROM THE TEMPLATE

Sketch #1

8. The work of installing brackets can be performed from a skip, scaffolding, or the support beams themselves. In any case be sure the working conditions are as safe as possible.

9. For the bolted channel type bracket, set the face 5/8'' outside of the two plumb lines. Measure the distance to each line very carefully at top and bottom. (Welded bracket practices will be outlined in 5 -d3.)

10. Scribe the bracket hole location on the beam flange.

11. Set the bracket to one side and drill, burn or punch 11/16'' holes in the flange at the scribe marks. Holes should never be burned in the bottom flanges of support beams. When burned in, the top flanges they should be ''drifted'' to the required size. (If burned holes are apparently needed in bottom of flanges of support beams and no other solution is available, get approval from the general contractor's or the architect's representative.)

12. Reset the bracket on the beam. Install bracket support bolts finger tight. Check the distance from the plumb lines to the bracket flange. Shim between the beam flange and bracket web, if necessary, to plumb the bracket flange with the plumb lines. Shims must be of steel, as long as the bracket, and should be bent over the beam flange so they cannot work out. The 11/16'' holes have enough side play to permit the bracket face to be squared up with the two lines. The ''squaring'' must be exact, or the guide rails cannot be aligned with each other. The sketch illustrates this.

13. After the bracket is plumb and square, tighten the support bolts with a suitable wrench. The handle should be at least 12'' long and the bolts made up tight.

14. Standard 5/8'' machine bolts with hexagon nuts are generally used. The head of the support bolts should be down and the nut on top of the bracket web.

15. The distance of 5/8'' from the face of the bracket is arbitrary. Any convenient spacing can be used when dropping the plumb lines from the template.

16. However, it is considered advisable to allow 1/8'' between each guide-rail bracket face and the back of the rail. This will permit packing to be added or removed, if it is necessary to do so, in order to align the rails.

17. When one channel is to be used as support for the guide rails of two different elevators, the distance between the plumb lines of the two elevators should be divided and standard packing-plates used behind the guide rails to obtain the required spacing.

18. This is also true where two angle brackets are bolted or welded to a channel base mounted on a separator beam between two elevators.

CHAPTER 5
Section -d2

GUIDE RAILS

Setting Brackets – Bent Steel Types

Suggested:

Materials –	Tools –
a. brackets	a. hand kit
b. shim materials	b. electric drill and twist drills
c. sundries	

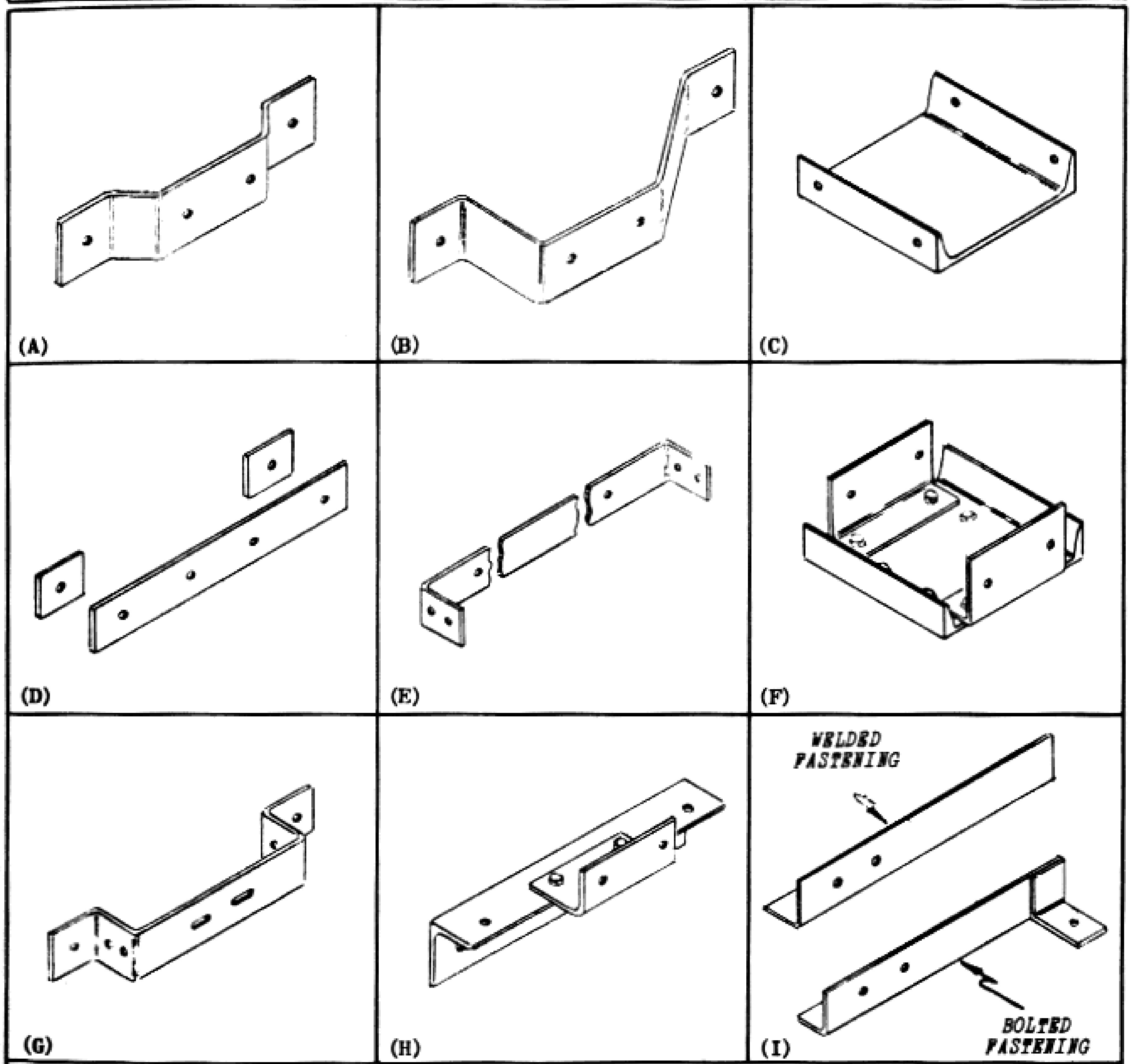
1. Bent steel brackets are manufactured in many shapes and sizes. The conventional "chair" or "hat" bracket is usually made of 1/2" by 3" or 4" mild steel, and bent to each company's specifications. Counterweight or "U" types are made of similar material for short spans but of heavier stock for longer "DBG" dimensions.

2. The installation procedure for these brackets is similar to that used for the channel types.

3. A check of the plumb lines is usually the first step. The brackets in sketch *1 are generally considered standard, but there are many more variations of them.

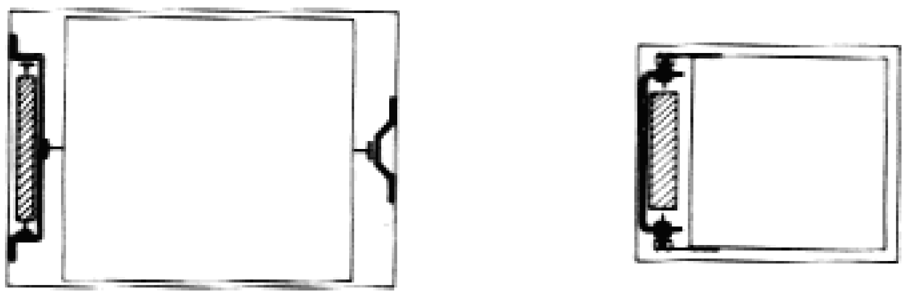
4. The bracket support bolts will already be in place, if the structure is of brick or concrete (or unless the brackets are being installed from a skip as described in 5 -e2). It is then merely necessary to set the brackets on the bolts, square up their faces with the plumb lines that are in front of the clip bolt hole locations, and then tighten the brackets. Where the elevator is being installed in a steel structure, it will be necessary to hold each bracket in place, scribe the beam web for the support bolt holes, then remove the bracket and drill the beam. A 1/4" hole is generally drilled first, and the hole then reamed with an 11/16" drill. Use 3" x 3" or larger packing plates as shims between the bracket feet and the beam or wall, if shimming is necessary.

NINE TYPES OF BRACKETS
(BENT STEEL AND MILLED SHAPES)



(A) Chair, Saddle, Regular or Hat.
(B) Special Chair or Hat.
(C) Channel
(D) Flat Bracket with Packing.
(E) Counterweight and Dumbwaiter.
(F) Channel and Angles for "Separator" Beam.
(G) Combination Bracket for One Car Rail and Both Counterweight Rails.
(H) Two Angles Form Car Rail Bracket.
(I) Counterweight Brackets for Use on Top of Steel or Concrete Beam.

SKETCH NO. 1



ELEVATOR DUMBWAITER

UNUSUAL BRACKET ARRANGEMENTS

Sketch #2

5. Bolt the bracket in place. It is recommended that not more than 1/2'' of packing be used.

6. Where it is necessary to shim the bracket in order to square the face with the lines, use steel strips about 1'' wide, and bend them over the edge of the bracket so they cannot fall out if the bolt becomes loose.

7. Be sure to arrange the spacing of the brackets carefully as suggested in -c1 of this chapter.

CHAPTER 5
Section -d3

GUIDE RAILS

Setting Brackets – Angle Types

Suggested:

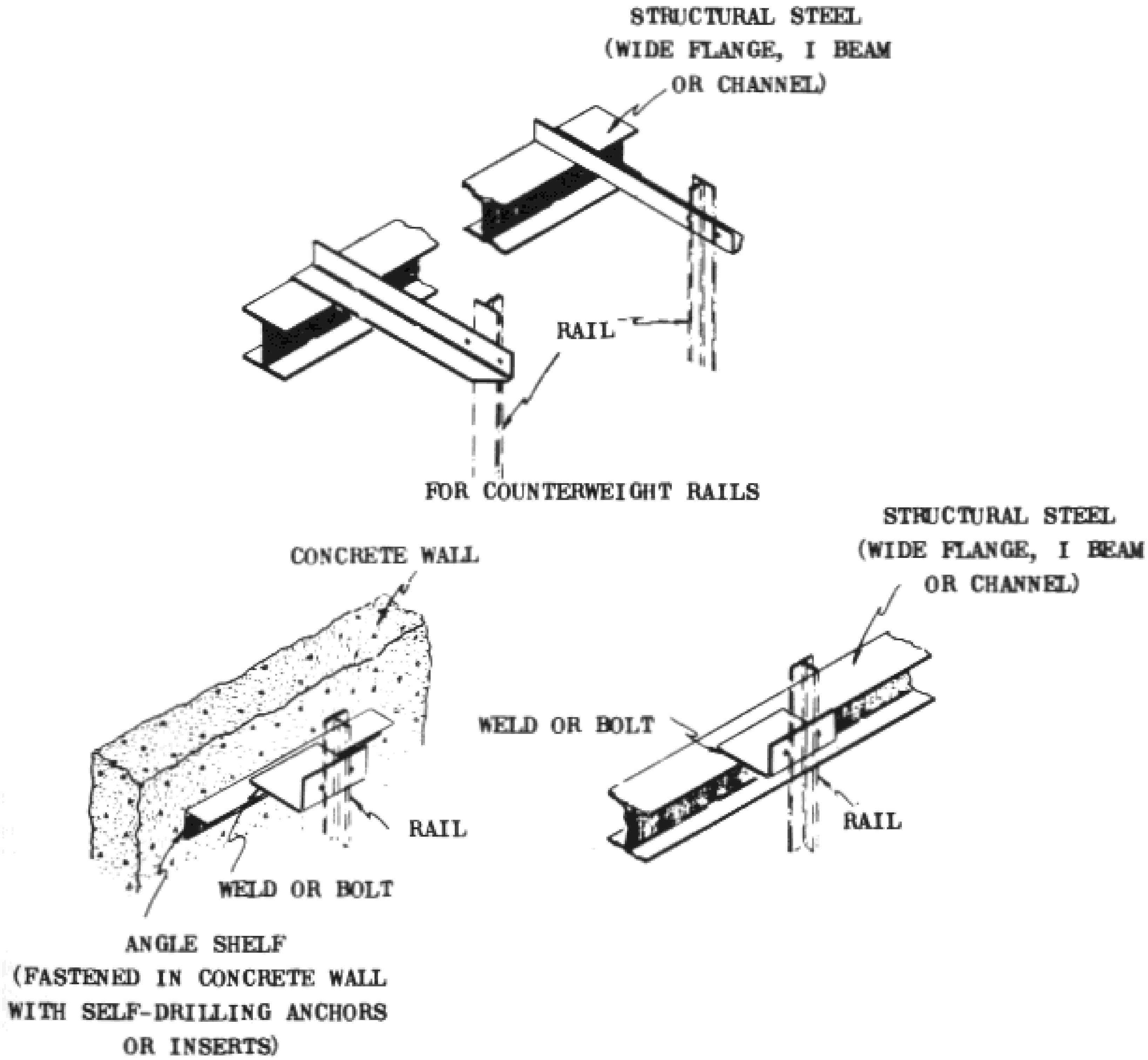
Materials –
- a. bracket parts
- b. bolts, nuts
- c. shims (optional)

Tools –
- a. hand tool kit
- b. 24'' level
- c. 6' folding rule
- d. electric drill and twist drills
- e. soapstone pencil
- f. electric arc welding equipment (alternate)
- g. ''C'' clamps

1. Section ''C'' of this chapter outlines several methods of installing fastenings for brackets. All are suitable for installation of angle type brackets. With respect to this article an ''angle'' bracket is defined as being made of one or two sections of commercial angle iron. Where two are used, the first is bolted to a wall or beam and thereby forms a shelf. The second angle is inverted and secured to the first. Generally, shims are not required for this arrangement but they can be used at the discretion of the erector or ''super.''

2. The lower or ''shelf'' section of the assembly has four 5/8'' factory drilled holes, two in each flange. Those in the vertical flange are spaced at a standard distance to

suit the normal bracket fastening arrangement for the company involved. The holes in the horizontal flange are also spaced to the individual company's engineering standards and are intended for bolts to hold the upper or ''clip angle'' part of the bracket to the shelf. See sketch *1 for typical arrangements.



SKETCH NO. 1

3. Usual procedure is as follows:

a) Using a small try-square, make a thin soapstone center line on the top of the horizontal flanges of all the shelf angles.

b) Install brackets, beginning with the lowest level.

c) At each, place the shelf portion at its approximate position and install the bolts or studs into the anchor device. Align the center mark with the plumb line, using a short straightedge, if the distance from the shelf-angle edge to the plumb line requires this precaution. (The straightedge could be held to the bracket by a 2'' ''C'' clamp.) However, on the average installation, the distance is such that the mechanic can ''sight'' the center mark, since plus or minus 1/16'' is sufficiently accurate for this operation.

d) The next step is to make the support bolts up snug to determine if the support beam or wall is out of plumb or badly out of square. If so, loosen the bolts and install shims to correct these conditions.

e) It is important that the horizontal flange of the shelf angle is approximately level two ways (i.e., front-to-back and postwise). Shim to obtain this condition.

f) There is no great advantage beyond appearance to having this shelf angle perfectly square with the door sill line or guide-rail center line. If the support beam is reasonably square with the hoistway, no shims need be used to square the bracket. This is up to the discretion of the mechanic or super, as noted earlier.

g) After this shelf angle has been installed and permanently tightened, the clip angle is assembled to it.

h) The ''clip'' has two factory drilled holes in its vertical face but none in the horizontal. The two holes are spaced to accommodate the guide-rail clips as designed by each company's engineers.

i) The clip angle is held in place on the shelf angle. The distance from the plumb line to the vertical face is very carefully measured to obtain proper distance (i.e., 1/2" plus rail depth if plumb lines are set at the DBG-1"). Some companies allow 1/16" or more for shims.

j) The distance from the plumb line to the outside edge of each bolt hole is equalized to square the bracket with the future locations of the guide-rail back. The 1/2'' dimension is rechecked and the bracket is held firmly in this position.

k) At this point, with the horizontal flanges of the shelf and clip angles held tightly together, scribe the location of the shelf-angle holes onto the clip angle flange. Also make a soapstone line where the front edge of the shelf-angle lays against the bottom flange of the clip-angle.

l) Remove the clip angle. Center punch and drill the two holes, using a 1/4'' or 3/16'' drill to penetrate, then the proper size drill for the through bolts.

m) Clean off burrs from the bracket and re-assemble it, bolting it permanently in place on the shelf, aligned to its soapstone mark.

n) Re-check for plumb, squareness and distance to the plumb line.

4. This type of bracket assembly can be welded instead of bolted, of course. When this is done, the bracket clip is set on the shelf and held in place with 2 "C" clamps. The mechanic sets and aligns all brackets for a given level or floor, then does all the welding.

5. If heavy bracket stock is involved, the brackets can be "tacked" with a first pass of the rod, then the finish passes of welding done after the "C" clamps are removed. The length of welds and number of "passes" will vary with stock of material and duty.

6. Only qualified welders should be permitted to do this work.

7. Each company sets its own standards as related to local governing codes and regulations.

8. If one-piece angle brackets are installed as on flanges of "I" or "H" beams and channels, the same general procedure is followed as used to install the clip part of the two-piece assembly. However, it is often easier to drill the horizontal flange of the angle clip first. This can then be used to scribe the beam flange, which would be drilled last. Welding can often be used instead.

CHAPTER 5
Section -e1

GUIDE RAILS

Erecting Guides – Conventional Method

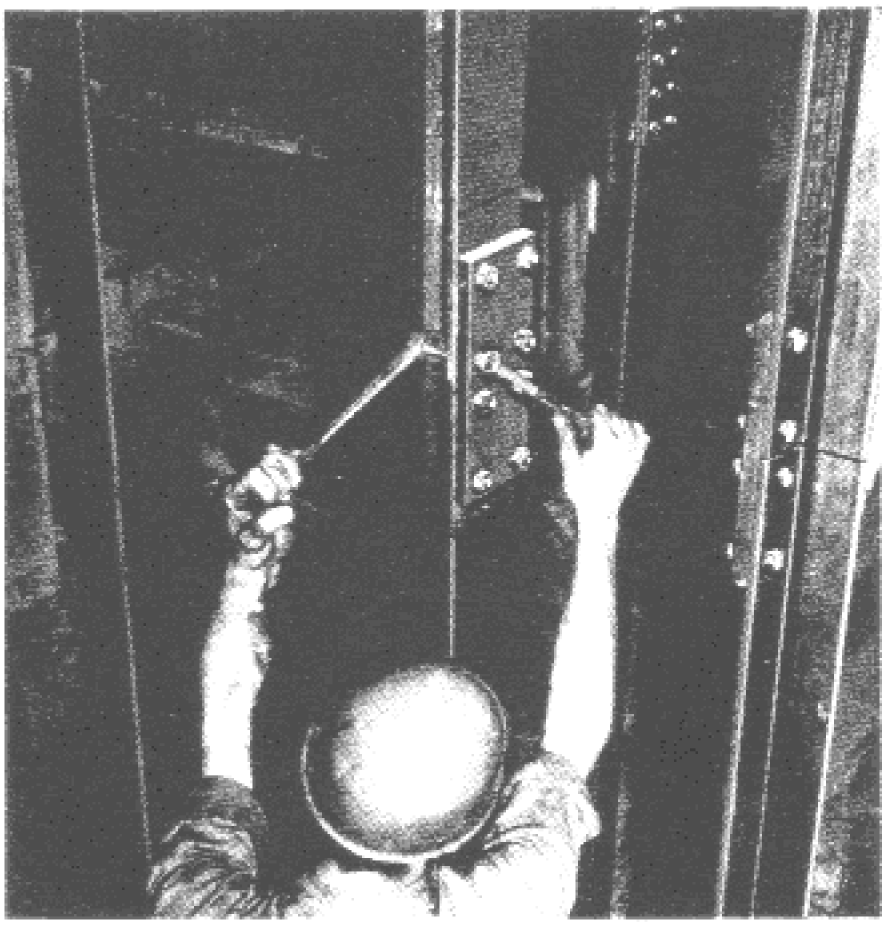
Suggested:

Materials –
- a. guide rails
- b. clips
- c. packing
- d. bolts
- e. sundries

Tools –
- a. hand kit
- b. scaffold or planks
- c. rope falls
- d. rail shackle

1. The "T" rails used by all companies in the United States and Canada are similar in form and their specifications are essentially governed by the requirements of the A.S.M.E. Safety Code. Rails are most accurately identified by weights per foot. The

1960 edition of the code establishes the following weights per foot for standard elevator rail sections: 8, 15, 18-1/2, 22-1/2 and 30 pounds. Until a few years ago many elevator contractors used guide rails that were end milled in both the blades and the backs. Others had only the blade edges milled. These practices were changed so that now essentially all United States and Canadian companies use rails that are end milled only in the tongue. However, the rear surfaces of the rail backs are milled smooth at those points where they contact the fishplates. The fishplates are milled on the faces which are bolted to the rail backs. Hole tolerances in the fishplates have generally been tightened up and thus the rail ends are held in satisfactory alignment. The fishplate thicknesses have also been increased to stiffen the joints.


"On the Job Training" Begins With Rail Work

2. Sixteen feet is generally considered a full length rail. The other length commonly stocked today is the eight foot "spacer" or "jumper" rail. The name derives from the fact that the short lengths are used to space-out or jump long rails where their ends coincide with bracket locations. Usually the superintendents of each company acquire a few leftover ends of rails which they use to start or finish suitable rail runs. This saves cutting full length rails.

3. Rail lengths are joined by fishplates and are held to the brackets by clips. Certain field conditions, duties or specifications require that guide rails be stiffened or "backed." This is generally done by clipping steel channels to the rail backs. Layouts indicate this condition when it is needed. Fishplates are made in several forms but the most common one today is manufactured of flat steel and has one surface milled to a closely held tolerance of flatness. It is drilled or punched to have eight holes, four for the end of each guide rail it is to join. The holes have about 1/32" clearance (1/16" maximum) for the rail bolts and thus hold the rails in close alignment.

4. Other types of fishplates have been used, such as those cast as a "U" shaped retaining shoe and the two piece "front" fishplates. These were designed for specific purposes and in one way or another proved impractical. The one current type that varies from the conventional is that made of short sections of "T" rail. It is used on higher speed or exceptionally heavy duty elevators. Its prime function is to provide extra stiffness at rail joints.

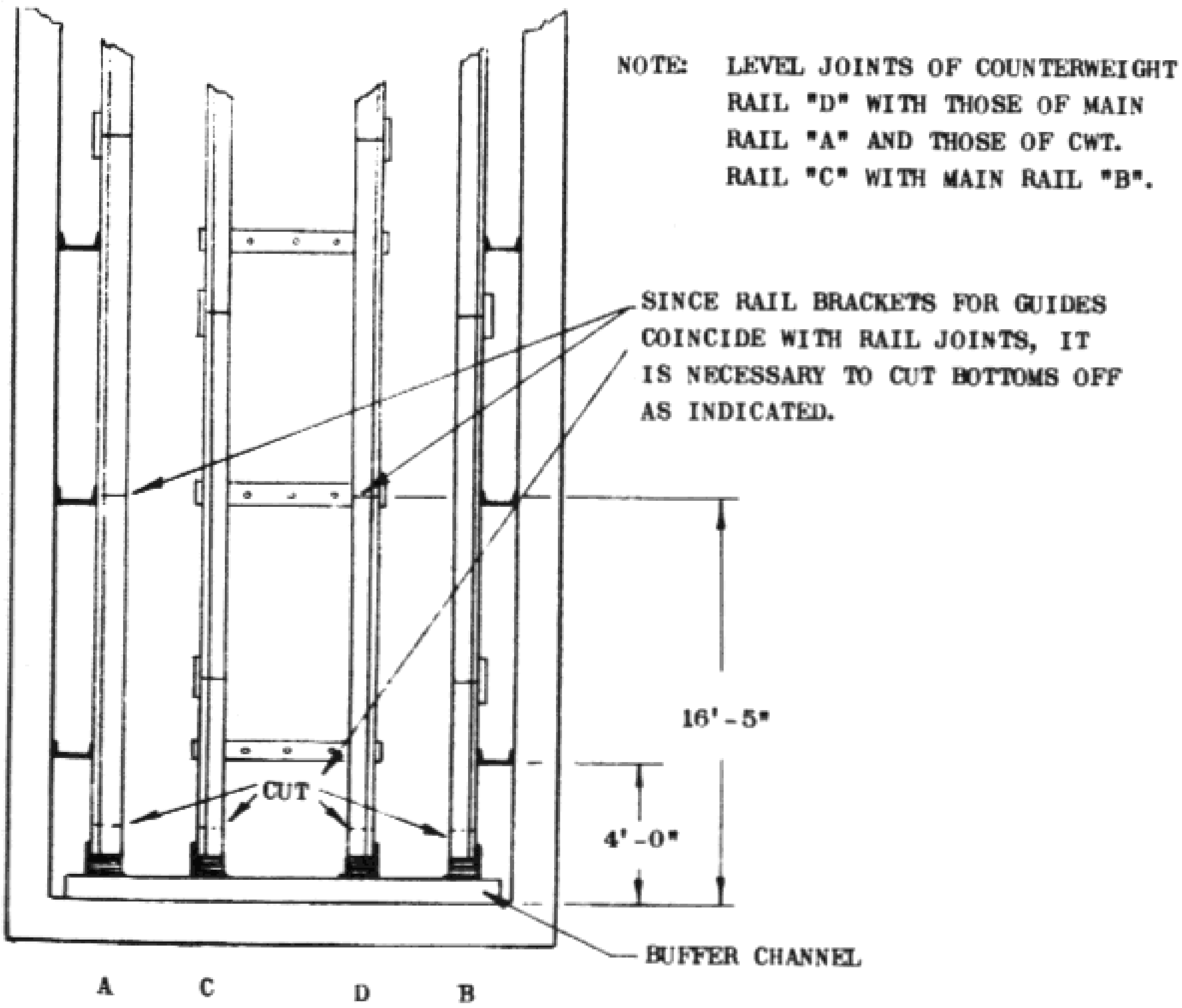
5. Rail clips also vary in accordance with engineering opinions in the several manufacturing elevator companies. The most common is the forged steel clip that has been used for many years. A variation of this is used in Europe where some contractors forge the clip and its bolt in one piece. The forged clip is designed to hold the rail back firmly to its brackets.

6. Several companies manufacture bent steel clips or forged clips which are designed to allow the rail to slide in the clips while still holding the rail snugly to its brackets. These clips were introduced to avoid distortion of guide rails as buildings compress. They offer greater advantages in high-rise buildings than in low.

7. When forged clips are used, a space of about 1/16'' is generally left in each rail joint to allow for ''take up'' during building compression.

8. With bent (or so called ''sliding'') clips, the rail joints are butted together.

9. Some companies have their drafting room prepare a layout of rail joint locations. This is called a ''rail sketch'' and indicates not only the relative locations of fishplates but also rail lengths and approximate bracket vertical spacings in relation to fishplates. If such a sketch is not provided the mechanic must accurately plan his rail installation. Sketches 1 and 2 help to illustrate the utility of a rail sketch.



Sketch #1

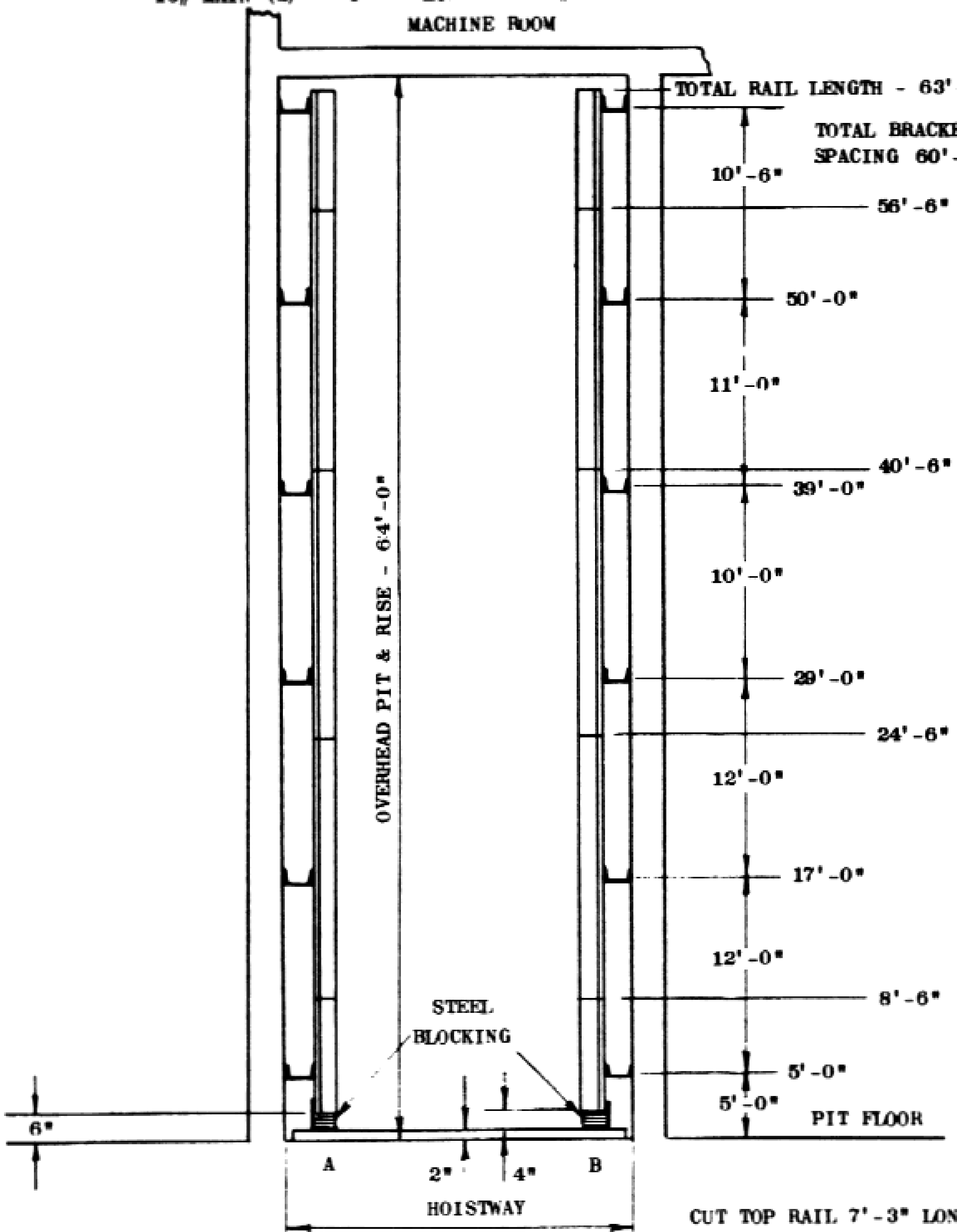
EXAMPLE OF GUIDE LAYOUT

HOISTWAY WITH 64'-0" OVERHEAD, PIT AND RISE (TOTAL)

RAILS SUPPLIED:

15# MAIN (7) - 16'-0" LONG   8# CWT. (7) - 16'-0" LONG

15# MAIN (2) - 8'-0" LONG   8# CWT. (2) - 8'-0" LONG



USE BOTTOM OR "STARTER" RAIL 8'-0" LONG. ALL FISHPLATES WILL CLEAR BRACKETS.

CUT TOP RAIL 7'-3" LONG FOR CAR AND COUNTERWEIGHT (NOTE: THAT PART CUT FROM RAIL "A" CAN BE USED ON RAIL "B")

Sketch #2

10. Rail bottoms should rest on their buffer channel angle brackets or on some form of blocking that rests on the buffer channel. This represents a reversal of former opinion. The reasoning followed is that rails on a solid base cannot slide and cause false operations when and if a safety operation occurs.

11. It is especially important to have a solid base under each rail when "sliding" type clips are used.

12. Since heavier fishplates have been generally adopted and rails are solidly bottomed, the arguments for staggering of fishplate joints have been largely eliminated. As a result, few companies now follow the old practice of "staggering" rail joints. However, as noted previously, it is customary to start one run (or side) of rails with the tongues up and the opposite side with the grooves up. By following this practice there is less waste since excess ends can often be used to piece out of the tops of the opposite side.

13. The rail sketch will indicate what length of guide rail is needed as a "starter" in order to keep fishplates clear of the maximum number of brackets. Sometimes standard 8'-0" or 16'-9" lengths of rails can be used as starters. Often this is not possible because bracket spacing does not permit it. Sketch #1 illustrates this condition and indicates how the rails should be cut to suit field conditions.

14. The A.S.M.E. Safety Code (for elevators) requires that each run of car and counterweight rails shall be so located that guiding members of car and counterweight frames cannot travel beyond the ends of the guide rails. (See Rule 200.8 of 1960 Safety Code.)

15. Before beginning to install, or "stack" rails, examine all tongues and grooves. Clean dirt or burrs from them with a wire brush and a thin, second cut, flat file. Practices vary in this but it is generally easier to clean up all rails as one operation on a small job rather than to clean them individually before hoisting.

16. Eight and fifteen pound rails are usually hoisted on a single whip rope fall. Multiple blocks are used for heavier rails where they are hauled by hand. Electric or gasoline powered hoists are often used for this work today. It is important to locate the rope-fall block centrally between the four rails so all can be laid into place as easily as possible. Most men use shackles on the load end of the fall to facilitate "hooking" the rail on.

17. If the pit floor is finished, place the car and counterweight bumpers into position.

18. Determine from the rail sketch or your study what lengths of rail you must start with. Select these and install them, placing steel blocking under the bottom of each stack in accordance with the standard of the company you are working for.

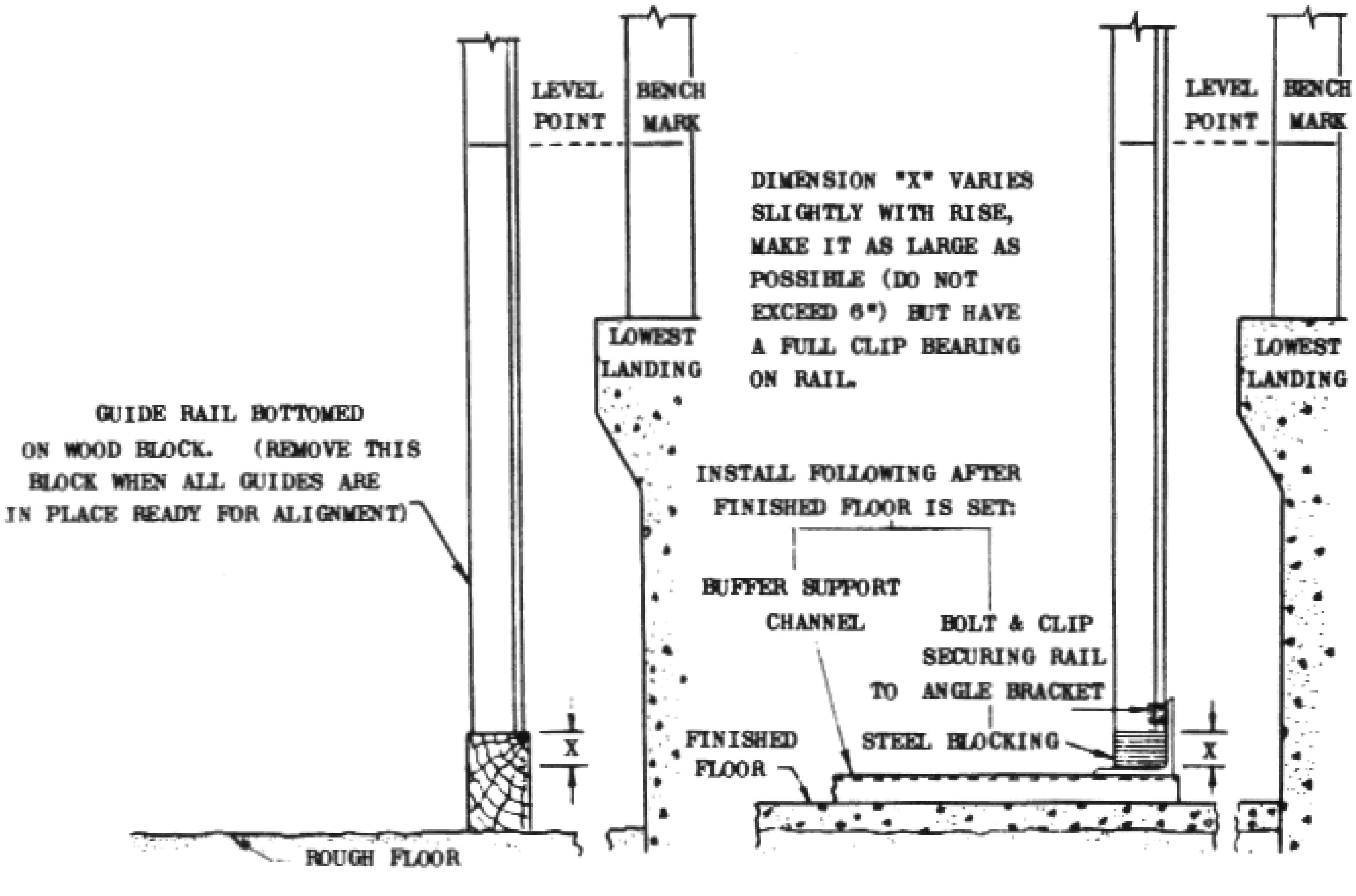
19. Once these lengths are installed, all the others can be placed in accordance with the plan outlined by the rail sketch. Clip all rails to brackets and make up the fishplate.

20. Once the rails have been stacked, they are carefully aligned and the joints are filed.

21. Where pit floors are rough it is necessary to provide temporary blocking to hold the rails at the proper height until the floor is finished and the buffer channels and clip angles can be installed.

22. To accomplish this it is necessary to determine from the layout how far below the lowest landing the rails will extend. Once this distance is established, the rails are marked to indicate it and clipped in their approximate place. They are set permanently by leveling out from the bench mark at the lowest landing. It is advisable to use forged clips on the first few brackets in these cases.

23. Sketch #3 illustrates the method of starting rails under these conditions.



Sketch #3

24. Study sketch #2 as a review of this section.

25. Note that from the rail sketch (sketch #2) you can determine the location of brackets and their positions with regard to the fishplates. The total height of the hoistway from pit floor to and including the overhead is 64'-0'. About 63'-3'' of rail will be used in each run. By using 8'-0'' lengths of rails as ''starters,'' no fishplates will interfere with the brackets. Since fifteen pound rails will be supplied for the main or car rails and eight pound rails for the counterweight, some seven 16'-0'' lengths, plus two 8'-0'' lengths will be needed for each. One 16'-0'' length of each will be burned off for ''topping out.'' This will provide the needed two pieces of each size 7'-3'' long. It will result in very little scrap since the tongue end can be used on one run and the grooved end on the other.

26. The installation of guide rails is one of the most important functions in elevator installation. Guide rails form the axes from which the location of all other components are indexed.

CHAPTER 5
Section -e2

GUIDE RAILS

Erecting Guides — ''False'' Car Method (Working Platform)

Suggested:

Materials —
- a. aligning wire
- b. brackets and fastenings
- c. rails, fishplates and bolts
- d. shims or packing

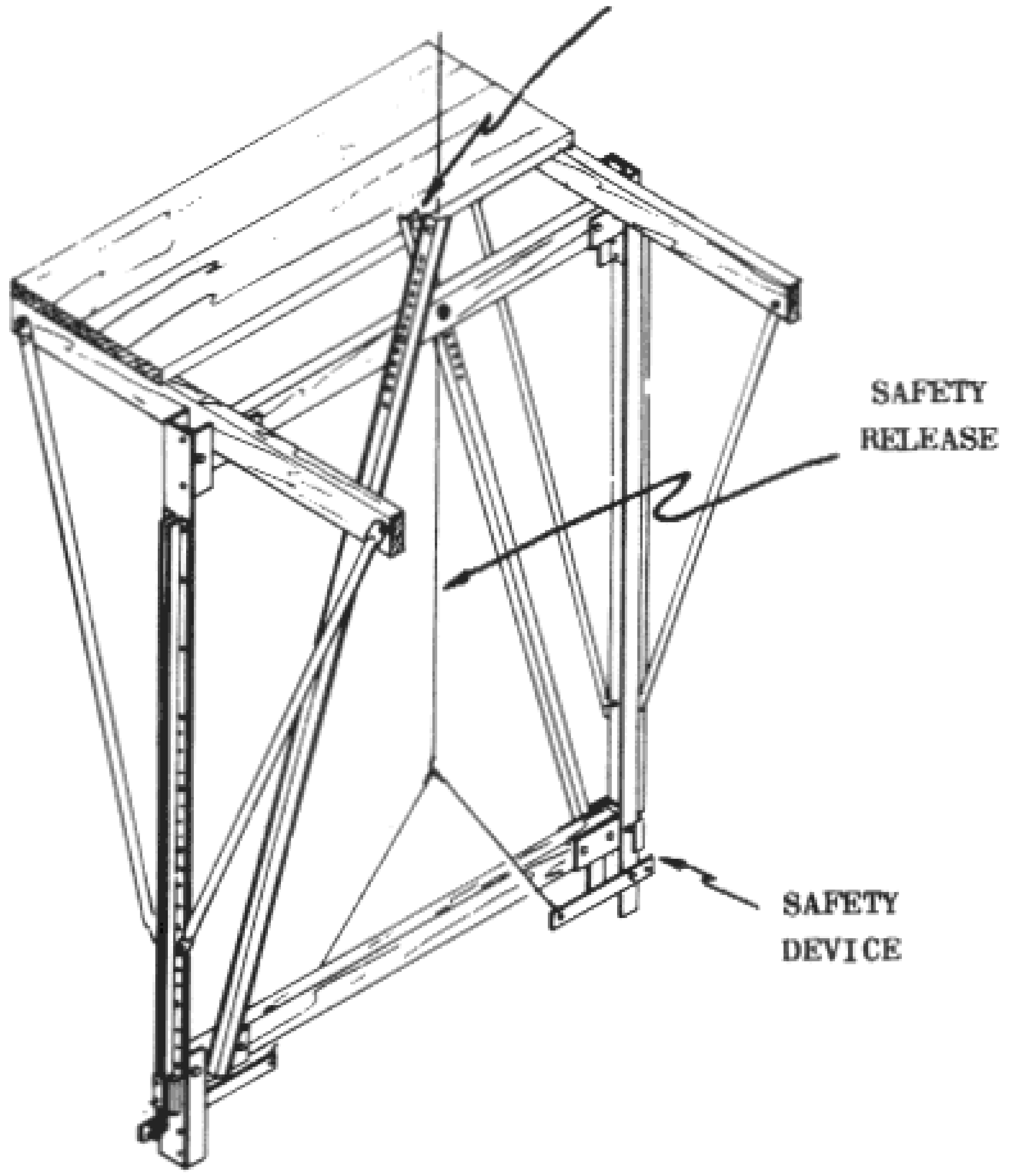
Tools —
- a. ''false'' car
- b. hand tool kit
- c. aligning wire clips

1. It is often difficult and sometimes dangerous to install guide rails and brackets from planks or temporary scaffolds. European, Asiatic and Latin American elevator contractors traditionally avoid this by having building contractors provide scaffolding at every floor. This is cumbersome, however, and since it is generally built on posts that run the full height of the hoistway, it is not too practical for tall buildings.

2. A number of American firms have been developing moving scaffolds, ''skips'' or ''false'' cars over a period of years. When these are equipped with safeties, they probably form the safest and most practical means to install elevators.

3. They vary considerably but the general sequence of using them is as follows:

a) Perform preparatory work and rail layout study as for the conventional method. Rig a second rope-fall, centered between the car guide locations to lift the ''false'' car.



Sketch #1

b) Having dropped and adjusted plumb lines from the top template or planks, install the bottom run of brackets to those line locations.

c) Working from a plank or secured ladder, install the second level of brackets.

d) Install the four bottom lengths of guide-rails. Clip the bottoms of the plumb wires to the rails and again weight them.

e) Assemble the "false" car on the main guide-rails. Reeve it up to the second rope-fall.

f) Place necessary tools on the car and hoist it above the rail far enough to permit installing the next level of brackets. (The "false" cars are designed so that this can be accomplished without their safeties leaving the permanent guide-rails.

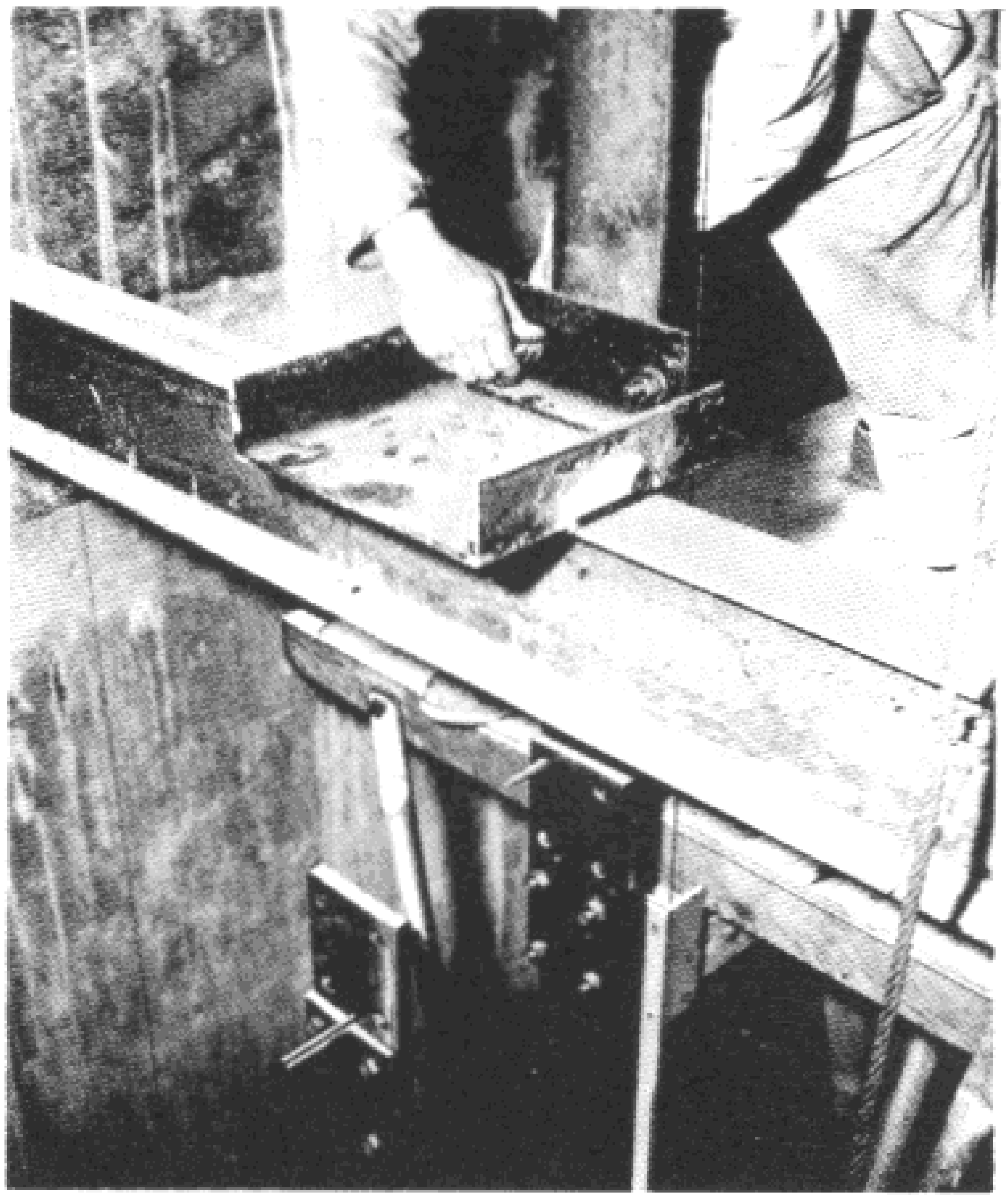
g) After the third level of brackets are installed to the plumb lines, lower the "false" car. The helper then goes to the bottom, hooks on the next four rails and the mechanic joins them at the fishplates.

h) The "false" car is then raised so clips can be installed and the rail roughly aligned to the plumb wire.

i) The car is then raised to the next bracket level and the procedure repeated until the rails are topped out.

4. It is obvious that the "false" car and plumb line arrangements must be designed to permit movement of the car without disturbing the lines.

5. The "false" car method is quite efficient in hoistways where brackets and other material can be distributed to each floor at convenient locations. The car capacities are limited of course, and aside from that, the men have to pull them up by rope-fall. Electric winches or similar power tools are of considerable assistance in moving the car.



The Plumb Line Passes Thru
This "False" Car Frame

CHAPTER 5
Section -e3

GUIDE RAILS

Erecting Guides — European Method

Suggested:

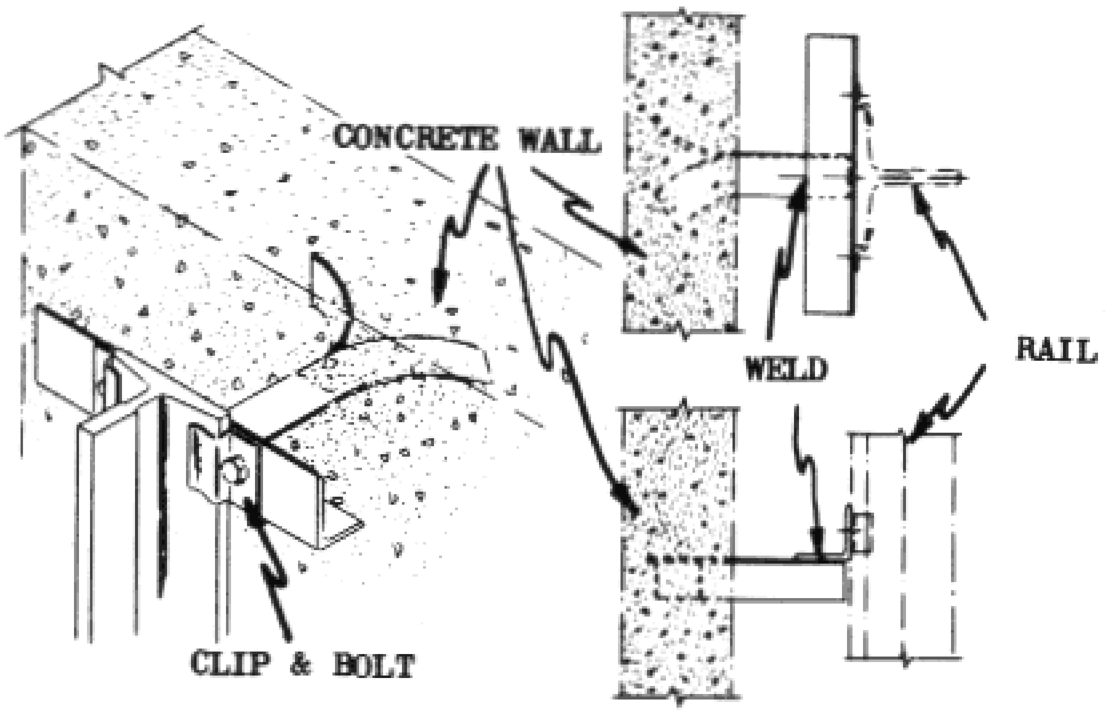
Materials —
- a. brackets
- b. rails, fishplates, bolts
- c. packing
- d. concrete

Tools —
- a. special template
- b. scaffolding at all floors
- c. hand tool kit

1. Building construction practices in Europe include many variations from those in the Americas. Contractors often perform work that would be considered unusual or as an "extra" in the United States. The supply of scaffolds in elevator hoistways with almost full platforms at every floor is an example.

2. Another is that building contractors provide blocked out holes or ''pockets'' for elevator guide-rail brackets in the concrete walls or beams. These are ''pitched'' at whatever vertical distance apart they are required.

3. To utilize these holes, the guide-rail brackets are formed with splayed feet which are grouted into the wall pockets. No wall anchors or inserts are used. See sketch *1 for one type of these brackets.



Sketch 1

4. One manufacturer uses the following practice for its standard sized elevator:

a) Standard sized steel templates are prepared in quantity. These are designed to clamp onto the main and counterweight rails and to hold them in exact alignment. Preparatory planning is similar to domestic companies.

b) Counterweight guide-rails (at rear) are hoisted by hand operated mechanical hoists. As each length is raised, the next length is clamped on by its fishplate. Brackets are bolted on in their planned locations.

c) When each run is complete from top to bottom, it is temporarily tied in its approximate location.

d) The car guides are handled in a similar manner.

e) After all guides are topped out, the bracket feet are turned into the wall pockets and the templates secured to all four rails. The templates are spaced about one and a half meters apart for the height of the hoistway.

f) With all four rails held in alignment to each other, the hoist is used to aid in aligning the car guide locations to the front walls. Once this relationship has been established the rails are bottomed and then blocked with timber at several points to prevent shifting.

g. The contractor then sends concrete men in to grout all bracket feet.

5. This system may seem crude but it is being widely used for standardized elevators in housing developments. The duties and the rail sections are considerably lighter than any permitted for passenger elevators in the United States and Canada.

6. This description is included as a matter of general interest. Its European proponent claim high efficiency in multiple unit installations.

CHAPTER 5
Section -f1

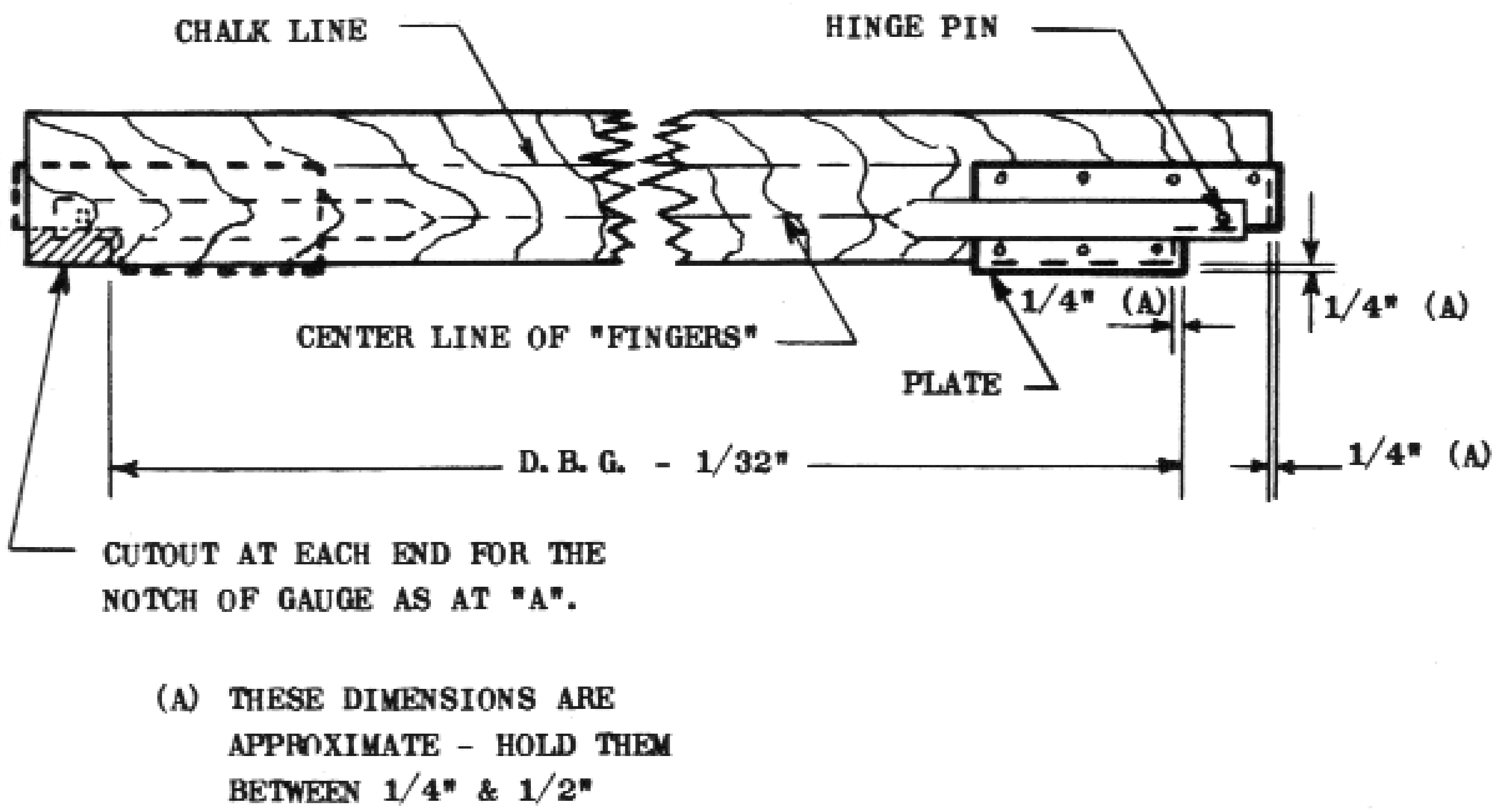
GUIDE RAILS

Rail Gauges – Distance Boards

Suggested:

Materials –
- a. shim stock or packing plates
- b. 48 #14x3/4'' wood screws
- c. 2''x4'', straight plank or board

Tools –
- a. hand tool kit
- b. rail gauges (pointers)



Sketch 1

1. Rail setting or aligning gauges do not follow any fixed pattern among the various companies installing elevators. They do, however, have a common purpose, which is to assure the correct "DBG" (Distance Between Guides), and to check the square setting of one rail to its opposite.

2. Reasonably straight, unwarped boards or planks must be used when making a guide rail distance board such as shown in sketch 1. A 1" x 4" pine timber would be satisfactory for short boards but a 2" thickness might be required for long ones, although this size would be heavy to handle. The edges do not have to be planed. They should be as long as the "DBG" plus four (4) inches.

3. Make a chalk line mark about 1-1/2" from one long edge of the board. Set a gauge at one end with its long edge on the chalk line. Mark the position of the gauge on the timber, including any cutouts or notches needed. Do the same with the opposite gauge at the other end.

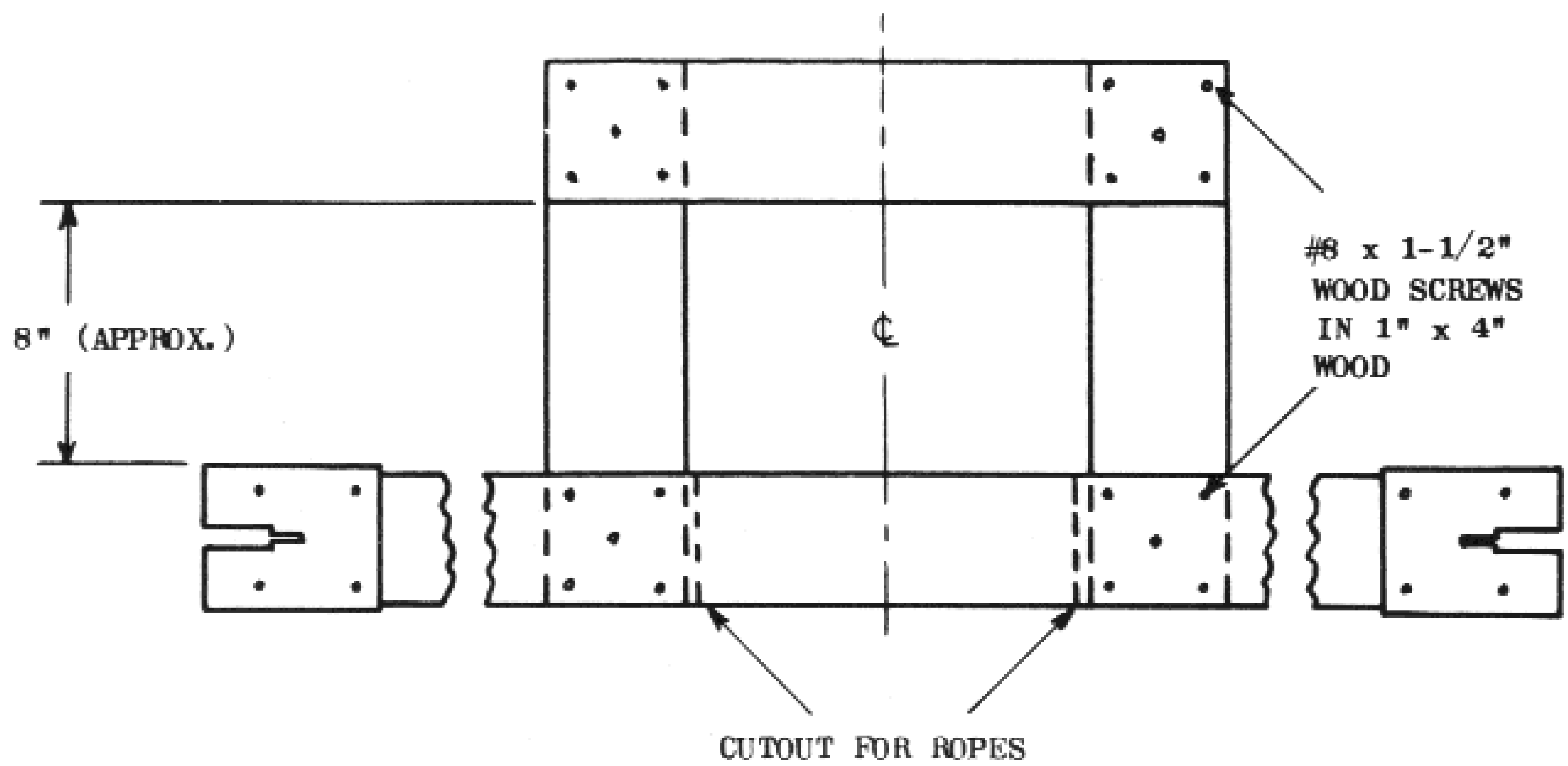
4. Drill through bolt or screw holes and, where indicated, cut out the timber 1/2" back of each marked notch. (See sketch *1.)

5. Mount one gauge on the wood, aligning its edge exactly with the chalk line.

6. Mark the "DBG" less 1/32" very accurately on the board, measuring from the rail face edge of the first gauge.

7. Mount the second gauge with its long edge on the chalk line and the face on the mark indicating "DBG" less 1/32".

8. Cut off any excess lumber.



Sketch 2

9. Both gauges should be aligned to and square with the chalk line.

10. If the gauge is the "pointer" or arrow type, hold the gauge board vertically against the guide rail so the finger or pointer edges are flat against the rail. Mark the wood at the points. (The gauge fingers should be free to swing, but should have no play in their hinge-pin holes. If the play at these points seems sufficient to cause error in rail alignment, return the gauges to the factory or office and request a different set.)

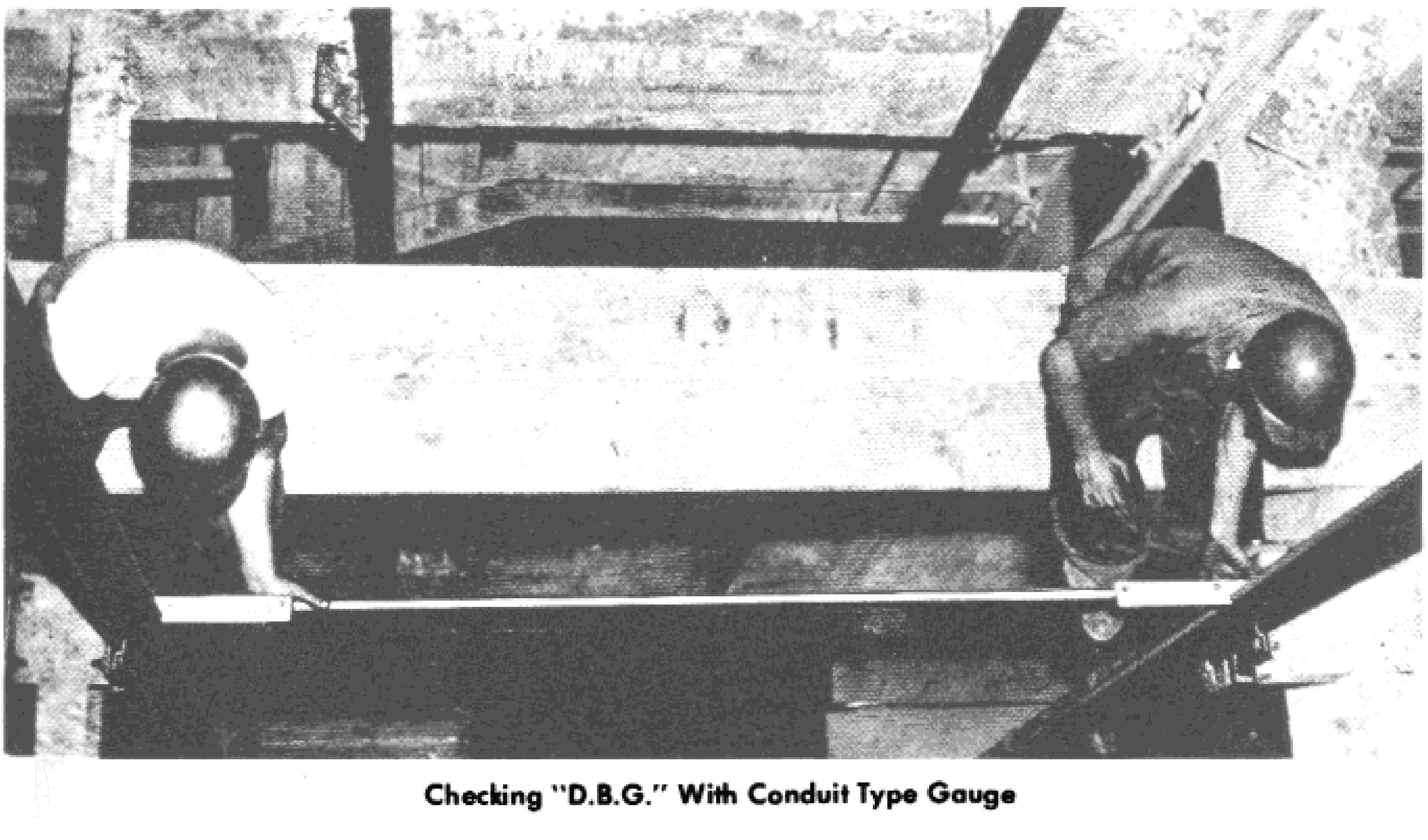
11. Make one distance board gauge for the main guide rails and a second board for the counterweight rails.

12. If the ropes are installed before the gauge is used, a special distance board may be required. Make a standard gauge, then offset it by screw-fastening other boards to the template. Cut out the central portion of the template. Sketch *2 illustrates this method.

13. Several companies now make the pointers on aluminum angles rather than on flat plates. The angles are provided with two retainer rings, each of which has a setscrew.

14. A pair of gauges is placed on the ends of a straight piece of conduit cut to appropriate length. The assembly is held against the blade of a straight length of guide rail and the setscrews are tightened.

15. This type of tool is convenient to use and will fit between hoist ropes, if used on a completed elevator.



Checking "D.B.G." With Conduit Type Gauge

GUIDE RAILS

Aligning and Filing Guides

Suggested:

Materials —
- a. shim material
- b. packing plates

Tools —
- a. hand tool kit
- b. steel straightedge
- c. vixen files
- d. plumb-line steadying clips
- e. distance boards
- f. •22 annealed iron wire or piano wire
- g. plumb line gauges

1. Almost every experienced mechanic has developed a few ''kinks and gadgets'' of his own to aid in aligning guides. These do not affect the general scheme of alignment, which is to set each rail as near to perfectly square, parallel to, and at the correct distance from its opposite. Therefore, the ''general scheme'' of aligning guides is given herewith.

2. Guide rails are usually aligned for the entire hoistway as soon as they are installed in low or medium height buildings. Due to building construction methods on high-rise structures this is often impossible, therefore, the rails are straightened for about ten floors at a time. When working in this manner, however, care must be taken to lap each section. If this is not done, each ten floor section may be perfectly aligned within itself, but not with the adjacent sections.

3. For hoistways where the entire length of rails is to be aligned at one time, install a plumb-line steadying clip about six inches below the top of the hoistway. Thread the end of a wire down through the hole in the clip and fasten the weight to the end of the wire.

4. Uncoil the wire, rolling the coil carefully to avoid kinks. Lower the weight into the pit.

5. Cut the wire and fasten it to the rail top. Do not fasten it to the steadying clip, because this may pull off the rail, dropping the wire and causing damage or injury.

6. Repeat this procedure on each of the other rails in the rise.

7. At the bottom of the hoistway remove the weights from each wire, and thread the wire ends through steadying clips. Fasten the clips to the rails about two feet above the bottom.

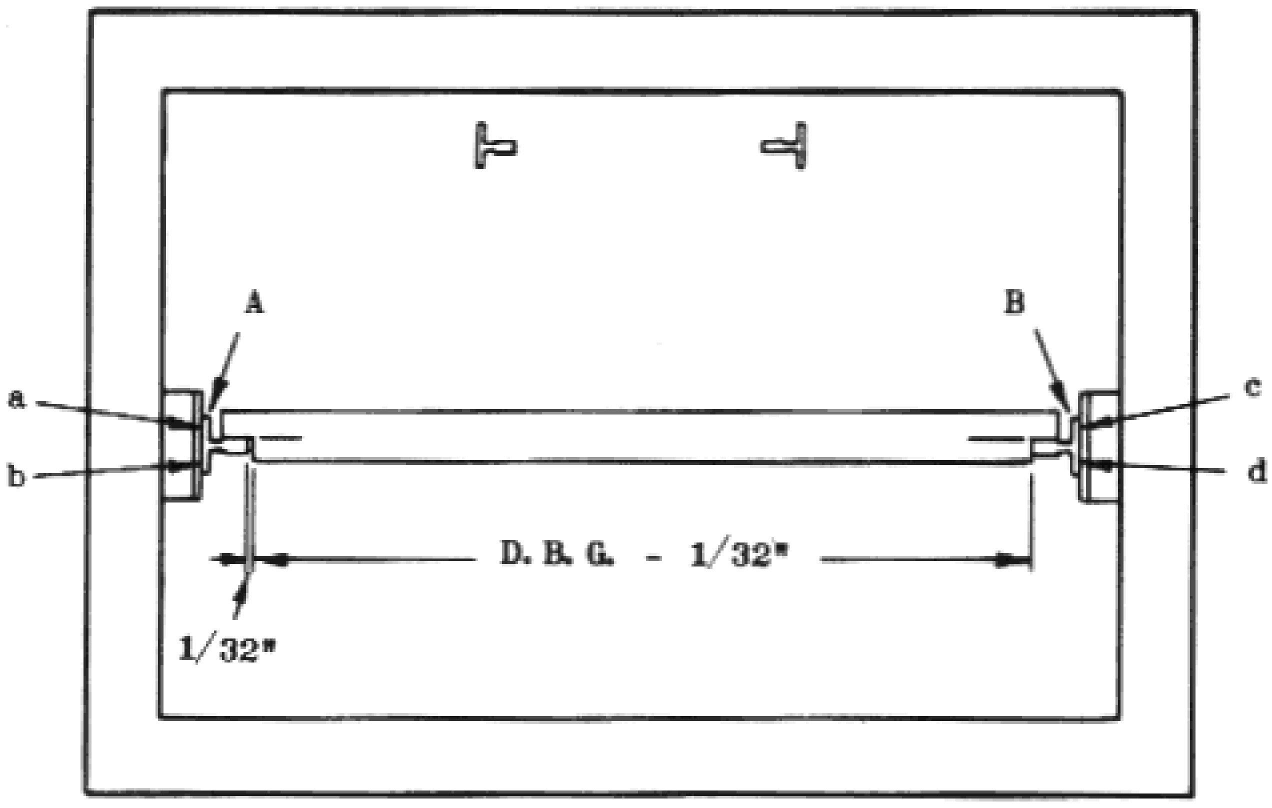
8. Hang heavy weights on the wires. (Some mechanics use piano wire on high rise jobs and install turnbuckles on them at the pit end instead of weights. Very tight lines can be obtained in this manner. It is especially good in open towers or very windy hoistways.)

9. All wires should then, if perfectly aligned, be suspended 1/2'' in front of and parallel to their respective rail faces, and exactly in the face centers for their entire lengths. The object of aligning the guide is to be as near to this condition as possible.

10. Starting at the top of the run of rails and working from a skip or scaffold, straighten one rail to the line from top to bottom. Then place a distance board between the main rails at the top brackets. (See sketch #1.) Since we have constructed distance boards as long as the distance between guides, less 1/32'' (or D.B.G. – 1/32'') there should be a clearance of 1/32'' between the distance board and ''A'' rails, if the board is held firmly against the face of ''B.''

11. The distance board gauges should be exactly on their own center line.

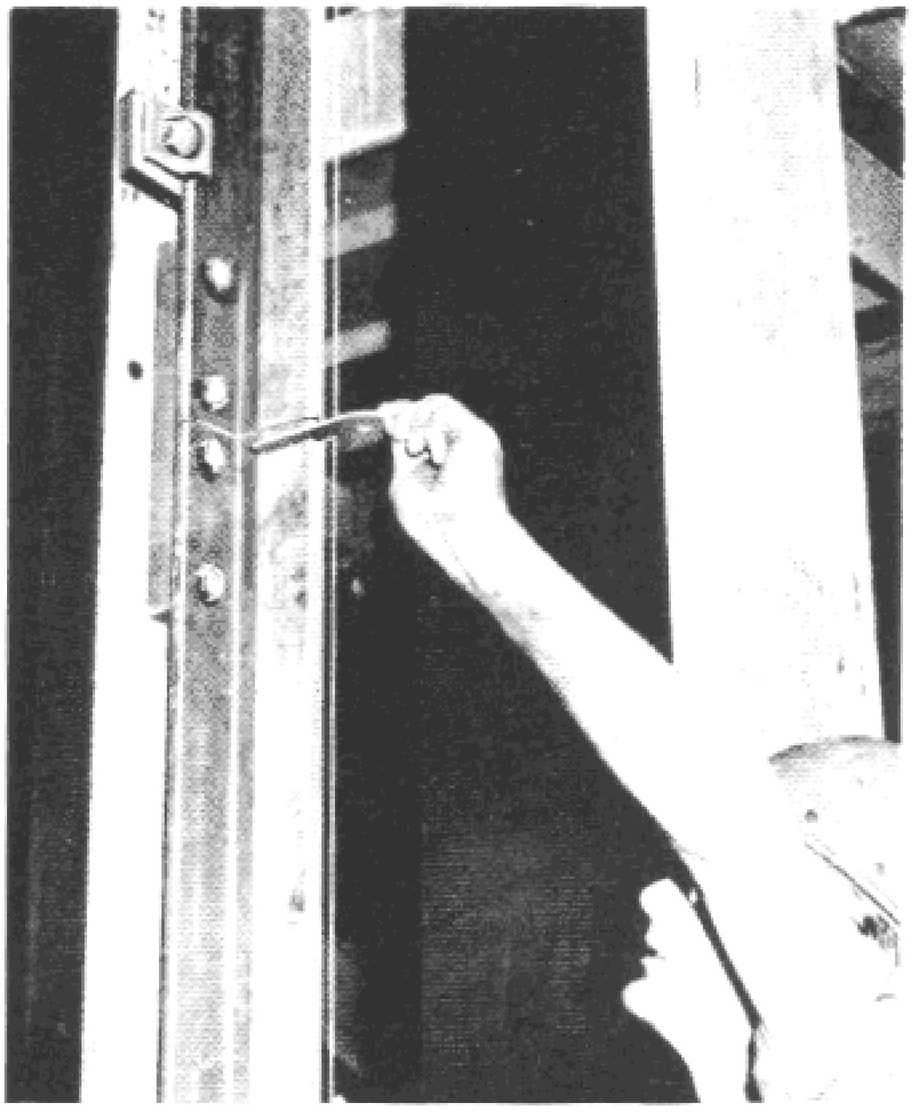
12. Should the distance board be tight or loose in the rails, remove or add packing between the second rail back and bracket until a 1/32'' clearance is obtained. Check this with a thickness gauge or 1/32'' steel shim.



Full-Width Plate Type Gauges Should Be Notched To Accommodate Wires (See 5 -f1, Sketch #2).

Sketch #1

13. If either gauge is off the center line, add packing at a, b, c or d to obtain a true center. It is sometimes necessary to remove one packing plate at, for example, a-b, and add a shim at either a or b to square the rail and obtain the proper DBG. If shims are used, the edges should be bent so they cannot fall out if a bolt should become loose.



Checking Rail Alignment To Plumb Wire With Gauge

14. After the rails have been set square and with the proper "D.B.G." at the top brackets, go to the pit and set the rails at the first bracket above the bumper channels.

15. Lay the distance board aside temporarily and, beginning at either the top or bottom of the hoistway, align all rails at joints and brackets to the plumb lines. This means that at each joint and bracket, shims or packing plates may have to be added or removed until the plumb wires are 1/2" from the faces of their respective guide rails. The rails may have to be moved from one side toward the other so the rail is centered on the line. This is accomplished by hitting the edge of the rail back with a heavy hammer.

16. Remove the plumb wires and clips.

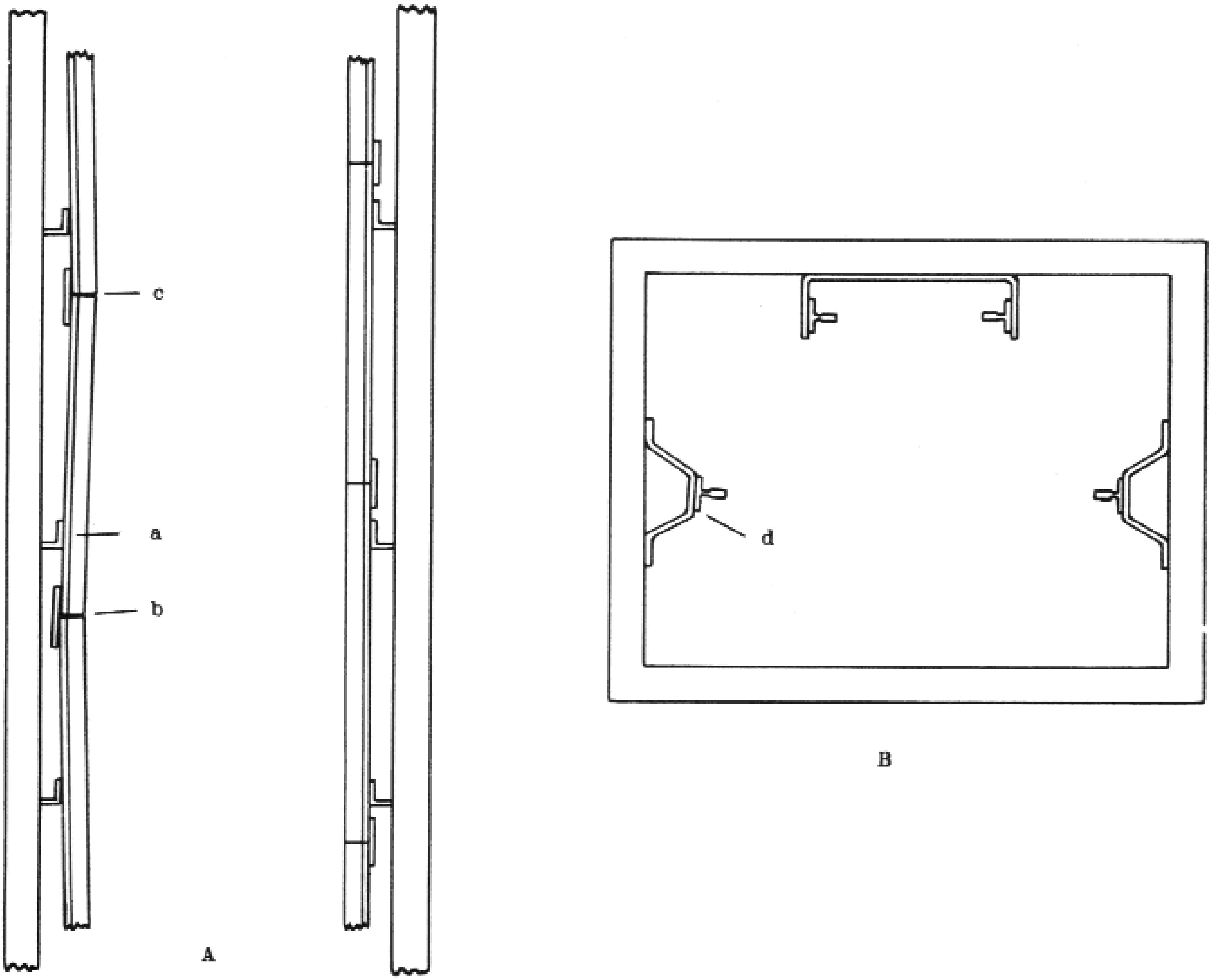
17. The rails are then plumbed or aligned and the approximate "DBG" has been obtained. Release the "skip" safety device and move the "skip" down to the next bracket or fishplate and repeat the original procedure, i.e., square the rail with the distance board. This not only assures the squareness but also the exact "DBG".

18. As an alternate to measuring with a rule to confirm the 1/2" distance from plumb line to rail, some companies use the plumb-line gauge illustrated in the photo. This gauge provides a convenient means of checking the distance and it also determines if the rail is square and aligned.

19. When aligning rails at a fishplate, it is extremely important to determine whether or not the rails are square. If they are out of square and the brackets above are trued up, it is generally advisable to check the bracket below before using shims at the fishplate. A slight error on a bracket often has a great effect on an adjacent rail joint. Sketch #2 illustrates several (greatly exaggerated) results of poor bracket installation.

20. Sketch #3 illustrates the methods of packing fishplates.

21. Obviously, therefore, a good rail installation is largely dependent on its brackets. When aligning rails, do not pack fishplates unless the brackets are reasonably square and plumb. Recheck brackets, if several consecutive fishplates cannot be aligned easily.



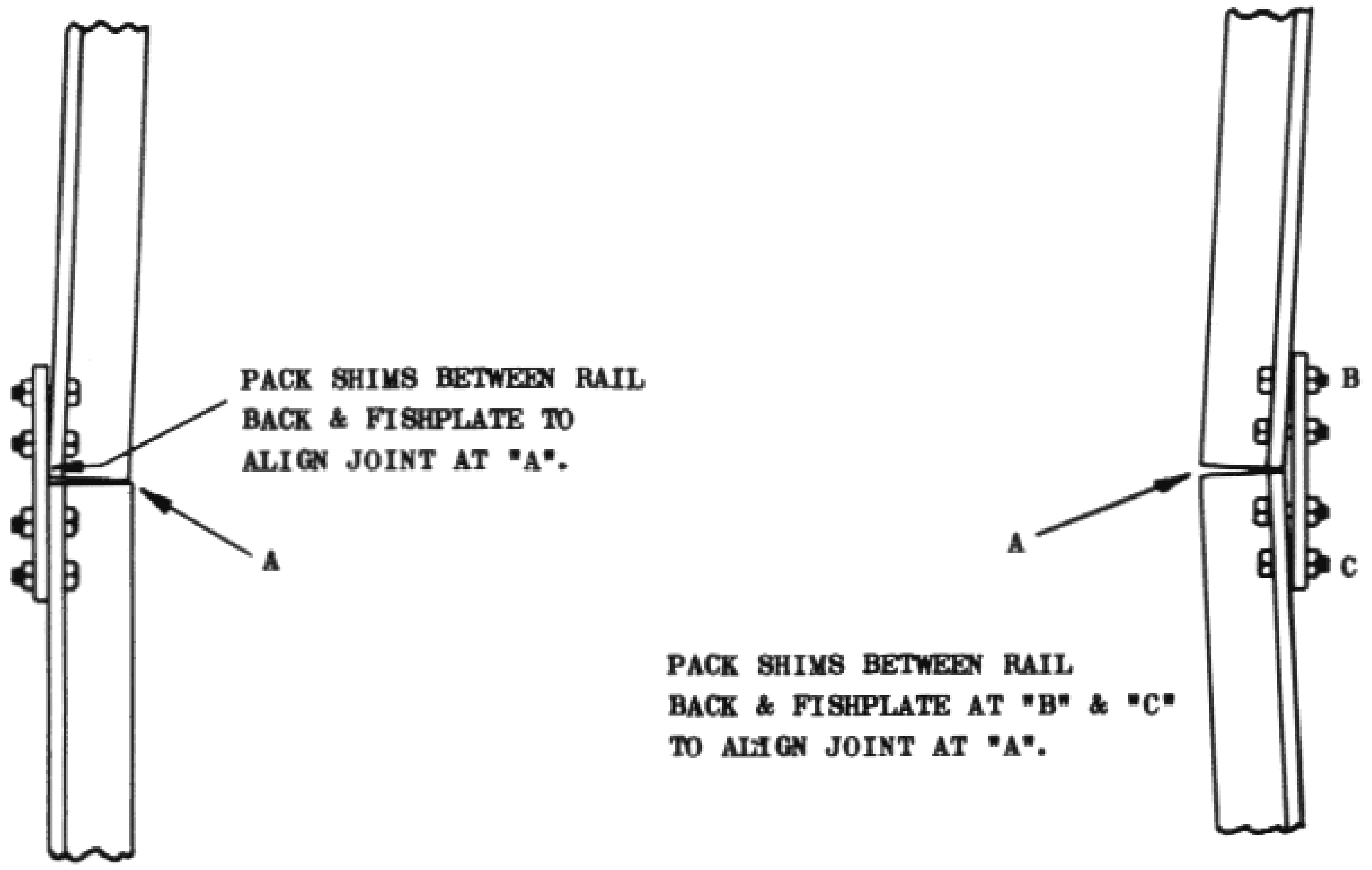
A. BRACKET OUT OF PLUMB AT "a" WILL RESULT IN DISTORTED RAIL JOINTS AT "b" & "c".
B. BRACKET OUT OF SQUARE AT "d" WILL DISTORT RAIL JOINTS ABOVE AND BELOW.

Sketch #2

22. Work all brackets and joints in sequence. The alignment can be done in the down direction by beginning from the top pair of brackets or in the up direction by starting from the pit, but the work must be done systematically in one direction.

23. An inexperienced mechanic may find it easier and better to set his "DBG" on the first top (or bottom) bracket, then completely align and square one rail to its extremity. He may then return to opposite rail, and more easily align it to its mate.

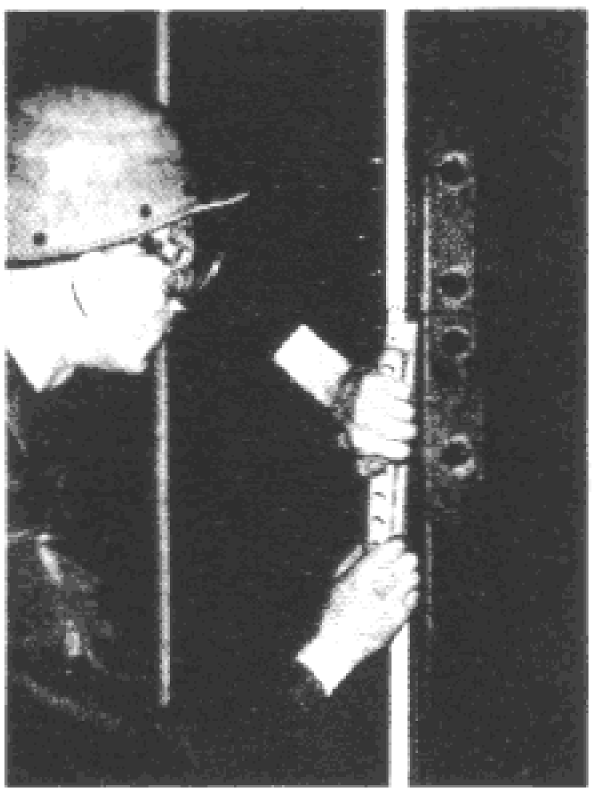
24. After each joint or bracket is aligned, the bolts must be tightened with a socket, box or open-end wrench, the handle of which should be at least 12" long. After all



Sketch #3

rails are aligned, it is advisable to hammer-test all bolts in a run of rails. Tighten all loose bolts.

25. Sometimes it is necessary to align rails in sections on high-rise installations. That is, align from the pit to the tenth floor, then from the tenth to the twentieth floor, and so on. This is a common method when elevator mechanics follow closely behind the steel men. In such cases, it is important to overlap the alignment by setting lines from pit to the tenth, then change the lines to floors eight to twenty, then eighteen to thirty. This method ensures that each rail section will align with the preceding one.



Long Strokes With The File Produces Smooth Joints

26. As guide-rail joints are aligned and squared, at the fishplate, they should be filed smooth to eliminate any possible knocks. A steel straightedge at least 36'' long should be used to check the filing. Set the straightedge on each of the three sides of the guide rail surface. Use long strokes with the file. When completed, there should be no appreciable hollow space between the rail and straightedge.

27. A vixen file is recommended for this work, but care must be exercised with it because of its fast cutting properties. Vixen files should be mounted on flat surfaced holders such as the one shown in the photo on the preceding page. The holder reduces the chance of hand injuries and also assures that the file will plane the rail smoothly. We emphasize that ''hollow'' cuts are to be avoided. They create car sway and, if deep, rail bumps or knocks.

28. Wash down the rail riding surfaces. Cotton waste soaked in kerosene, followed by emery paper may be used, if the rail condition warrants it. A final cleaning is always necessary when the installation is about completed.

29. Where rubber-tired roller-guides are used, the rail blade surfaces must be left free of oil.

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CHAPTER 6

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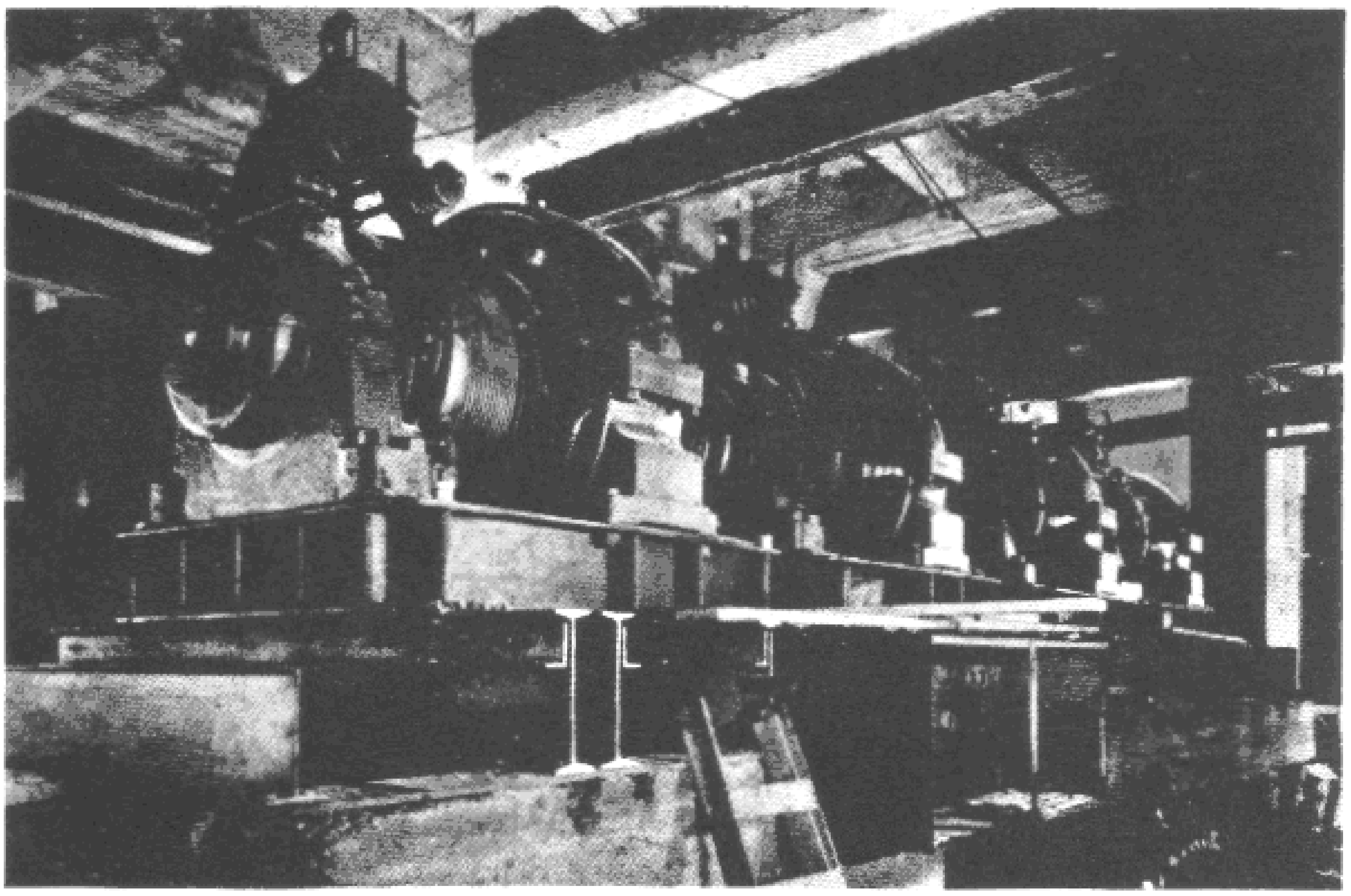
CHAPTER 6
Section -a1

MACHINE ROOM AND OVERHEAD WORK

General

1. The draftsman of an elevator contractor shows the size and general arrangement of the machine room and overhead on the layout. He works from architect's and building engineer's plans to show these areas, usually to scale. Approximate locations of the elevator equipment are also shown.



Gearless Machine Arrangement—Note Supports, Beams, Shelf Angles and Conduit Box

2. These layouts are made to conform to the A.S.M.E. Safety Code and codes of governing bodies in the United States and Canada as well as some overseas countries. Code requirements for overhead and machine rooms of elevators are not consistent and even where they exist, there may not always be a governing body to assure that the code is adhered to.

3. The American Safety Code outlines overhead and machine room requirements in Rule 101 of the 1960 edition. Some of the more important stipulations are that enclosures be of fire resistant materials, that adequate access be provided and elevator equipment shall be partitioned from other building equipment. Hydraulic elevator machine room requirements must conform to Rules 101 and 300 of the

safety code. Enforcement of these requirements is not the responsibility of the elevator constructor.

4. Although Rule 105 of the safety code does not require that beams must be used to support elevator machines, it is common practice to provide steel beams for this purpose in North America. In our opinion, their use tends to provide a better working sequence and reduces the need for a heavy concrete floor slab to support loads imposed by the elevator equipment. Most other countries use steel beams under large gearless machines but some omit them under small gearless and most geared elevator machines.

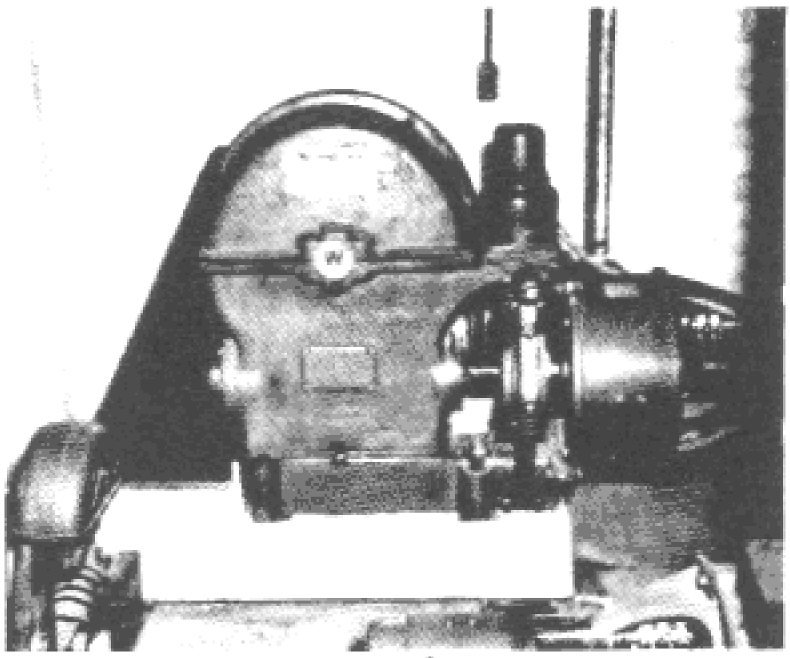
5. This variation automatically introduces diverse construction practices. Where steel machine beams are used with machines above it is customary for the builders to leave out the overhead concrete slab until machine room equipment has been hoisted and beams set. In some European countries the builder often pours the concrete before the elevator contractor has material on the jobsite. This makes it necessary to have the layout marked up to indicate locations for holes for ropes, tapes, conduit and similar items so wood blocks can be nailed in the concrete forming to provide the holes. Frequently the holes do not align exactly once the rail plumb lines have been established, so the holes have to be enlarged. Floor patches become necessary. Also the architect and contractor are expected to provide a hoisting trap door or hatch in the machine room floor so machine room equipment can be hoisted to the top landing, then transferred to a second hoist to be lifted to the machine room.

6. Obviously it is not common sense to have expert factory assemblymen carefully align a geared machine, then have the field men disassemble the machine, transport it up a stair, then reassemble it under field conditions and with men less trained for machine assembly. Thus it becomes mandatory for the trap door to be provided in the machine room floor. Extra expense for owner and elevator contractor results.

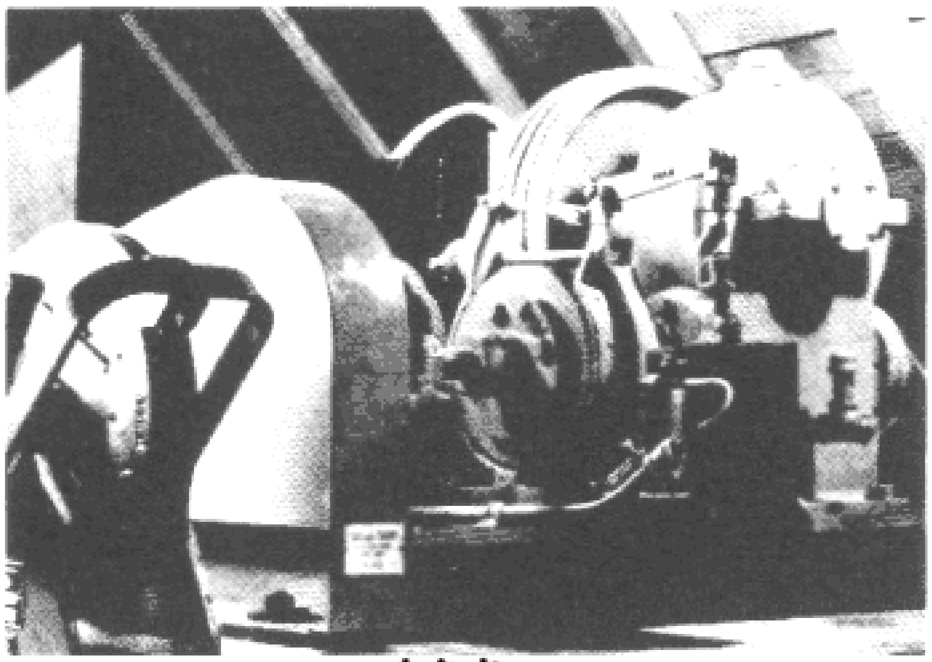
7. While we believe the use of steel machine beams is both practical and economical, European companies appear to find the contrary to be true. The decision as to which method to follow is commercial in aspect and is the prerogative of the architect, the elevator and building contractors working within the terms of the building specifications.

8. Aside from the machines and sheaves, there are a number of other elevator components in the overhead and machine room. These include controllers, selectors (or floor controllers) relay and dispatch panels, motor generators, overspeed governors, P.A. system controls and other accessories as well as considerable wiring. These items are located by the draftsmen. They are placed on steel or concrete in accordance with job ''specs'' and details, and some are sound isolated.

9. Wire conduit or troughs should be run before the concrete floor is poured, as a general rule.



Westinghouse



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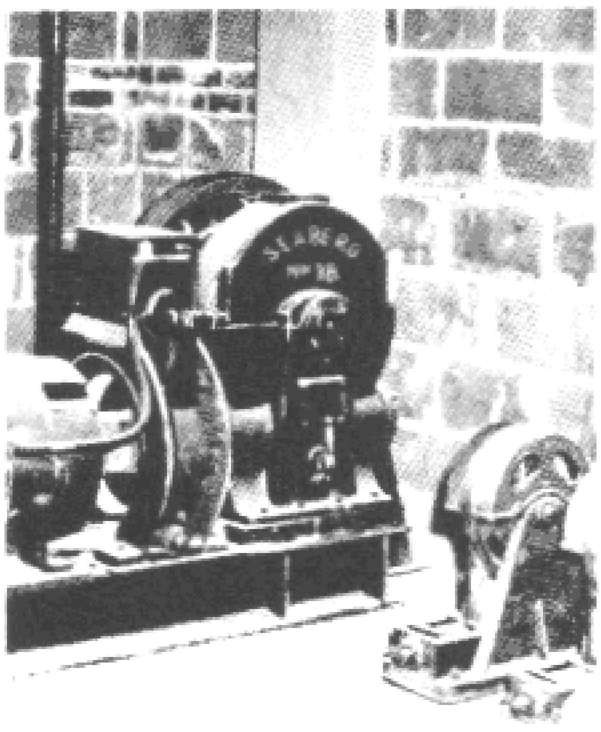
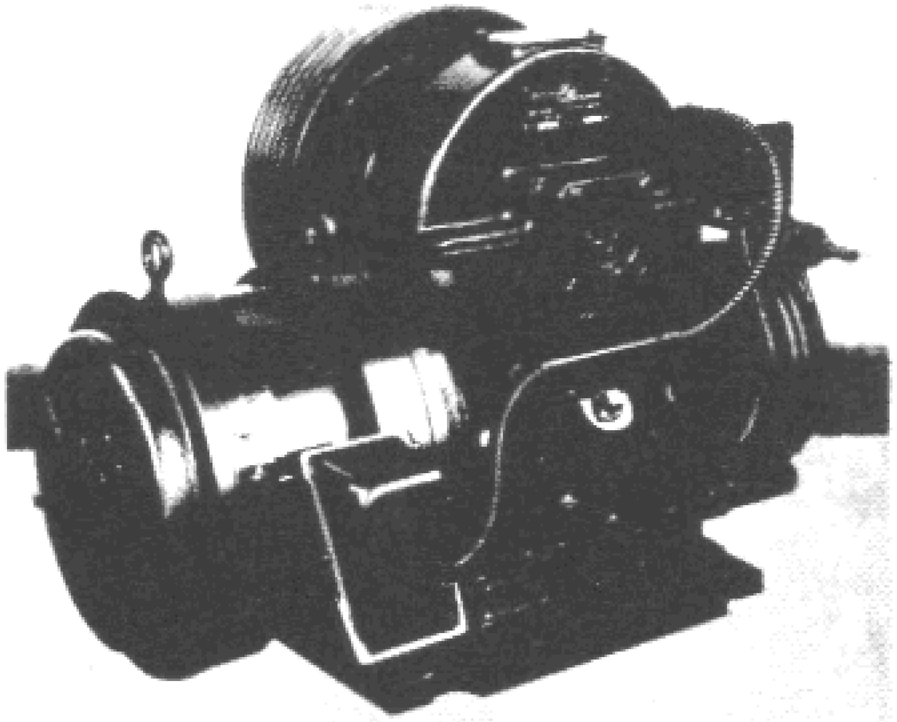


Seaberg



Montgomery

Four Types of Geared Elevator Machines

CHAPTER 6
Section -b1

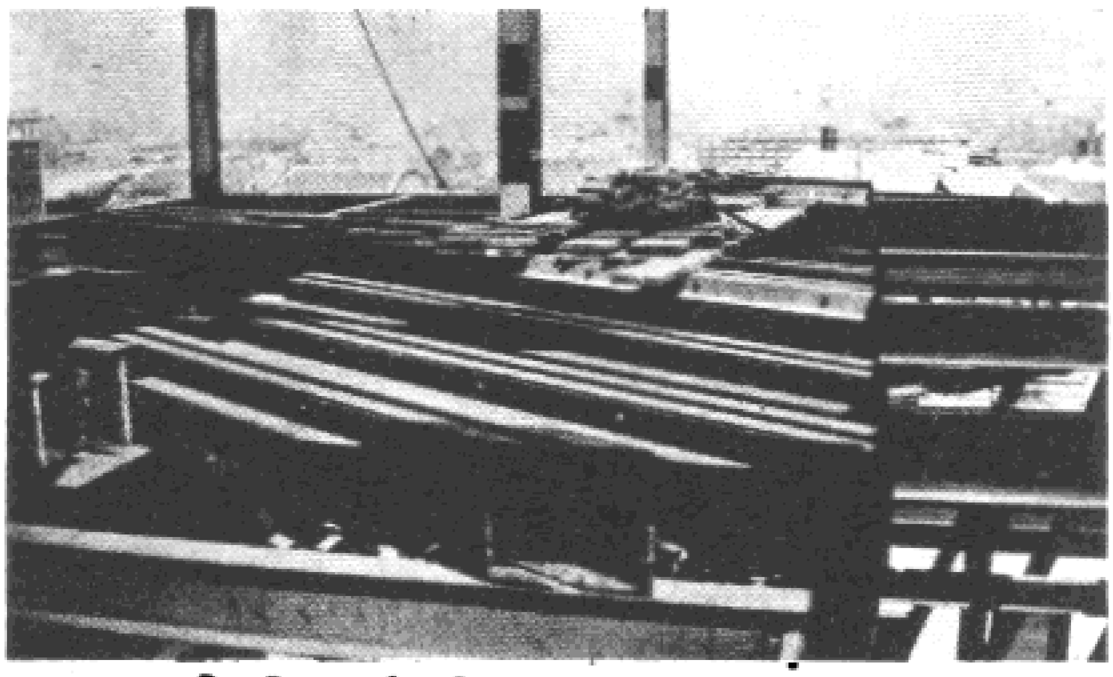
MACHINE ROOM AND OVERHEAD WORK

Beam Types

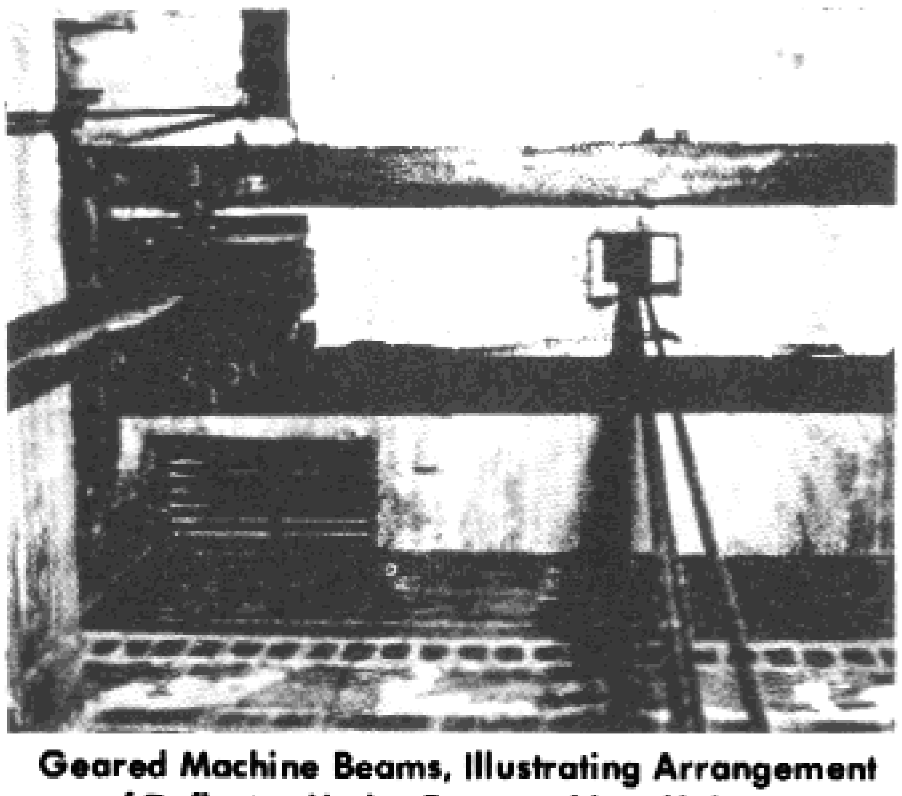
1. The only materials currently used for elevator machine and overhead beams are steel and concrete. The concrete must be reinforced with steel. Its use requires that care be exercised to get bearing surfaces smooth and on the same plane for

both machine and secondary types of sheaves. Shims can be used to compensate for minor differences. It is more difficult, in general, to provide anchors for bolts in concrete beams than it is in steel. It is also more difficult to get exact alignment between beams and guide rails.

2. In spite of these drawbacks, there are many countries in the World where steel is a scarce and very expensive commodity. Most of these countries must import the rolled steel shapes and, therefore, must expend hard earned foreign exchange for them. Because of these conditions, such areas form building structural parts of reinforced concrete. Not only machine beams but separator beams, buffer structures and other parts that we normally build of steel are made of reinforced concrete.



Box Beams for Gearless Elevator Machines



Geared Machine Beams, Illustrating Arrangement of Deflector Under Beams—Note Hoistway Ventilating Grill in Lower Left Corner

3. Concrete beams are designed by engineers. Although basic formulas are reasonably universal, interpretation of them is not. As a result, while concrete beams about 8'' wide and 12'' deep are commonly used in many areas the Brasilian practice is to use beams only about 4'' wide and as much as 24'' deep.

4. Steel beams also differ in section. The ''I'' beam has been the most widely used for geared machine beams over the years. Recently ''H'' beams have become popular for some installations, even on gearless machine units where ''box'' beams were formerly employed. Box beams are usually formed by bolting channels together with the flanges facing each other. Fixed spacing is maintained by means of ''spreader'' or spacer pipes between the channels. The bolts pass through the pipes. Angles are used for beams on some small elevators and dumbwaiters.

5. Auxiliary beams, such as those used to support small pulleys, safety governors, controller legs, and other non-load bearing equipment, are often of angle or fabricated steel.

6. All load-bearing beams should be designed by engineers, not construction men. Draftsmen generally calculate beam sizes based on engineering data. The only responsibility the elevator mechanic has in regard to this is to be sure that the beams supplied correspond to those specified on the final layout and shipping notice. If they do not, he should consult his superintendent before using them.

7. For jobs with steel machine beams, the conventional procedure in elevator installation is to set the machine beams and machine room equipment, after the rails are stacked and aligned.

8. Usually the overhead sheaves, both driving and driven, are all supported on the beams. Because of this, the beams must be carefully set and definitely aligned in relation to the car and counterweight guide rail centers.

9. All beams of the various pairs or sets for a particular machine or sheave must be aligned and leveled with each other. Determine the location of the sheave centers in relation to the beams and plumb these points to the desired positions in relation to the guide rail centers, before securing the overhead beams in place.

10. Machine types are now quite generalized as drum, geared traction, or gearless traction. Hydraulics are also installed but the great majority of machines now built are of the traction types. Regardless of the machine type, some overhead construction work is usually required. This applies even to small underslung elevators where the ''overhead beams'' may consist only of channel or angle sheave brackets that are bolted to the rails. ''Hydros'' can be an exception.

CHAPTER 6
Section -b2

MACHINE ROOM AND OVERHEAD WORK

Steel Structures — Machine Beams

Suggested:

Materials —
a. sundries

Tools —
a. hand tool kit
b. rollers
c. crowbars
d. planks and wood blocks
e. 24'' level
f. chain hoists
g. pullers
h. dollies and pry dollies
i. arc welders
j. rigging accessories

1. Clear the hoistway of all men, before beginning to set overhead beams.

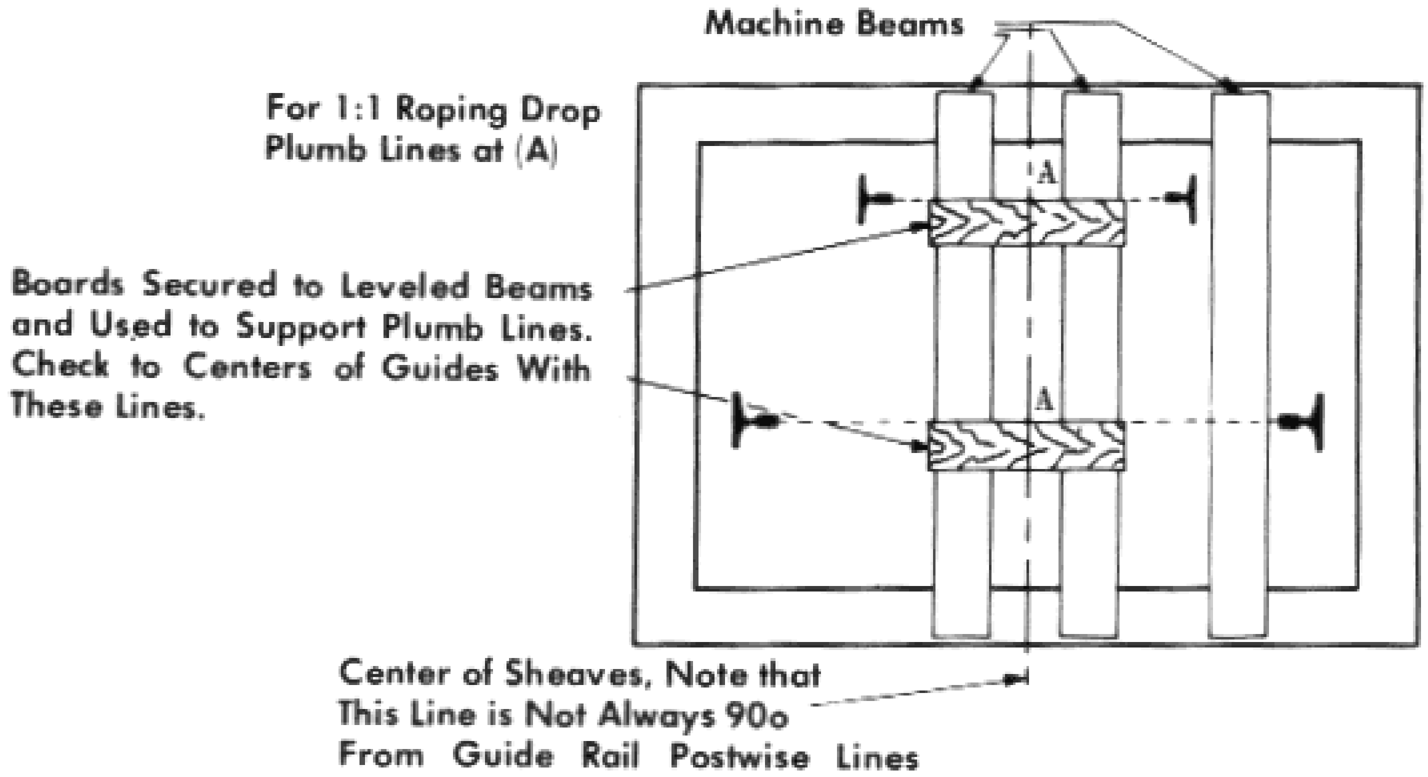
2. The procedure of the work is considerably affected by field conditions. Often the biggest problem is that of storing the machine until the beams are set and the machine room concrete floor is ready. Where space conditions permit the machine to be stored in the machine room clear of the hoistway, it is very simple. If space is limited, some mechanics follow the practice of hanging the machine above the beams on a chain hoist until the slab (machine room floor) is ready. This practice is satisfactory only if timber shoring or blocking is also placed under the machine. Thus the chain hoist acts as a safety feature only. Another method is to hang the machine only until the beams, which should be drilled and indexed in advance, are slid under it and set, and secured at the pre-marked locations. (Beams can be secured by means of clips, through bolts or welding in accordance with standard practice of the company you are working for.) The mechanic then places a blocking frame and the sound reducing on the beams, and lowers the machine into place immediately. This permits him to run conduit and go ahead with other work, disregarding when the slab is poured.

3. Usually beams can be slid across one corner of the hoistway and then dragged into place. If this cannot be done, rig a chain hoist or a rope tackle.

4. After the beams are in their approximate positions, examine the final layout to determine exactly the location of the beams in relation to the main guide rail centers and the drive sheave center. Estimate where the sheave center will lay between the beams. Place a guide rail aligning clip on each rail, level with each other and near the top. Cut a 1'' x 6'' (approximate) board equal to the ''DBG'' in length. Jam it between the rails so that it just rests on the clips. Mark the exact center of the

"DBG" on this board. Arrange a similar board for the counterweight guides, also.

5. Temporarily level the beams, using full width steel shims, if any are necessary. Put a short board across the beams at the car lead of the sheave center point. Drop a plumb line from the board to the desired location on the guide rail, postwise line. (See sketch #1.) This may be the center of the "DBG," as for most cars roped 1:1, or it may be some inches off center as for 2:1 cars. "Double wrapped" roping on gearless units throws the rope lead off center about half the diameter of the rope. Check your layout for the exact amount.



Sketch #1

6. Plumb down for the counterweight guide rail end of the beams in the same manner. In the case of double wrap traction machines, be sure to allow for the "pull-off" of the secondary sheaves as indicated on the plan-view of the final layout, just as was indicated for the "car drop" in paragraph 5.

7. After the beams are aligned with the sheave and guide centers, check their levels once again. Check the positions of the beams in relation to the machine bedplates, tie down or kickplate bolt holes, also.

8. Secure the beams to the building structure. Present day methods of doing this are to weld or drill through the flanges of the machine beams and building supports, and through bolt them. If one of these methods of fastening is used, there is no chance of the beams slipping during the grouting in, or at any other time. If no grouting is to be used, the beams must definitely be through bolted or welded.

9. Where the machine is arranged to be set directly on the beams or on a frame, this work may now be done. Where the machine is stored to one side or suspended for mounting on the concrete slab, nothing further can be done until the concrete forms have been built, the slab poured, and set. Do not place the machine on the slab before the building superintendent or concrete engineer authorizes it. They generally require 6 to 10 days drying time before permitting the slab to be loaded.

CHAPTER 6
Section -b3

MACHINE ROOM AND OVERHEAD WORK

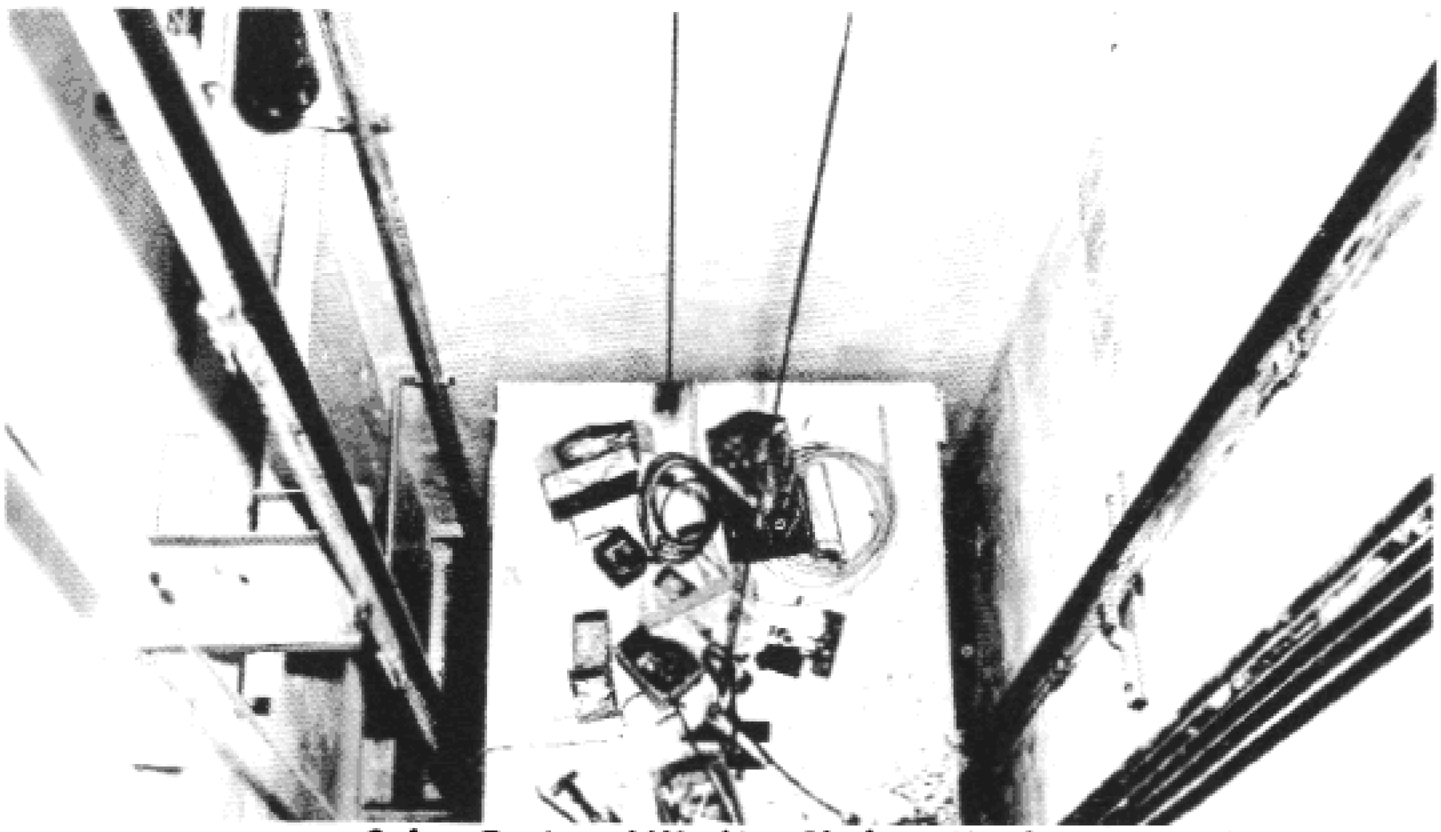
Concrete Structures – With or Without Steel Machine Beams

Suggested:

Materials –
- a. self-drilling anchors
- b. washers
- c. bolts
- d. shims

Tools –
- a. hand tool kit
- b. electric hammer
- c. chucks for anchors
- d. wood saw

1. New methods of using concrete for building construction are being devised constantly. Some of these apply to our work. For example, in a recent housing development, in France, the general contractor used pre-cast concrete for wall panels and floors. In conjunction with this, the elevator mechanics installed the machine room equipment on the pre-cast machine room slab while it was lying on



Safety Equipped Working Platform Used to Install Rails in Concrete Hoistway

the ground. The building crane was used to lift and place the entire assembly under the elevator foreman's direction.

2. Normally, application of elevator equipment to concrete structures is not quite so radical as this French innovation. (Although we must keep in mind that what is common practice today was radical a few years ago. Welding applied to elevator field work is an example.)

3. On a world wide basis we install elevators in concrete structures under three general conditions. First is the concrete framed arrangement or full concrete hoistway where we install steel beams to support our machines. The procedure is almost identical to that described in 6-b2, and preceding articles. An exception is the use of bearing plates. The tops of the concrete supports for our machine beams must be reasonably smooth, of sound and reinforced concrete and level with each other. On the supports we lay steel bearing plates. These are usually 1/2'' x 6'' in section and as long as necessary to span the machine beams and distribute the load. The bearing plates are leveled with each other and the beams are then set in place on them. Once the beams are located properly, the entire area is filled with concrete. Generally, the floor slab is poured at the same time so it is necessary to put blocking in the forms for rope, tape and conduit holes.

4. The second method we follow in concrete structures is more common outside this continent than it is here. Essentially it is to have the contractor provide the machine beams of reinforced concrete. The most efficient manner of doing this is to have the beams and floor poured after all our equipment is hoisted into the machine room. Where this delay of pouring cannot be arranged there should be a hoisting trap door provided between the machine room and top landing so machine room equipment can be hoisted conveniently.

5. The chief difference between supporting our equipment on concrete beams rather than steel lies in the area of leveling the machine (i.e., plumbing the drive sheave) and also securing the machine in position with bedplate bolts, tie downs or kick angles. On steel we can use welding, clips or through bolts. On concrete we must install anchors of some kind or through bolts through the concrete itself. This can be slow, hard work.

6. The other common method of installing elevators in conrete structures is to set the machine directly on the reinforced concrete machine room floor. This is used to some extent in the United States and Canada especially for dumbwaiters, but it is more popular in Europe and some parts of South America. It is actually a variation of the practice of setting machines on concrete beams since the floor is designed by the concrete engineer to sustain the anticipated loads. The floor becomes the supporting beam in effect.

7. In this type of construction the floor is often poured before our equipment is delivered and the problems are similar to those described in paragraphs 4 and 5 of this article.

8. Controllers and other equipment are generally fastened to the concrete floor by means of anchors and bolts.

CHAPTER 6
Section -b4

MACHINE ROOM AND OVERHEAD WORK

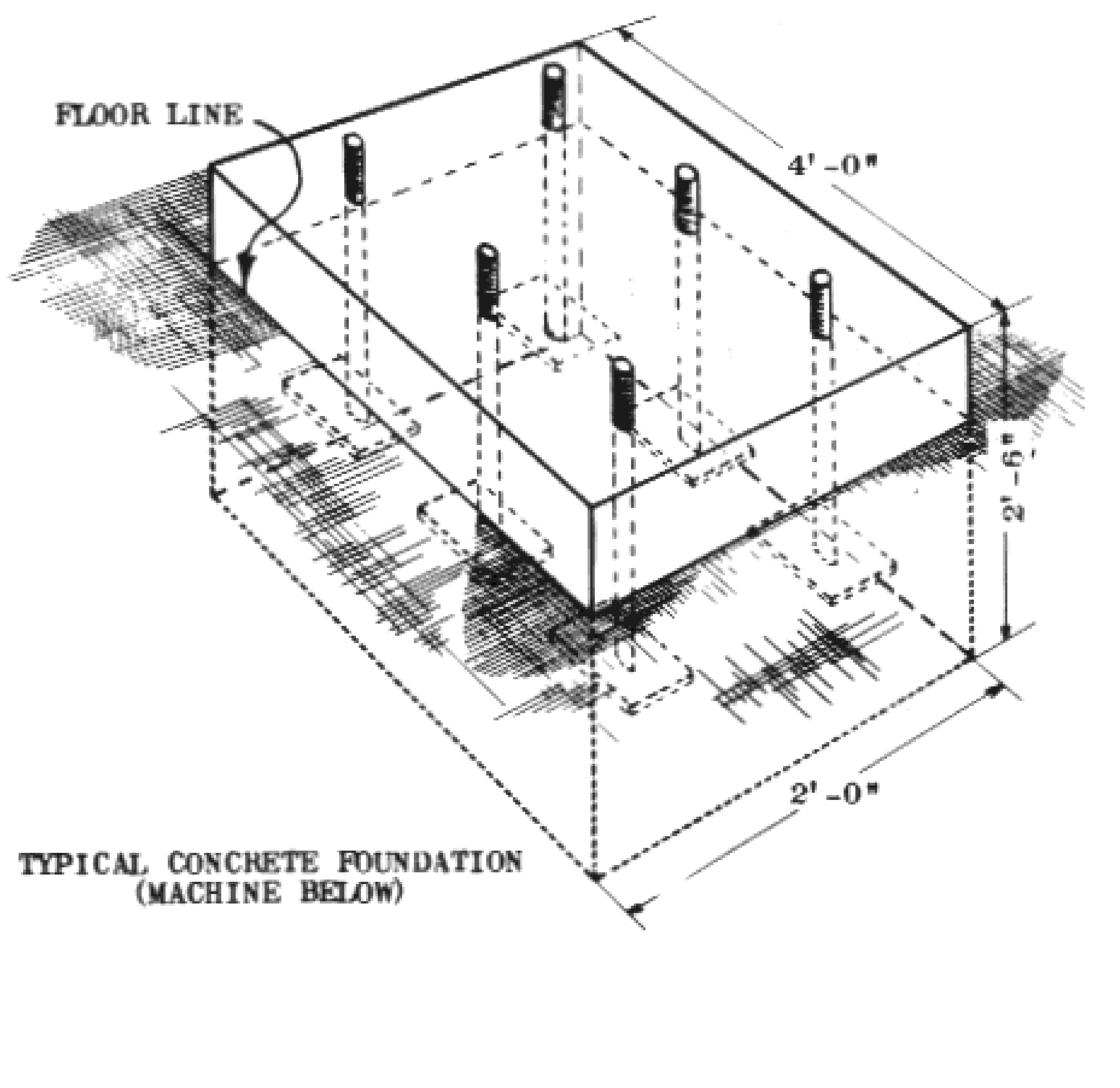
Machine Foundations – Machine Below

Suggested:

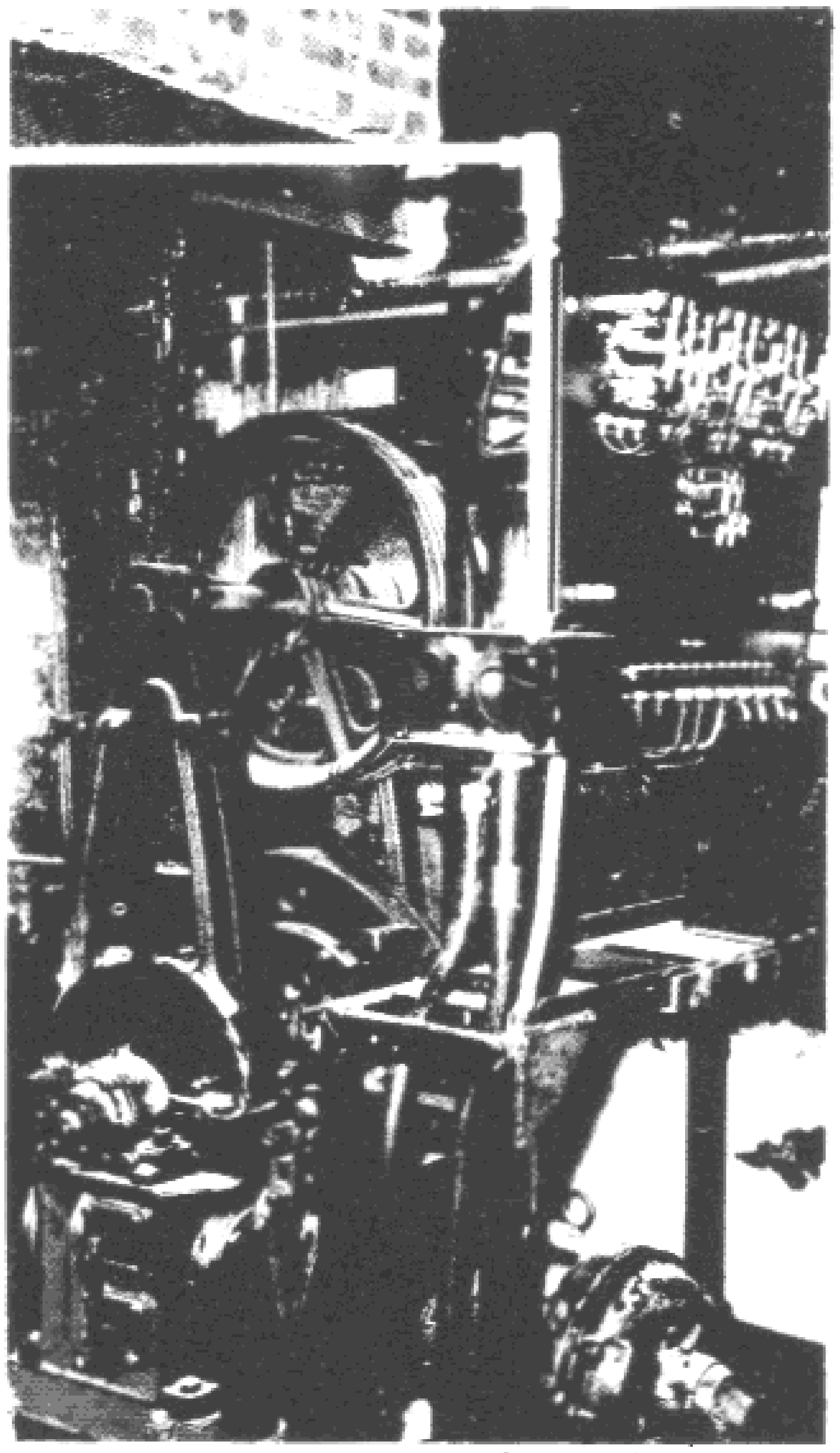
Materials –
- a. flat iron or special washers
- b. binding wire
- c. wood for template
- d. bolts

Tools –
- a. hand tool kit
- b. wood saw

1. Essentially the weight on an overhead machine is in the downward direction. On a basement machine almost all the pull or "thrust" is upward. For this reason, a basement machine needs a foundation or anchor heavy enough to resist the up-thrust of the entire loaded elevator, plus "impact" that may result from an application of



Sketch #1



Basement Machine and Controller — Note Deflector Mounted on Machine

the safety. The responsibility for the size and type of this base is the designing engineer's. The mechanic is merely to follow the instructions given on the final layout and detail drawings.

2. Although beams or steel frames are sometimes used for basement machine foundations, they are customarily of reinforced concrete. Generally, the concrete is poured by the building contractor. He also builds the forms and installs the reinforcing. Proper specifications should be examined to be sure that this meets all requirements.

3. The elevator constructor must set the foundation bolts in place before the concrete is poured. This is done by first preparing a wood template. Any substantial size of reasonably clear boards can be used, but 1'' x 4'' is handy to work with. The template is made to approximate the machine bedplate shape. It is drilled where the foundation bolts are to be installed. The center of the drive sheave is indicated on the template.

4. Pipe spacers the thickness of the bedplate are made. The foundation bolt washers are installed on the bolts, and placed in the template. The pipe spacers, nuts and lock nuts are put on the bolts.

5. The template is set in place in the wooden foundation form. It is aligned to the guide rail face and centered, blocked and fastened, so that it cannot move when the concrete is poured. The bolts are secured to the reinforcing rods with binding wire at a few points. It is possible to do this without throwing the bolts out of plumb.

6. When the concrete has been poured and set, the building superintendent or architect should give approval that the concrete is ready, before the machine is set on the foundation and bolted in place.

7. Most companies cast or fabricate bedplates so that the foundation bolt holes have a little clearance to permit shifting the machine for alignement.

8. Always use cut washers and lock nuts on foundation bolts.

CHAPTER 6
Section -b5

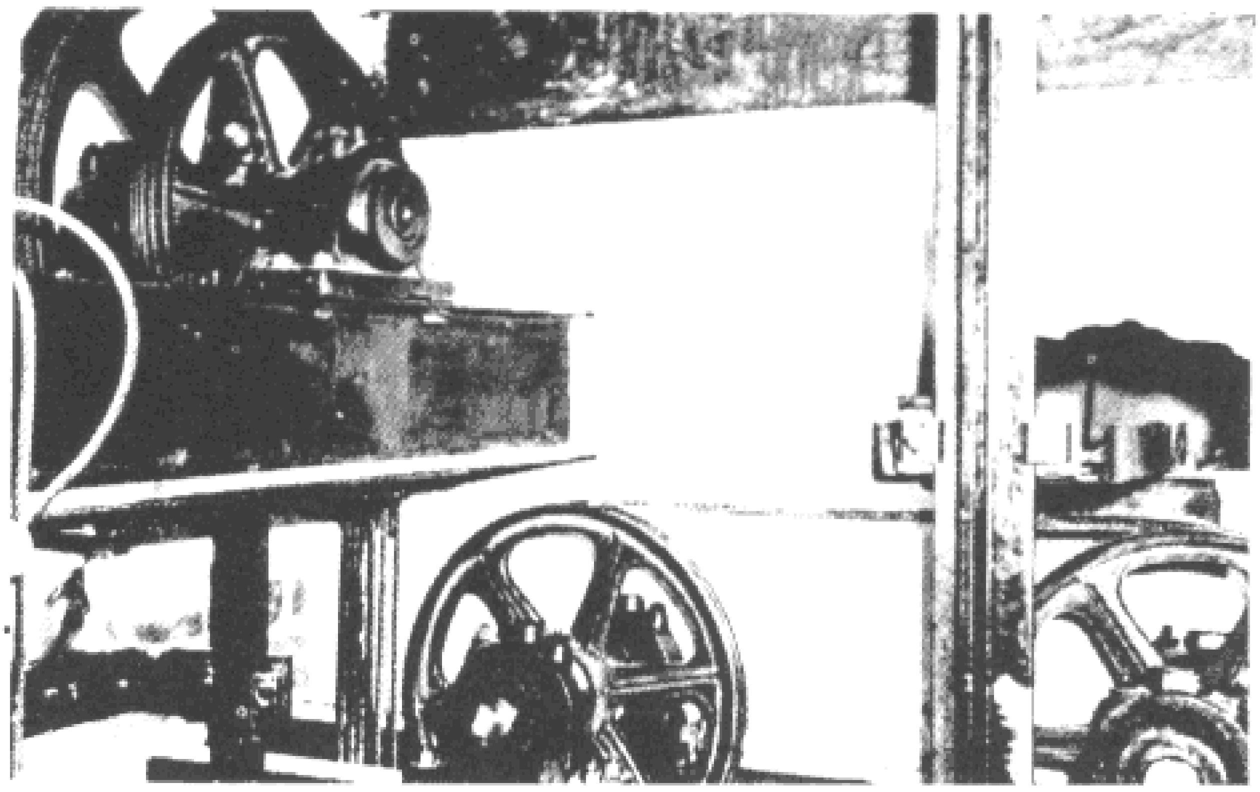
MACHINE ROOM AND OVERHEAD WORK

Installing Overhead Beams – Machine Below

Suggested:

Materials –
a. bolts
b. washers
c. sundries

Tools –
a. hand tool kit
b. electric drill
c. burning outfit
d. welder
e. electric hammer
f. straightedge



Arrangement of Overhead Beams and Sheaves for Machine Below with Underslung Car

1. The ideal condition for the overhead work of a basement machine would probably be one where the overhead sheaves were plumb aligned to the drive sheave and deflector sheaves of the machine. Generally such a condition is not possible.

2. On installations with 1:1 roping, the overhead beams are mounted to obtain a plumb lead from the car sheave center to the car hitch. The lead to the center of the drive sheave is kept as plumb as possible without causing interference with the lead of the ropes from the counterweight sheave to the deflector in the machine room.

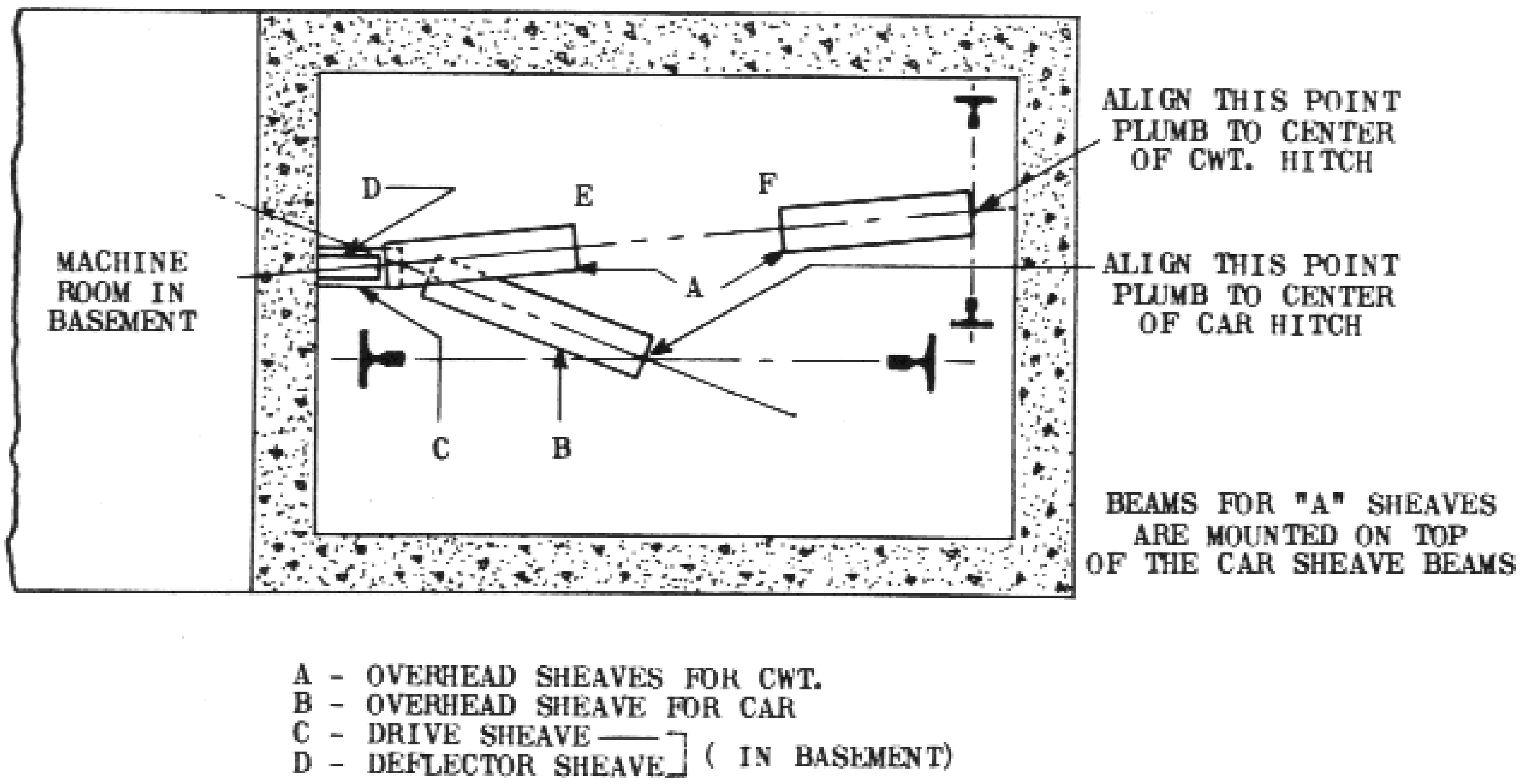
3. A study of sketch •1 will make this quite clear. Bolt, or weld (do not clip), all beams to the building steel. In the case of masonry walls, the beams are grouted in.

4. Make all pairs of beams parallel and level.

5. Use flat steel plates for beam bearing points on masonry walls. "Kick angles" should be installed to prevent the beams from shifting. These are bolted or welded to the overhead beam flanges and also bear against the masonry.

6. One end of each counterweight sheave beam is often mounted on the car sheave beams or framed into them. The factory, as a rule, supplies blocking, to provide clearance between the car and counterweight sheaves, if this is needed.

7. To install the sheaves, first set them in their approximate location on the beams. Plumb the car sheave center to the car hitch. Do the same with the counterweight sheave. If necessary, shift the sheaves (and bearing stands) slightly away from each other at the machine end to provide clearance of at least 1" between the rope leads. Do not exceed 1/8" to a foot of "pull-off" from a plumb lead. If two sheaves are used in line as "E-F" of sketch #1, align them with each other by means of a straightedge or string, while at the same time maintaining their plumb drops to the points below.



Sketch #1

8. Sheave alignment for underslung elevators presents more problems in alignment and clearances than those for 1:1 or even ordinary 2:1 jobs. Layouts and hoistway conditions for these jobs must be studied very carefully.

CHAPTER 6
Section -c1

OVERHEAD WORK

Installing Machines — Geared

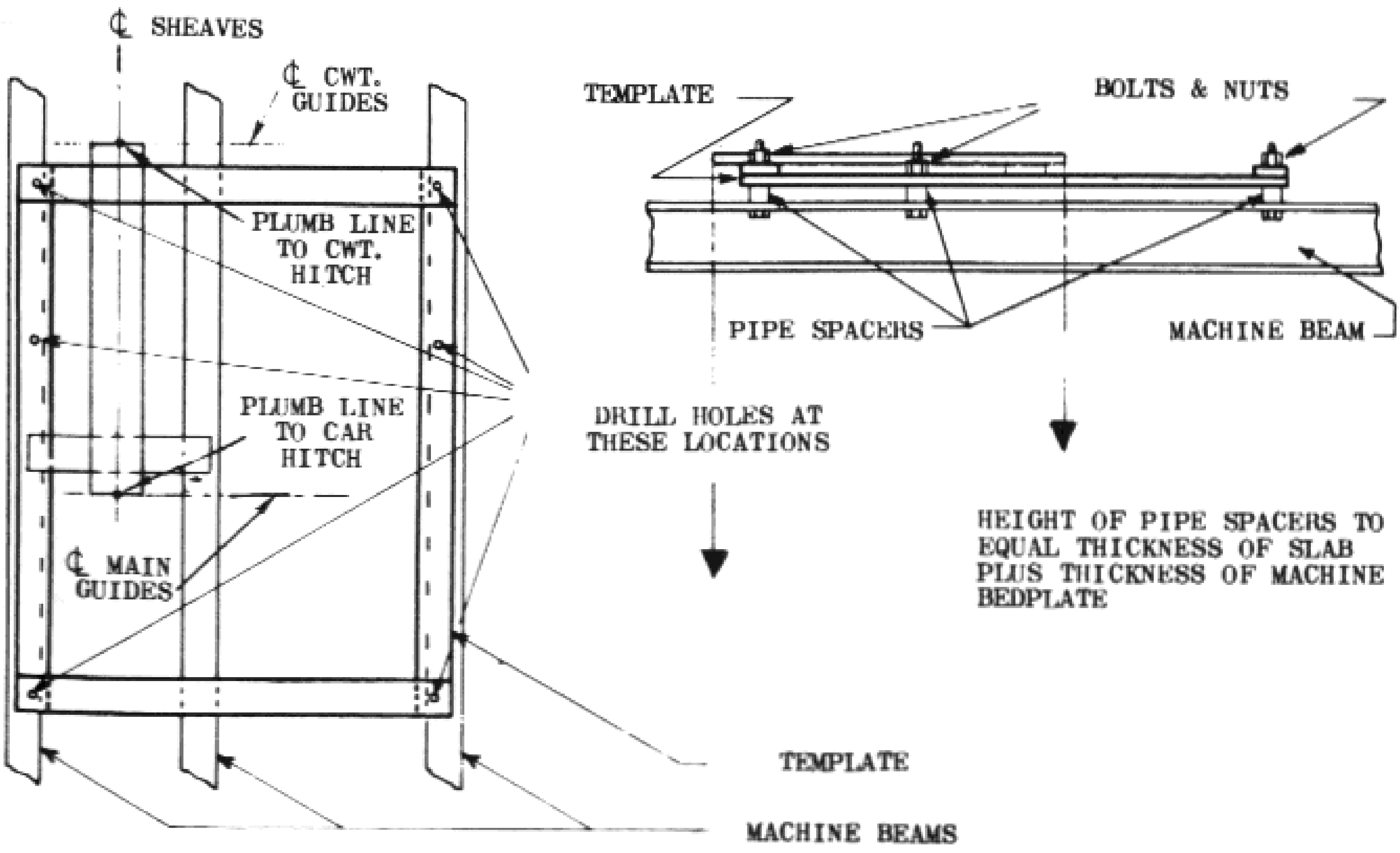
Suggested:

Materials —
- a. sundries
- b. steel shims
- c. sound reducing pads
- d. graphite

Tools —
- a. hand tool kit
- b. level (12" or larger)
- c. rollers
- d. planks
- e. crowbars
- f. welders
- g. electric drill

1. Once machine beams have been set level and secured, study the final layout to learn what type of fastenings are to be used for the machine. These may be tie down bolts, kick angles and/or sound reducing arrangements.

2. If a slab is to be above the beam tops and tie down bolts are to be used, make a wooden template the shape of the machine. A separate drawing or sketch should be



Sketch #1

provided by the company for the template. Establish the location of the bolt holes by laying the template on the beams and aligning it to the rails. Then drill the beams. Set the template on the machine beams with the tie down bolts in place in it and spacers on the bolts between beams and template. (Refer to sketch *1 on preceding page.)

3. Get blocks of wood for locations of machine room conduit or troughing, rope and tapes in place, after the carpenter builds the forms. Then have the contractor pour the floor slab.

4. If the machine room slab is to be flush with the tops of the machine beams, or, if a base of channels is to be used, mark the tie down bolt hole locations on the beams, drill them, and set the machine in its approximate position, either on the beams or channels, as specified. If soundproofing is to be used, its arrangement will be indicated on the final layout, but will probably employ the use of a base of channels or it will be mounted on top of the concrete slab.

5. In either case, once the base is provided, roll the machine into position and drop plumb lines from the center of the drive sheave rim at front and back. These plumbs should extend to about the rail tops (sketch *2). If a deflector sheave is indicated, the plumb at the deflector side of the drive sheave must be suspended from a straightedge as described in section -d1 thru -d3 of this chapter.

6. Cut a piece of board 1/32'' longer than the ''DBG'' of the car rails. Then, jam it between the rails near their top. Mark the exact center of ''DBG'' on the board. Do the same at the counterweight guides. (Generally these are the same boards that were installed for setting the machine beams and were then left in place for this work.)

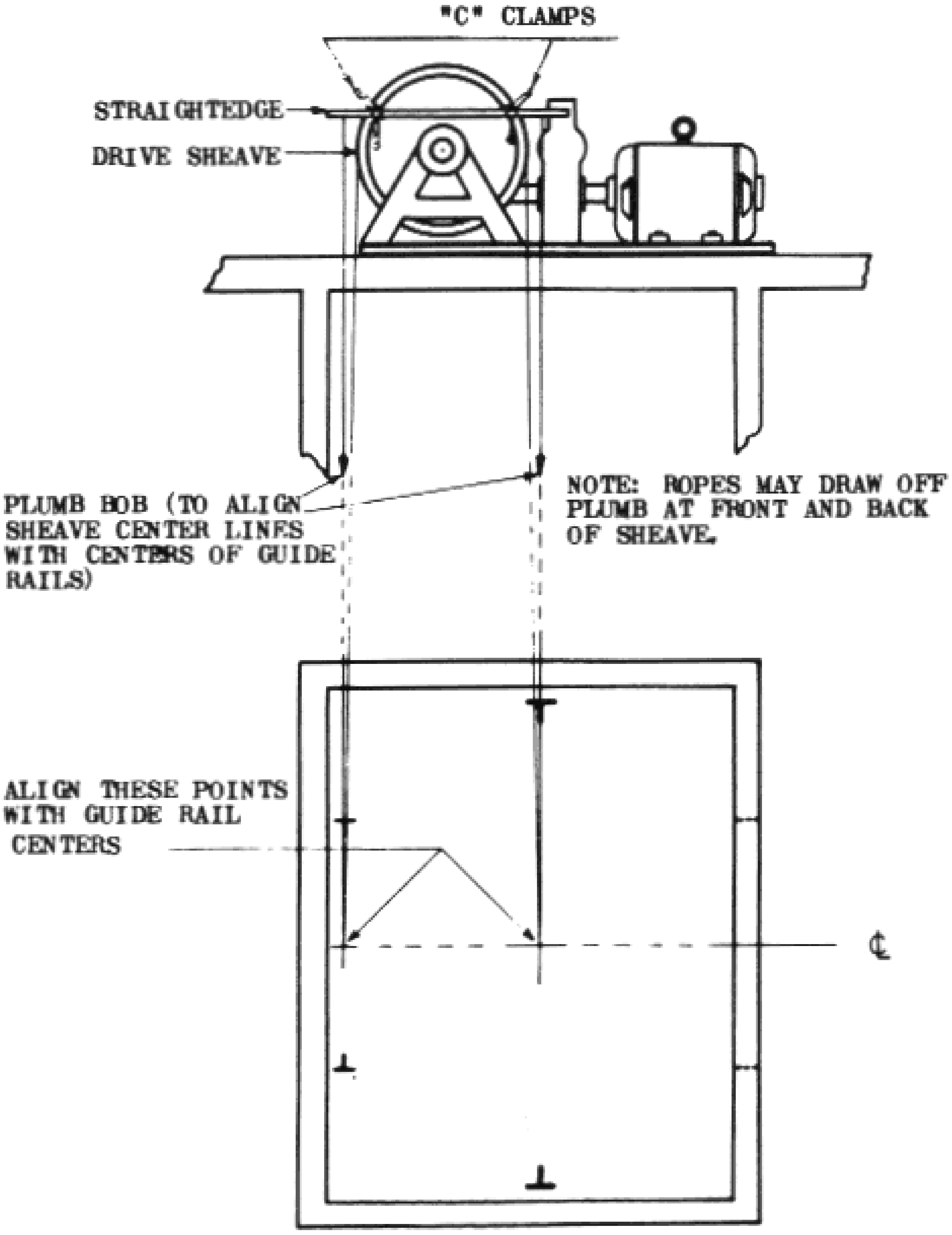
7. Referring to the final layout, determine the exact location of the drive sheave rim centers in relation to the guides. The plumb lines referred to are dropped at the center of the drive sheave on both the car and counterweight sides and the ''bobs'' hung about 1/2'' above each of the boards.

8. The helper ''jockeys'' the machine with a crowbar, until the plumb lines coincide exactly with the marks on each board.

9. On elevators with 1:1 roping, these sheave plumb line points are generally at the exact center of the ''DBG.'' With multiple roping (2:1 or 3:1), or with underslung equipment, the locations vary and should be checked with extreme care. In all cases, align the sheave centers with these locations, and disregard the positions the cables will assume when the elevator is roped up.

10. Once the machine has been located, each end may be raised about 1-1/2'' and rubber sound reducing pads (if specified) slipped under the bedplate in accordance with the layout. The machine should again be checked for location, after the pads are installed.

11. The kick angles can then be bolted or welded in place.



Sketch #2

12. If no pads are used, the tie down bolts or kick angles can be installed as soon as the machine is aligned.

13. On all installations, level the bedplate two ways. Use full width shims under the rubber pads, if necessary. In practice, the machine is usually considered level drive-shaftwise if the drive sheave is plumb.

14. Use washers under all nuts on foundation bolts and lock nuts on all bolts.

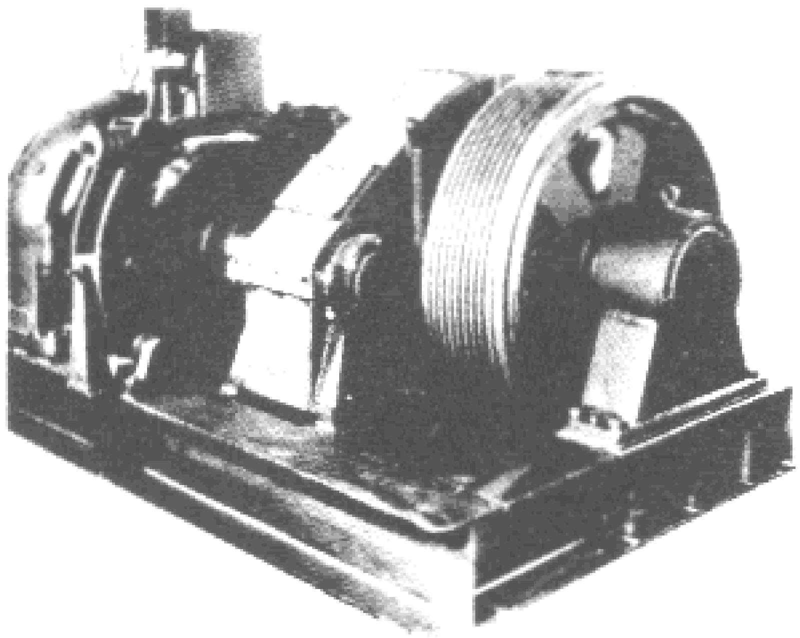
15. If a magnet brake with a brass sleeve is used, remove the brake stand and cores, and graphite the cores, brass sleeve and pins. Chapter 13 describes this procedure. Do not reassemble the brake until the motor has been aligned. This should be done, after the ropes are installed.

16. Many machines have motors bolted to the frames; others are self-aligning. Naturally these require no realignment.

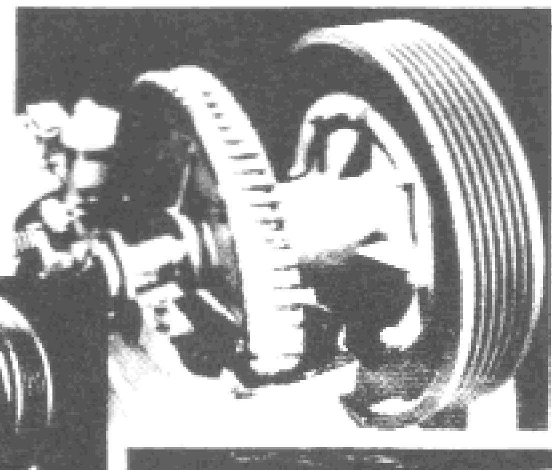
17. Ground all sound isolated machines with a flexible copper braid or wire at least *8 gauge in size.

18. If a deflector sheave is to be used, it is advisable to align the deflector and drive sheaves with each other and also with the guide rail centers, all at the same time. (See chapter 6-d1 thru -d3.)

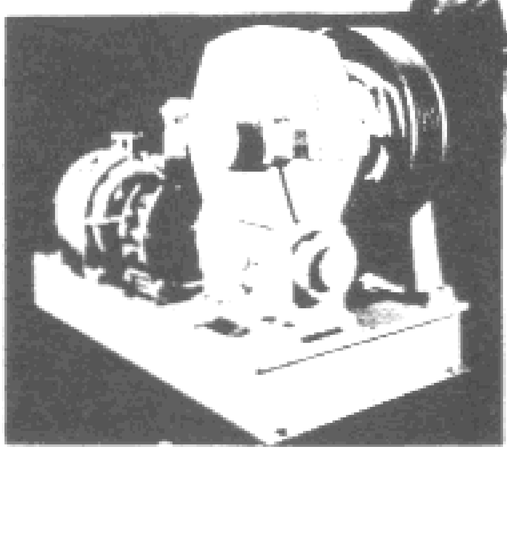
19. Paragraph 4, refers to a channel base. This base is comprised of several channels held together by 1/2'' thick steel plates welded to the top flanges. The height of the channels is equal to the planned thickness of the floor slab. The plates are designed to support the sound reducing pads. The channels are laid across the machine beams, two or more at the gear end and two at the motor end of the conventional bedplate. The assembly is aligned to the plumb drop points for the sheaves and then bolted, clipped or welded to the machine beams.

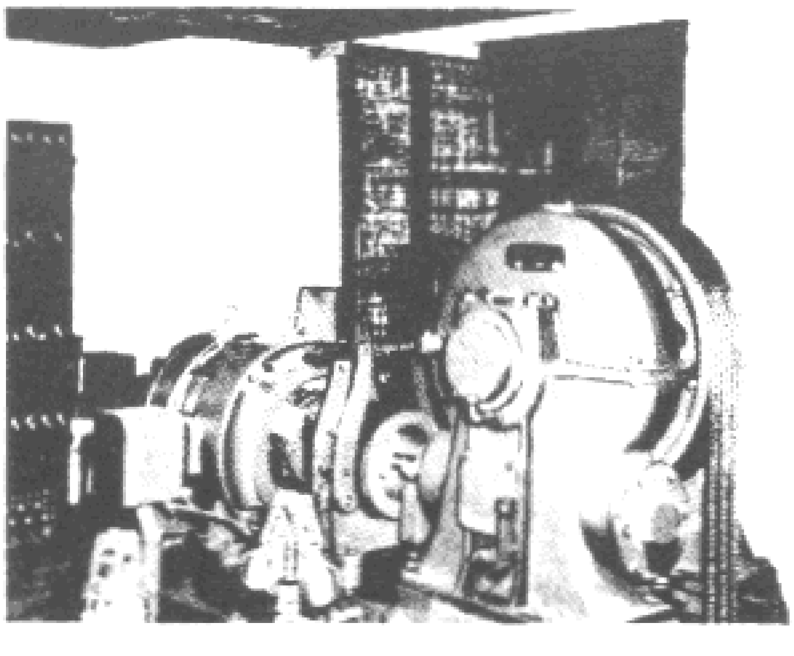


Otis External Geared



Dover





Haughton

Typical Geared Elevator Machines

20. The object of using the base frame is to permit the elevator constructor to proceed with installation work without waiting for the general contractor to form and pour the machine room floor. A second advantage is that conduit, troughing, wiring, rope and tape installation can all be done prior to installation of the floor. Rope holes and others will be properly located and can be of minimum size. No floor patches are needed.

21. Use of the blocking or base frame is quite widespread but its value in aiding efficiency must be determined as related to material availability, machine design and working methods. See chapter 6-c2 for further details.

CHAPTER 6
Section -c2

MACHINE ROOM AND OVERHEAD WORK

Installing Machines – Base Frames for Geared Machines

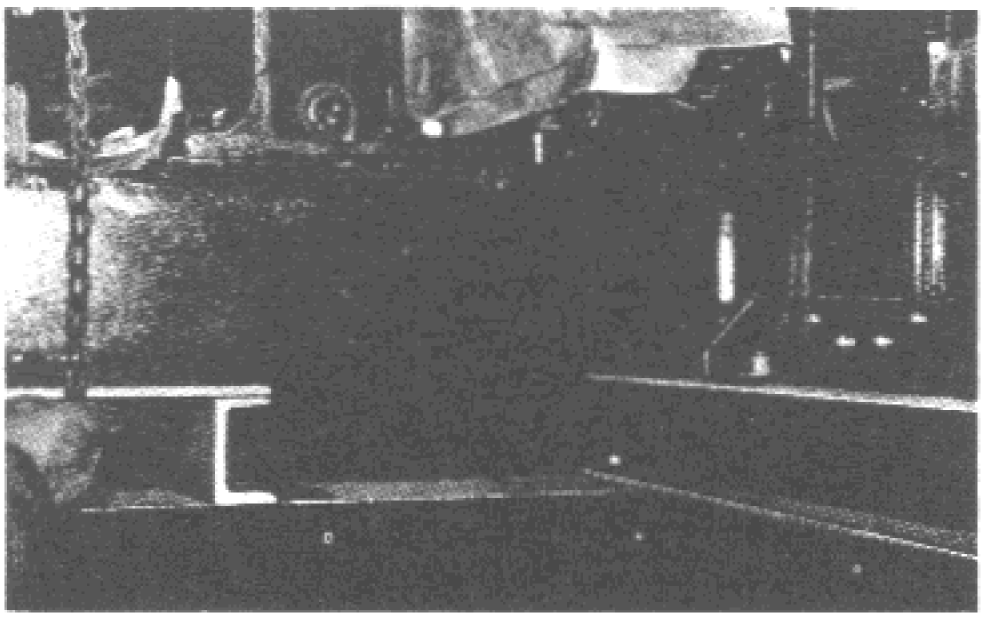
Suggested:

Materials –
- a. sundries
- b. steel shims
- c. sound isolation pads

Tools –
- a. hand tool kit
- b. level (12'' or larger)
- c. rollers
- d. planks
- e. crowbars
- f. electric drills
- g. welders

1. Several elevator companies use a framing between the machine beams and the machine bedplate.

2. The use of these frames was adopted to avoid unnecessary delay resulting from the time required for a concrete floor slab of a machine room to dry as well as any delay while waiting for the contractor to form and pour the slab.



Machine on Blocking Frame— Controller on Blocking Channel

3. As a rule the frames are made of steel channel, set on edge and at least as high as the floor slab thickness.

4. The channels have in some cases been laid on top of and parallel to the machine beams, but we recommend that they be set at 90° from the beams as shown in the photo.

5. In effect, the blocking frame is laid out in the form of a rough template, aligned to the planned position of the machine bedplate and bolted, clipped or welded in place.

6. The machine can then be hoisted or rolled into position, aligned and secured.

7. The carpenters build the forms for the slab later.

8. Before permitting the concrete men to pour the slab, put blocks in the forms to prevent the rope hole locations from being filled in or rope the equipment. Place controller, governor, relay panels and selector in permanent positions, using short lengths of channel or "I" beam; set on the concrete forms, if necessary. Be sure the forms can sustain the weight.

9. Run all conduit and troughing.

10. The slab can then be poured.

11. If the contractor delays work on the forms or floor, you can proceed to complete the entire elevator without loss of time.

CHAPTER 6
Section -c3

MACHINE ROOM AND OVERHEAD WORK

Installing Machines – Gearless

Suggested:

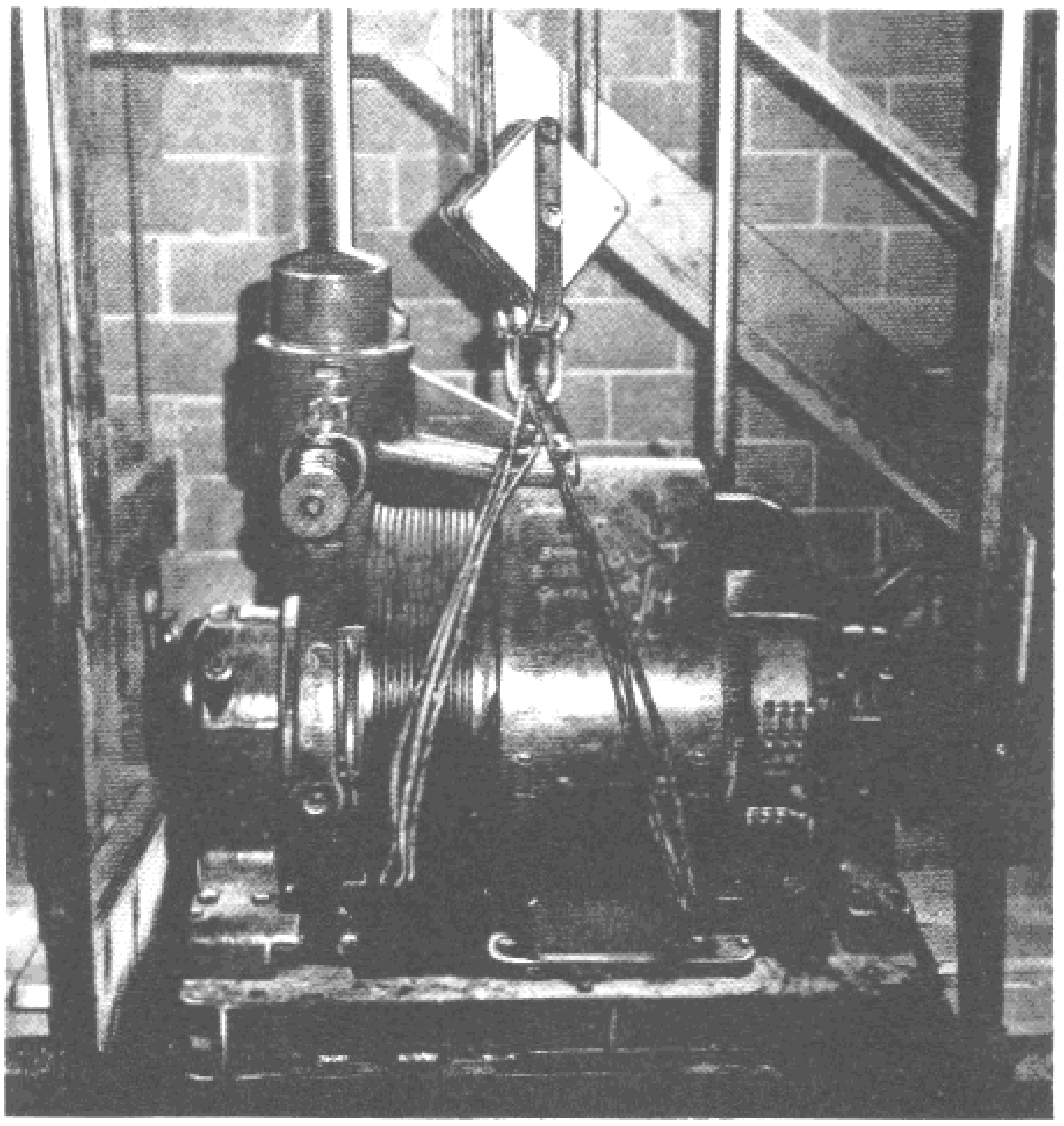
Materials –
- a. bolts
- b. washers
- c. shims
- d. concrete mix

Tools –
- a. hand tool kit
- b. rollers
- c. crowbars
- d. tackle
- e. machine wrenches
- f. welder

1. A number of elevator companies install gearless machines. These differ from the conventional geared machines in physical appearance and operating characteristics.

The main points of variation, such as the drive sheave and brake drum being on the armature shaft assembly, are easily discerned by comparing photographs in section -c1 with those in this article.

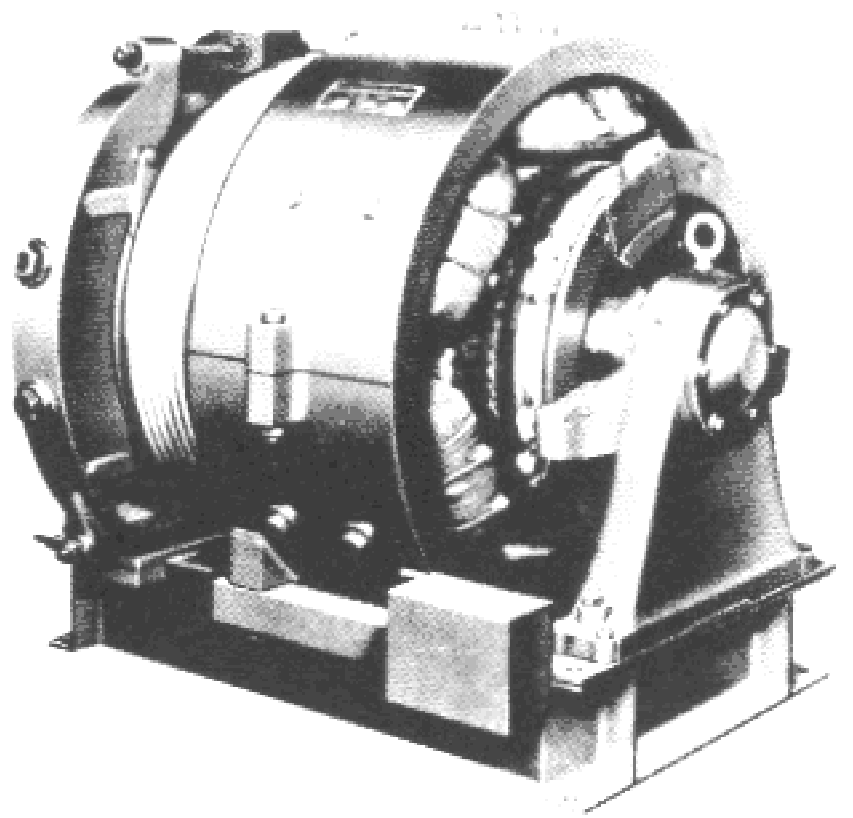
2. Gearless installation practices do not, however, differ greatly from those of the geared types. The chief difference is that gearless machines are almost invariably set directly on the machine beams.



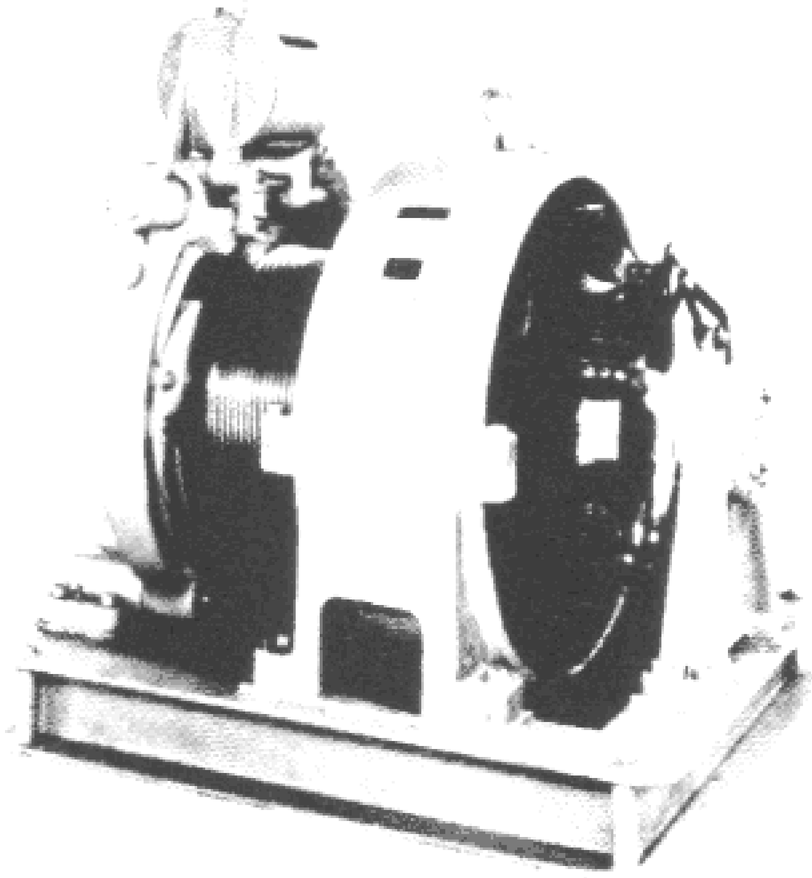
Gearless Machine Being Hoisted

3. The machine is rolled into position on the beams, and aligned with the guide rails and secondary sheaves, using the general method outlined in section -c1 of this chapter. With a few exceptions, gearless machines are double wrap traction (DWT), and as a result the secondary sheave is always offset from the drive sheave. Three exceptions are the machines of this type manufactured by the Montgomery Elevator Company, the Haughton Elevator Company and the Otis Elevator Company's 131HT, which utilize modified "V" groove drive-sheaves. The amount of the secondary offset varies, and should be indicated on the final layout plan-view. When the drive sheave is aligned to the guide rails, the proper allowance must be made for this.

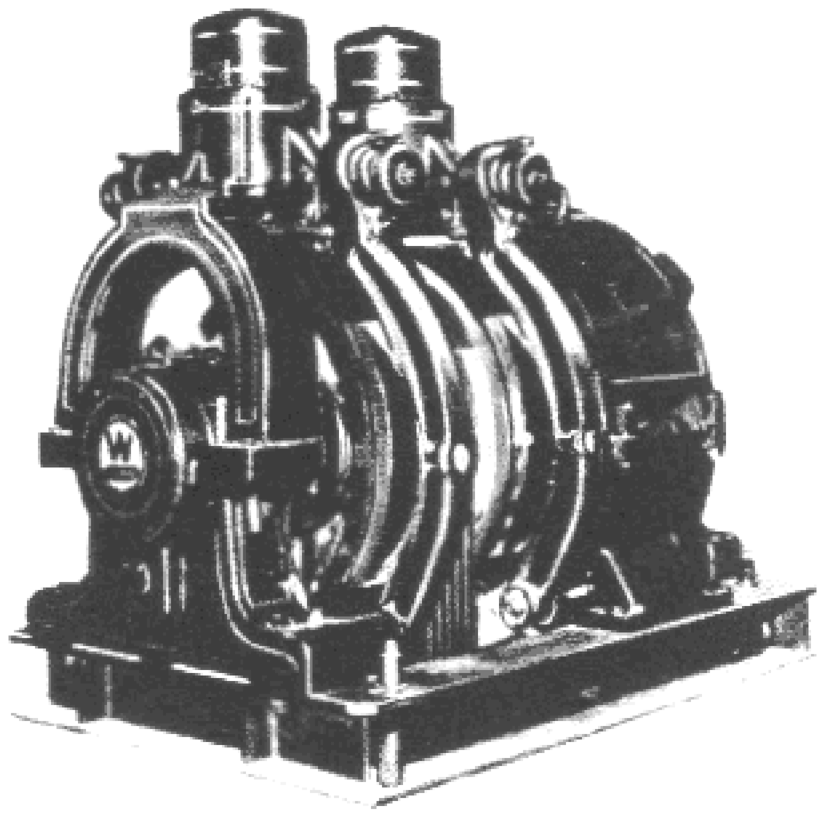
4. The drive sheave must be plumb, when it is aligned with the secondary and rails.



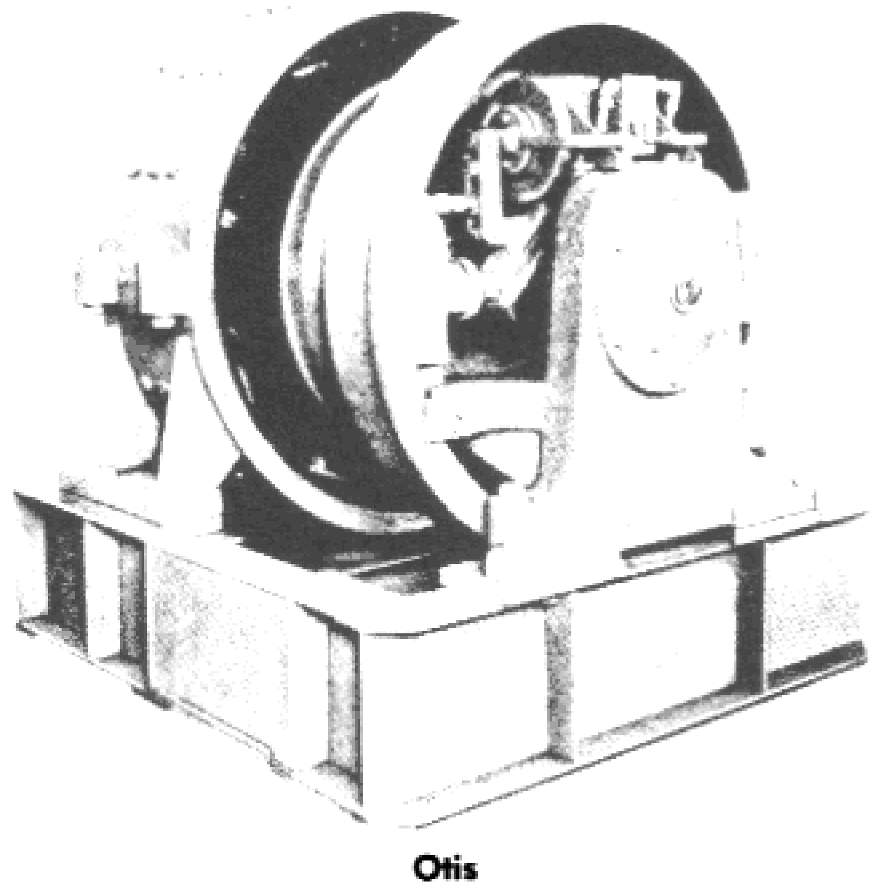
Haughton



Dover



Westinghouse with Safe Lift Brake



Otis

Various Types of Gearless Machines

5. Only steel shims are used to level the machine (i.e., plumb the drive sheave).

6. It has been common practice with many companies to grout under the bedplate with concrete, when the machine is set and the conduit or troughing run in. However, some of the later design machines are equipped with plain or perforated sheet steel base pans and thus eliminate the need for pouring concrete grout under a machine.

7. These machines are supported on steel beams which may be "I," "H" or boxed channel sections.

8. Although bolting to the beams has been common practice, welding is now being used for this purpose.

CHAPTER 6
Section -c4

MACHINE ROOM AND OVERHEAD WORK

Installing Machine – Drum Type

Suggested:

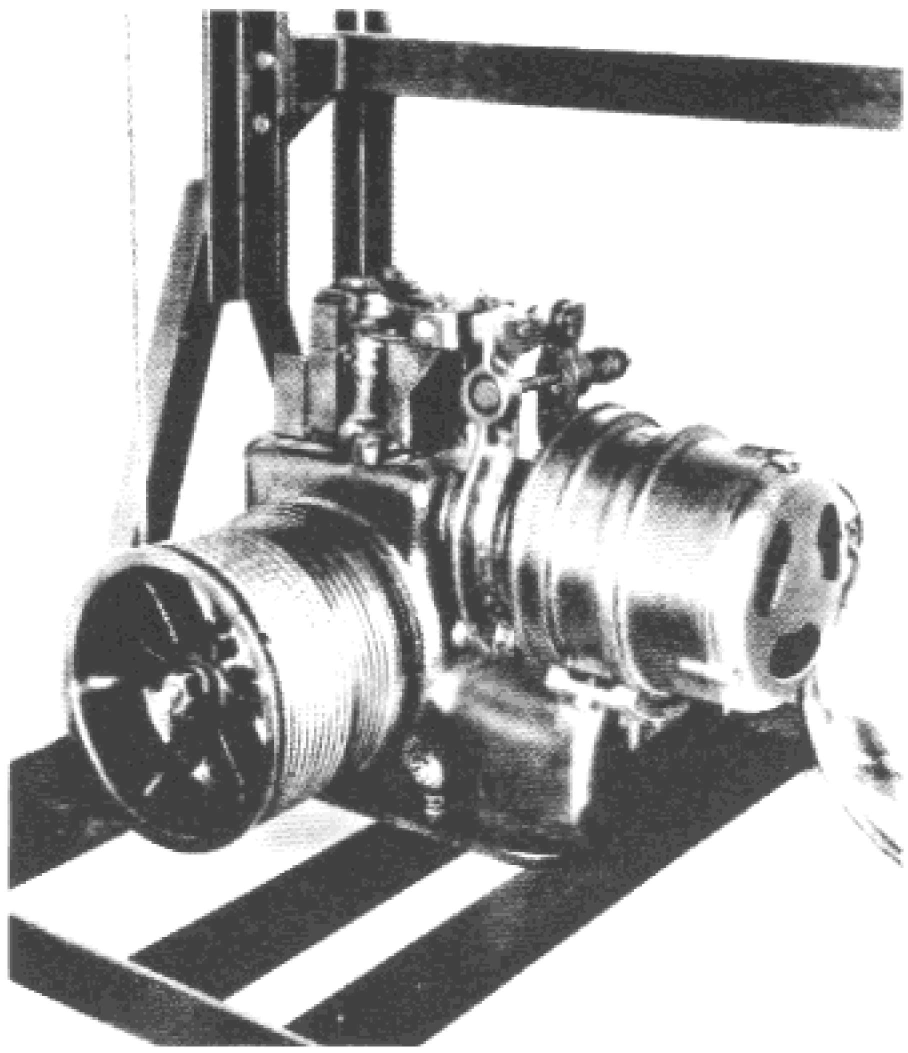
Materials –
- a. sundries
- b. steel shims

Tools –
- a. hand tool kit
- b. level (12" or larger)
- c. rollers
- d. planks
- e. crowbars

1. Despite the fact that the drum type machine was probably the earliest elevator drive developed, it is still considered practical for certain installations. Some mention of installation practices for these machines is, therefore, included herewith.

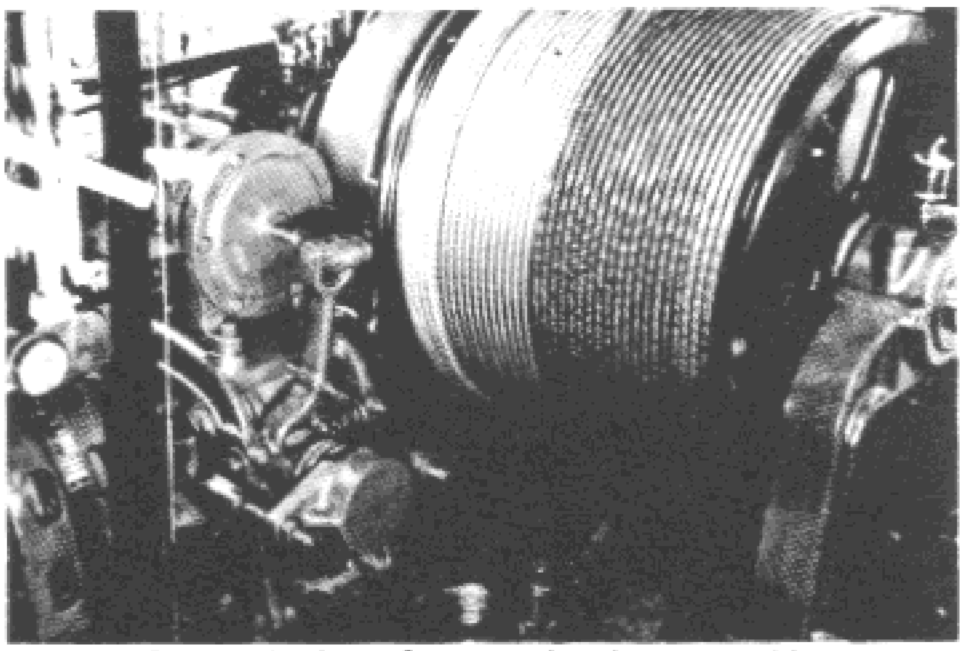
2. Drum elevators are designed for various arrangements of counterbalancing or none at all. One, for example, that has no counterweight is used for sidewalk elevators, dumbwaiters, and similar light loads. Another type has a single counterweight which is connected to the drum by means of counterweight ropes. A third arrangement has a counterweight for the drum and a separate counterweight riding above the first in the same set of guides and connected directly to the car crosshead. Although this type is not too common today, some details of it are included as a matter of general interest.

3. The winding drum on this type of elevator machine is cast in the form of a hollow cylinder supported on a shaft by spokes or ribs. The outer surface of the drum is grooved for the ropes. There are several grooving arrangements used. One begins at one flange of the drum and continues, threadlike to the opposite end. If two (or more) ropes are to be used, two (or more) adjacent "threads" are cut into the drum. This compares to a double thread worm, in cross section. This type of grooving is used in either clockwise or counterclockwise directions.



Drum Machine for Dumbwaiter

4. Another type of grooving often used employs two grooves or sets of grooves that begin at the center of the drum and "work" away from each other, that is, right and left hand grooving. With the car ascending, the ropes wind onto the drum and away from their drum hitch. Conversely the counterweight ropes unwind as the car ascends. This permits a plumb rope lead from the drum to the car to the counterweight as each approaches its upper limit of travel.



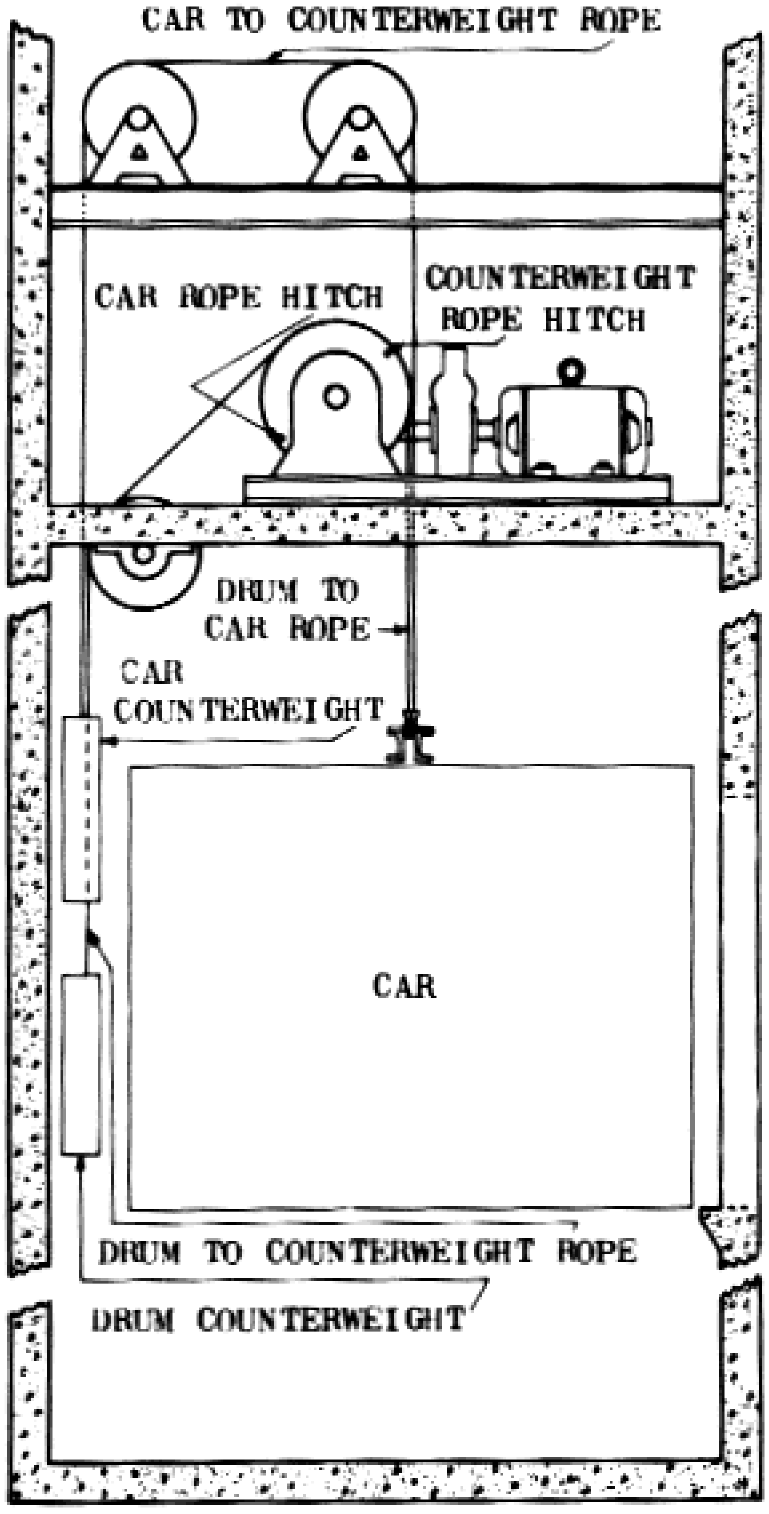
Drum Machine for Freight Elevator—Note Slack Rope Switch Arm Under Drum

5. This point of plumbing the rope lead from the drum to the car and counterweight is very important. Since the rope only seats in a half-round groove in the drum, any appreciable angle of "pull-off" from plumb may cause the ropes to jump a groove.

6. Because of this the layout supplied to the field men must indicate the exact drum location in relation to the car hitch. Some companies include a "drum sketch" on the final layout. In all cases, the drum is laid out and installed in conjunction with the planned position of the guide rail locations. This part of the installation is essentially identical to that of the traction machine installation.

7. The machine beams are set in accordance with the final layout.

8. The machine is hoisted into its approximate position and a plumb bob dropped from the position of the car rope lead to the car hitch or center of car rails. The same is then done for the counterweight side.



Sketch #1

9. The installation of foundation bolts, kick-plates, conduit and troughing is handled in the normal manner.

10. A "slack rope" or slack cable switch, mechanically operated by an arm mounted under the drum, is adjusted when the machine is roped.

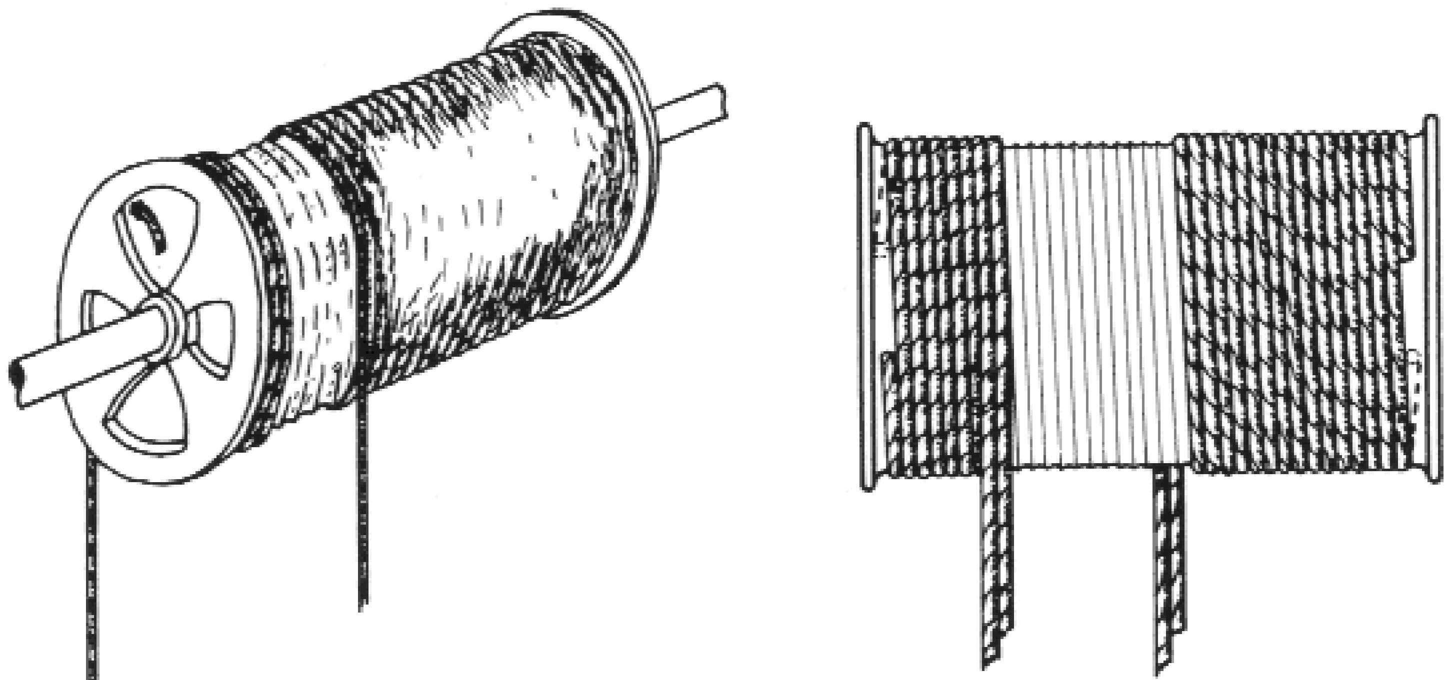
11. A "stop-motion" switch is a part of the machine assembly. It is usually mounted on the end of the drum shaft and should be adjusted as soon as the car can be moved from top to bottom of the rise. This device is intended to automatically cut off power and stop the car at terminals, and thus prevent the car or counterweight from being drawn into the overhead.

12. As noted previously three distinct ropes or sets of ropes are used on some drum machines. One (set) is hitched in the drum and to the car hitch. Another is hitched on the opposite end of the drum and to the drum counterweight hitch. The third (set) connects the car and "car-counterweight."

13. This is the type of installation that has two counterweights. As indicated, they run in the same set of guides and the "car counterweight" rides above the "drum counterweight." A minimum space of about 3' is maintained between the two weights. Sketch #1 illustrates this arrangement.

14. Hoist ropes on drum machines are subject to "side stresses" peculiar to them. This has a tendency to crystallize the ropes just inside the baskets or sockets of the shackles. Because of this, most codes require that drum machine ropes be resocketed every year or every two years. Sketches #2 and #3 illustrate the types of rope stresses set up due to drum grooving.

15. Where the drum does not span the distance between the car and counterweight guide rail centers, a deflector sheave(s) is used. This sheave, which travels on a fixed shaft to compensate for the pull-off of the rope lead, is generally termed a "vibrator sheave." It is set with its shaft parallel to that of the drum. The exact location is given on the layout, of course. For installations with the machine below, the general practice is to mount this sheave on the machine or on the wall just above it, depending on existing field conditions and design of the machine.



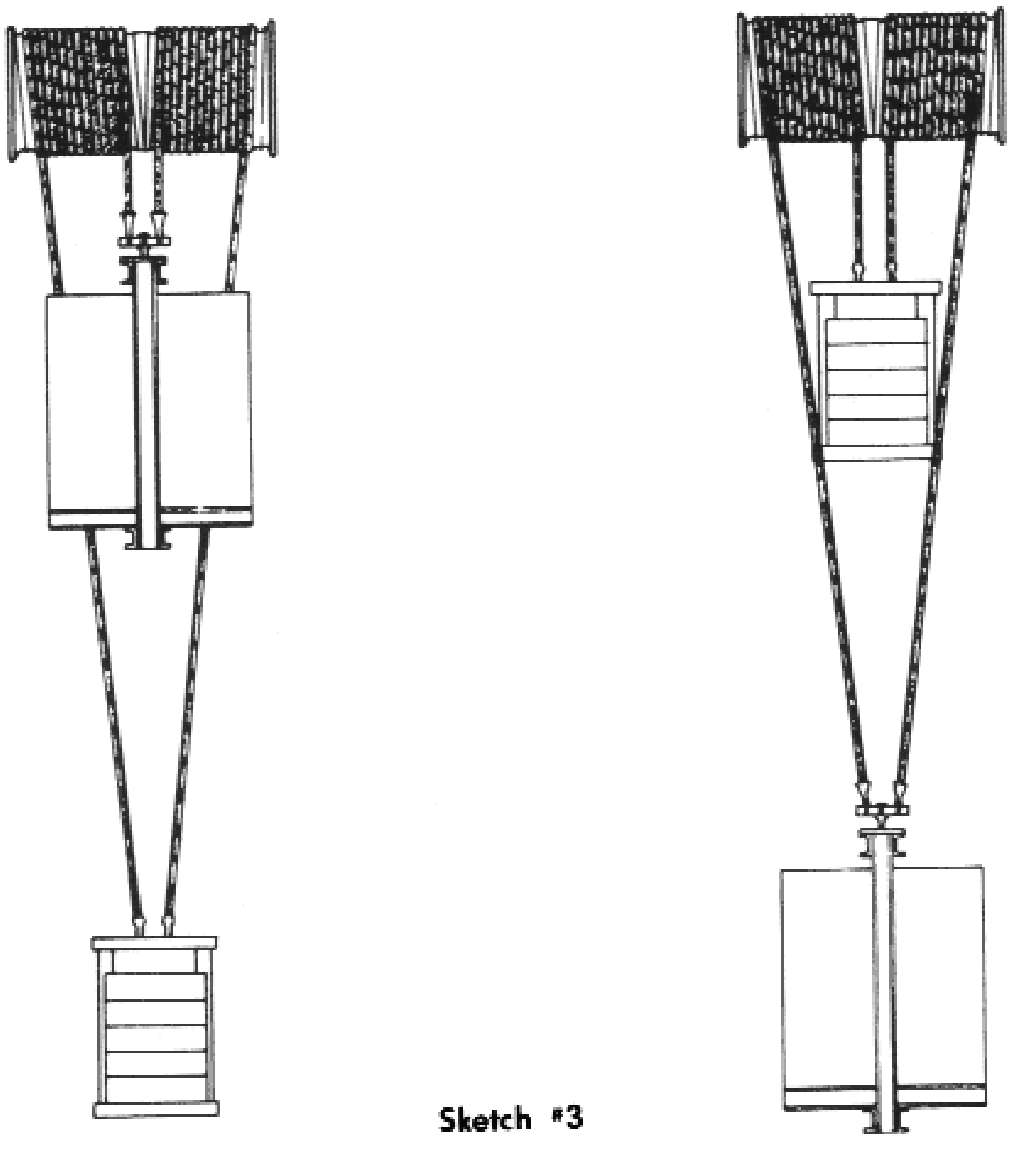
TO COUNTERWEIGHT TO CAR

SINGLE GROOVING
(1 ROPE)

TO COUNTERWEIGHT TO CAR

DOUBLE GROOVING
(2 ROPES)

Sketch #2



Sketch #3

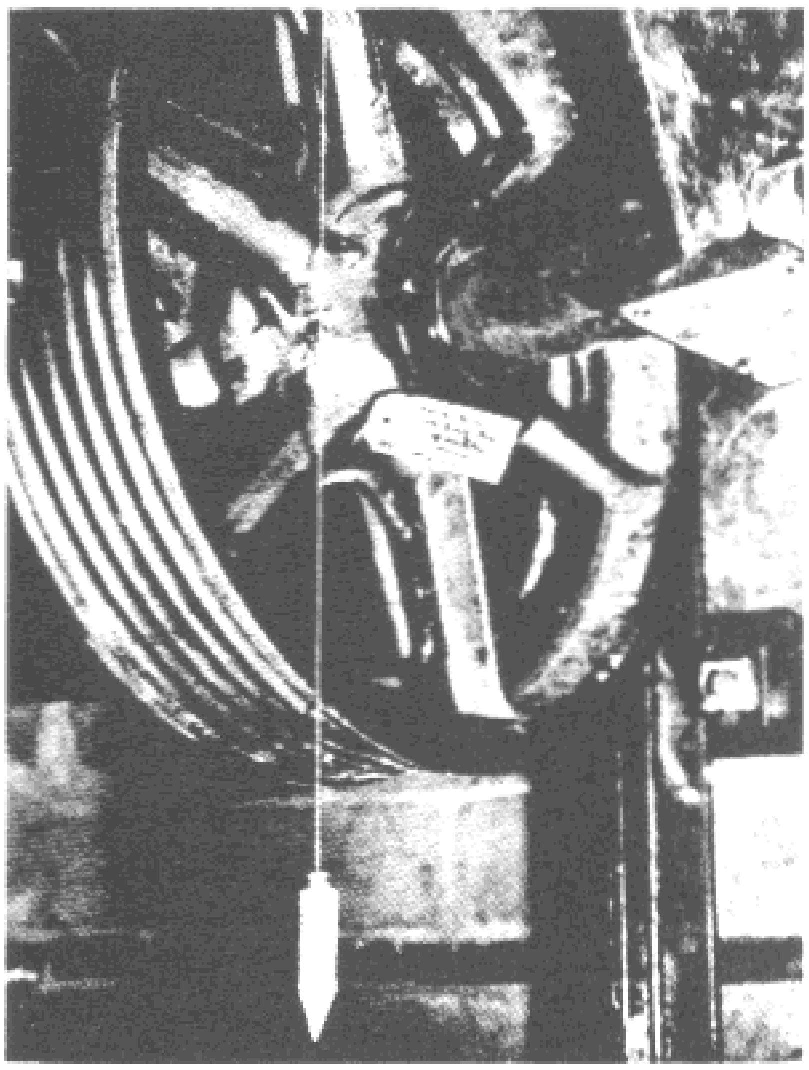
16. In general, the new drum elevator is now restricted in the United States and Canada to sidewalk lifts, residence elevators, and small freight elevators, none of which have counterweights.

CHAPTER 6
Section -d1

MACHINE ROOM AND OVERHEAD WORK

Deflector and Secondary Sheaves — General

1. There is always one driving sheave on an elevator. Auxiliary to this are sheaves variously termed, "deflector," "secondary," and on drum machines, "idlers" or "vibrators."



Plumbing Deflector Sheave — Bearings in Sheave Hub

2. On installations where the distance from the center line of the car guides to the center line of the counterweight guides (or from the "plumb drop" of the car to the "plumb drop" of the counterweight) are about equal to the diameter of the drive sheave, no deflector is needed. A secondary sheave is required on all double wrap traction installations, however.

3. Most generally, deflector sheaves are used with single wrap traction geared elevator machines. However, they are sometimes used on special gearless installations to route ropes, but in such instances they are merely auxiliary to the secondary sheaves. The prime purpose of these sheaves, wherever used, is to route the hoist ropes.

4. On the other hand, secondary sheaves are always used with double wrap traction gearless elevator machines. Their main duty is to assist in providing traction, although they often serve to deflect ropes as well. They have twice as many rope grooves as the specified number of hoist ropes. The sheave centers are always offset or off center, but parallel to their drive sheave centers.

5. The physical arrangement and installation is similar for the two types of sheaves. There are two general types in use; those which turn **on** their shafts, and those which turn **with** their shaft. Brief explanations of methods of installing the two types are given in this instruction under ''d2'' and ''d3.''

CHAPTER 6
Section -d2

MACHINE ROOM AND OVERHEAD WORK

Deflector and Secondary Sheaves – Sheaves Turning On Shafts

Suggested:

Materials –	Tools –
a. bolts	a. hand tool kit
b. cut washers	b. tackle
c. bevel washers	c. grease
d. shims	d. straightedges
e. kick angles	e. electric drill
	f. welder

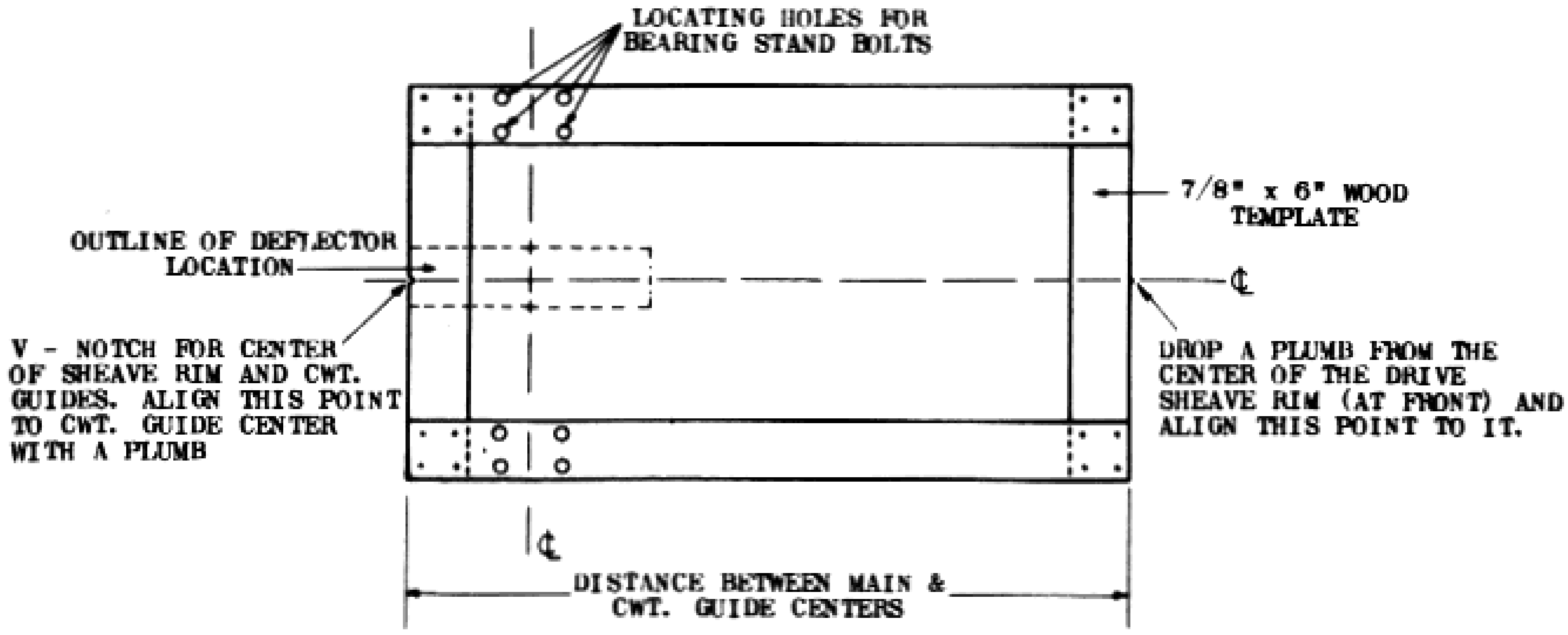
1. Regardless of whether a sheave is a ''secondary'' or only a deflector, the general method of installing it is the same, if it is a sheave with a bearing that rides on a fixed shaft.

2. These types have an antifriction or sleeve bearing that is mounted on a steel shaft. The shaft is supported by two brackets, which are fixed to the underside of the machine beams or other overhead work. The sheaves must be aligned with the guide rails and the driving sheave. They are to be plumb, when aligned.

3. If a large, heavy sheave is to be installed, use a 2:3 rope tackle, a chain ''puller'' hoist or a compact type chain hoist to lift it. Hang it from a hoisting beam, or from wood planks, or timbers set in the machine room over the counterweight rope hole. Be sure to allow ample safety factor in this, as in all rigging.

4. Mark the holes for the bearing stand bolts on the machine beam flanges. Drill the holes and insert the bolts with the bolt heads up.

5. If there is any doubt about measuring to mark the holes, a new mechanic may consider it advisable to make a template for drilling them. Mark the position of sheave and shaft centers on the template, so it can be plumb aligned to the driver and counterweight. Hold to the underside of the beams with ''C'' clamps. The bolt hole positions can then be marked on the machine beams. A type of template that could be used is illustrated in sketch *1.



Sketch #1

6. As a rule, experienced mechanics do not use templates but work from plumb lines and the layout to determine the positions of the bolts. This method is not difficult, but errors are more easily made. It is for this reason that we suggest a template be used for a few installations. On multiple car installations work can be simplified considerably by use of a template. Chance of error is reduced also.

7. After the holes are drilled and the bolts are in place, raise one support stand, and set it in place with the nuts finger tight on the bolts.

8. Then, hoist the sheave shaft and sheave into place, inserting the shaft end in the support housing, already mounted.

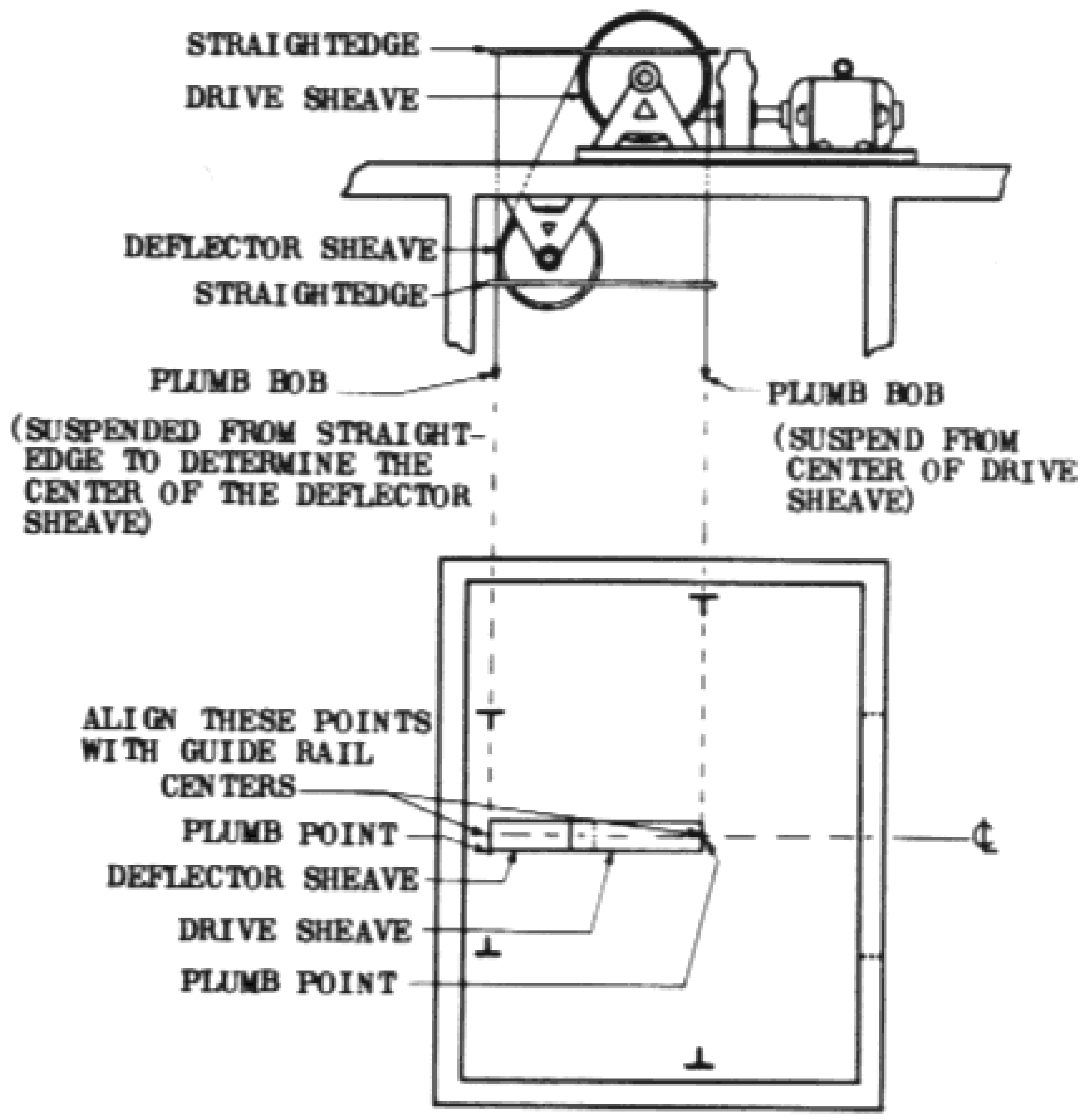
9. Lift the other support stand, and slide it onto the shaft. Bolt it in position with the nuts snugged up but not tight. Install the shaft end-plate or retaining caps, so that there is no possibility of the shaft sliding out of one support and falling down the hoistway.

10. Incidentally, in the interest of safety, always keep your slings on equipment until the danger of dropping it is past.

11. Snug up the bolts on the other bearing stand.

12. Use full width steel shims between the supports and the machine beams, if necessary, to plumb the sheave.

13. Next, drop a plumb line from the front center (or one front edge) of the drive sheave.



Sketch *2

14. Then, extend a straight board or straightedge from the counterweight (or rear) of the drive sheave. On many sheaves small "C" clamps can be used to hold this straightedge. Lower a plumb line from this board to the deflector sheave. (See sketch *2 for details.) Extend another straightedge from the front of the deflector sheave.

15. Measure between the two plumb lines and the straightedge, align the center line of the deflector with that of the drive sheave and with the guide rails.

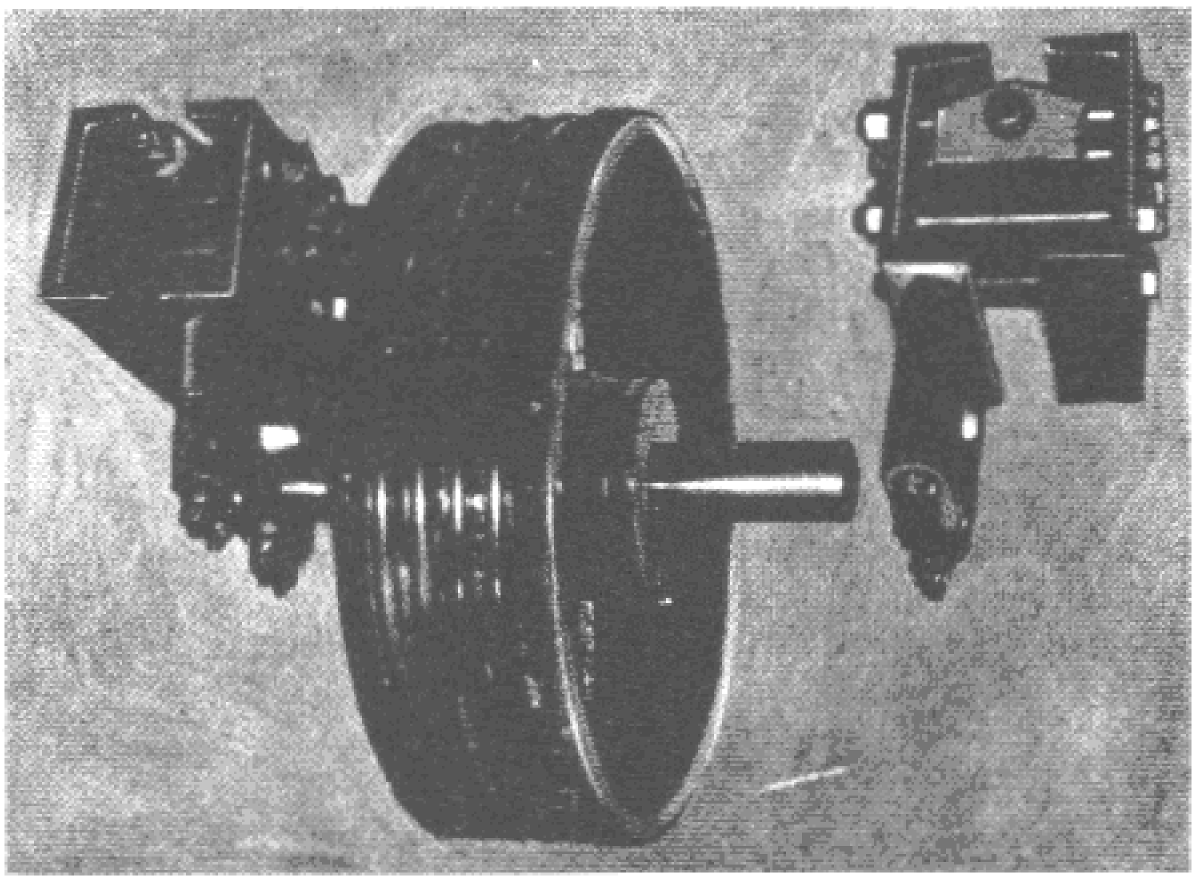
16. Recheck the plumb of the deflector sheave. Check the sheave center alignment a second time, if the sheave has to be moved to make it plumb.

17. Make all bolts tight and install lock nuts on the stand support bolts.

18. If lubrication is needed, put it in at this time.

19. A good alternate method of aligning the driver and deflector sheaves is to set the machine, then mount the deflector in place, and extend a light twine between the two sheave edges. By shifting the sheaves, without disturbing their alignment to the guides, until the twine is equidistant from all four points of contact on the sheave rims, a true alignment can be obtained. Due allowance must be made for any difference in the width of the sheave rims.

20. There are some mechanics who prefer to lay out and drill the holes in the machine beams for the machine bedplate (if used) and deflector sheave stand bolts, before the beams are set in place. Probably this is a time saving method. It is felt, however, that the practice permits too much chance of error for a new mechanic. Therefore, it is recommended that the new mechanic install deflectors in the manner described first, until his experience warrants the use of short-cut methods.



**Montgomery Deflector Sheave Bearing Stands
Arranged to Clamp on Beam Flanges**

MACHINE ROOM AND OVERHEAD WORK

Deflector and Secondary Sheaves – Sheaves Turning With Shafts

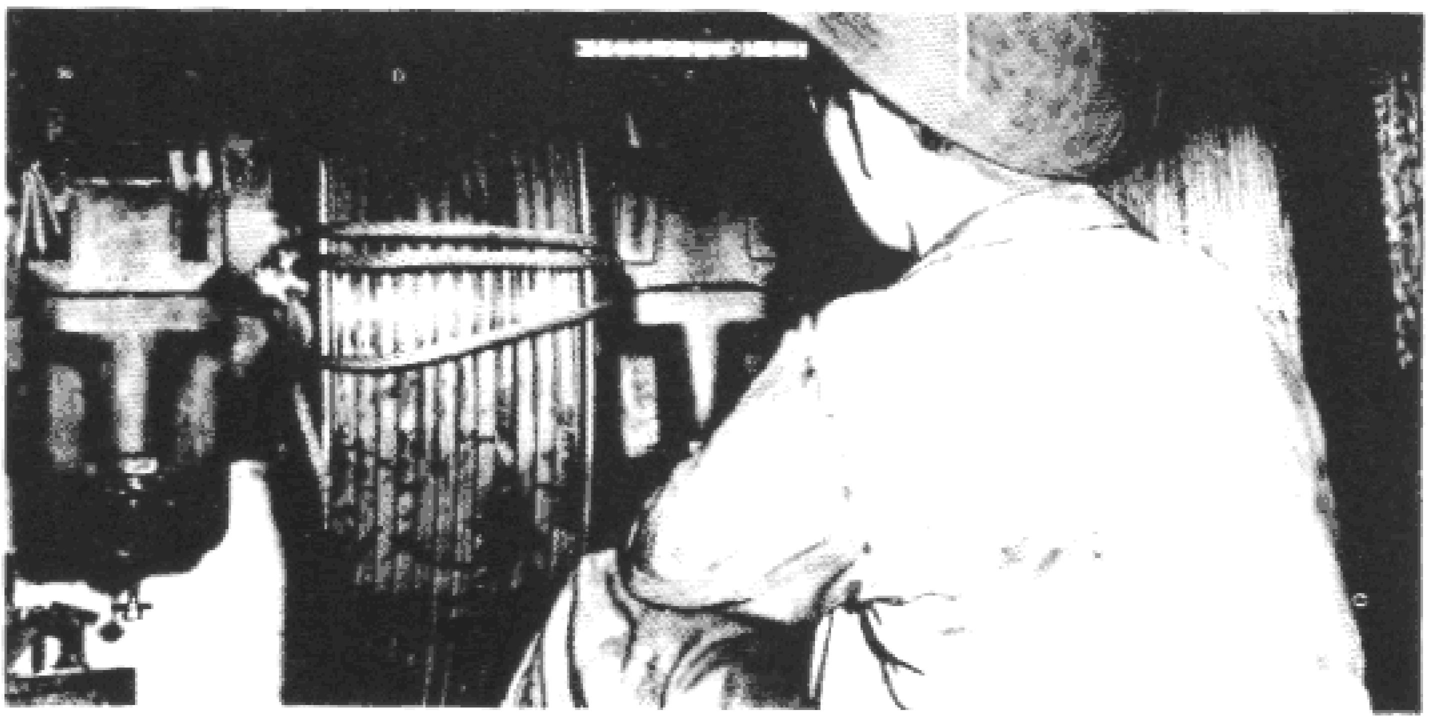
Suggested:

Materials –
- a. bolts
- b. cut washers
- c. cast washers
- d. steel shim stock
- e. kerosene
- f. red lead
- g. traction bearing oil

Tools –
- a. hand tool kit
- b. machine wrenches
- c. electric drills
- d. hoists, pullers or rope falls
- e. rigging slings, clamps, lumber
- f. arc welder

1. Although deflector sheaves may be manufactured to either turn **on** their shafts or **with** them, many companies' secondary sheaves are keyed or otherwise fastened to their shafts. The shafts have bearings, which rest in journals that may be oil or grease lubricated and are fixed to the underside of the machine beams. The bearings can be sleeve or anti-friction as in the case of sheaves with fixed shafts. The sleeve bearings have side movement or "float." Anti-friction bearings have side play limited to the amounts built in by the bearing manufacturer. (As a side note of interest, antifriction bearings can be damaged by over-lubrication. Follow the manufacturer's instructions on field lubrication. Generally new bearings are "packed" in the factory and need no field lubrication for several months.)

2. While reference will be made to secondary sheaves throughout this section -d3, the general installation practice may be said to apply to deflectors also, assuming



Measuring Float of Secondary Sheave

their shafts rotate with them. In order to provide a comparison with data in 6-d2, we will assume this sheave has sleeve bearings.

3. Secondary sheave bearing stands are ordinarily hung from heavy bolts that are set in predetermined locations in the flanges of the machine beams. Locate and set the bolts in their approximate positions, in a manner similar to that suggested in section -d2, of this chapter.

4. Rig the hoisting tackle. Lift and set one bearing stand in place. Snug the bolts. Hoist the bearing stand for the other side. Set one bearing in its stand, allowing it to hang loosely on the bolts. Lift the sheave into position, sliding one end of the shaft into the suspended bearing. Do this carefully, so the bearing oil feed chains or rings are not cramped by the shaft end. Be sure the shaft ends and bearings are clean when they are assembled. Put a thin film of bearing oil on shaft end, before hoisting it.

5. Slide the second bearing on the other end of the shaft, and secure it in the bearing stand.

6. Snug up all bearing stand and bearing bolts. Plumb the sheave. Use steel shims between the bearings supports and machine beams, if any are necessary to obtain a plumb sheave and shaft bearing alignment.

7. Check the layout to determine the required "offset" between sheave, drive sheave and rail centers, then align the sheave with the counterweight guide rail center. Be sure to keep the secondary center line parallel to that of the drive sheave.

8. Once the two sheaves are aligned, check the plumb of the sheaves again. If this requires adjustment, check the alignment again after the sheave has been replumbed satisfactorily.

9. Flush out the secondary sheave shaft bearings with light oil, if they are the oil lubricated type. Then, put red lead or pipe compound on the bearing drain plug and oil gauge threads, and install the gauges.

10. Pour oil into the oil reservoirs. Be sure to use the recommended grade of oil, and bring it to the correct level.

11. Revolve the sheave by hand and check the oil feed chains. Be sure that they travel as the shaft turns.

12. Bolt the end caps in place. Tighten all bolts and nuts on the assembly. Install lock nuts or cotter pins on the support bolts.

13. Install the rope guards temporarily. After the hoist ropes are installed, a final adjustment of the rope guards should be made. They should be set as close to the ropes as possible. Request exact data from the company's superintendent.

14. Where secondary sheaves are not set directly below the drive sheave, kick angles are installed on the beams at the car side of the bearing stands. These prevent the sheave from sliding toward the machine. They correspond to the kick angles or plates set at the back of the machine bedplate.

15. Currently kick angles are often welded to the beams rather than bolted.

CHAPTER 6
Section -e1

MACHINE ROOM AND OVERHEAD WORK

Controllers

Suggested:

Materials –
- a. bolts
- b. washers
- c. packing
- d. self-drilling anchors

Tools –
- a. hand tool kit
- b. electric hammer
- c. chuck for self-drilling anchors
- d. hand setting tool for anchors
- e. electric drill

1. The arrangement of elevator machine room equipment has evolved from a period where it was confined to the smallest possible space to one in which the architect and the elevator engineers cooperate more closely to provide suitable space. It has become common knowledge that machinery of any type operates more efficiently and is better maintained, if the machine room is adequate in size, well ventilated and lighted.

2. The engineers and salesmen of the elevator companies work with the owner and his representatives to obtain good conditions.

3. The layout engineer, when designing the controller arrangement, must consider the following factors:

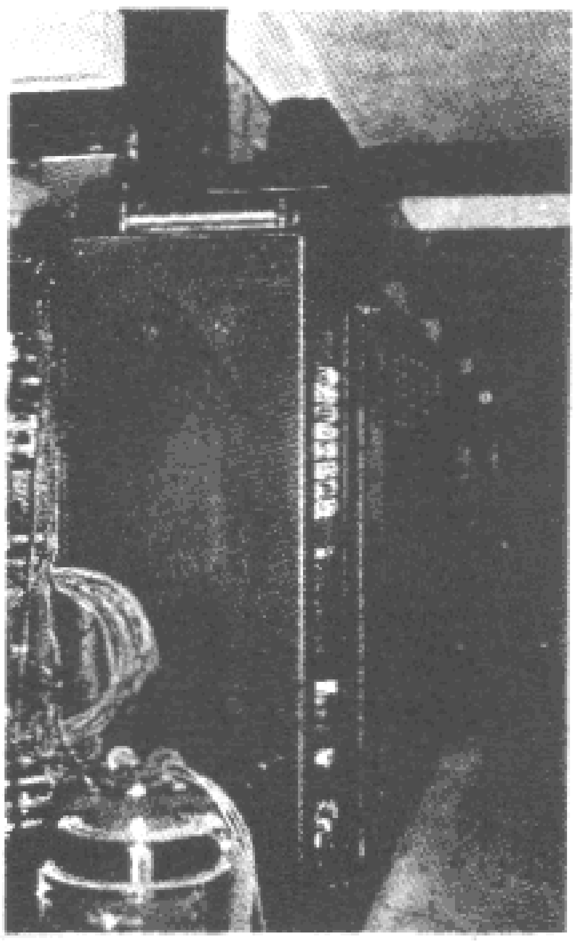
a) Local codes

b) Space available

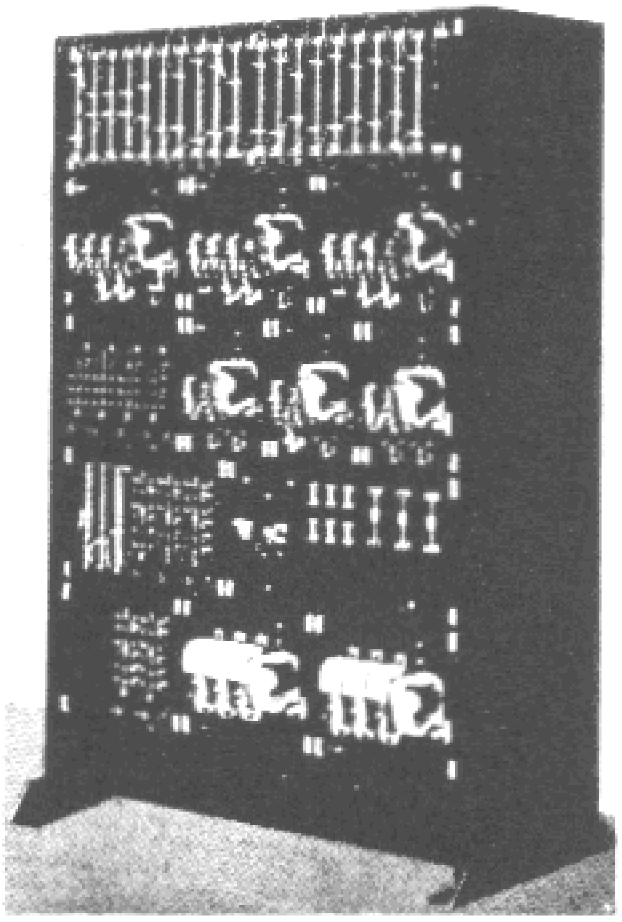
c) Ease of wiring

d) Ease of maintenance

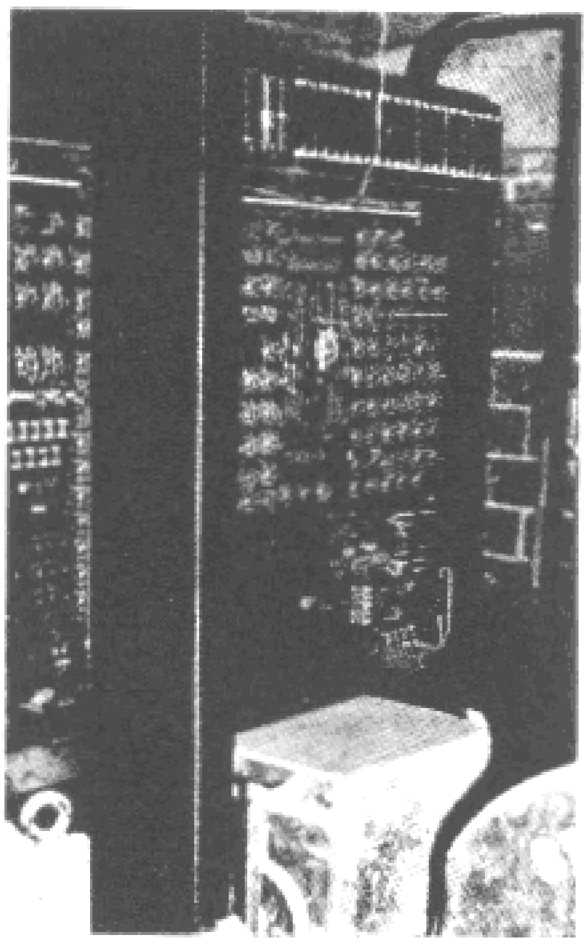
e) Appearance



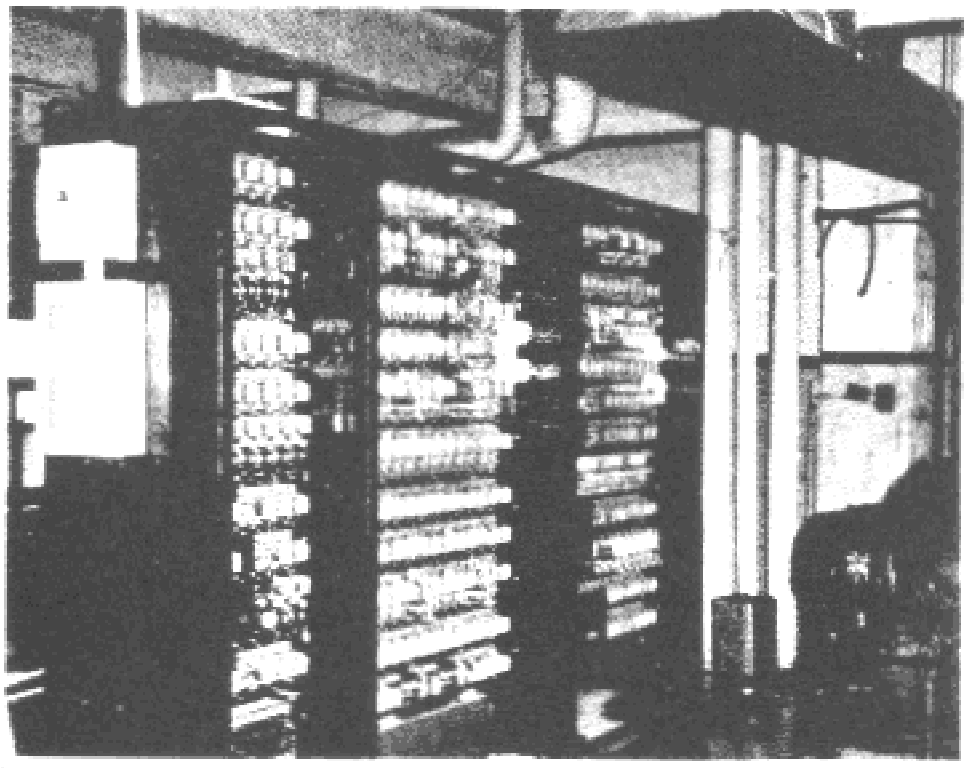
Westinghouse



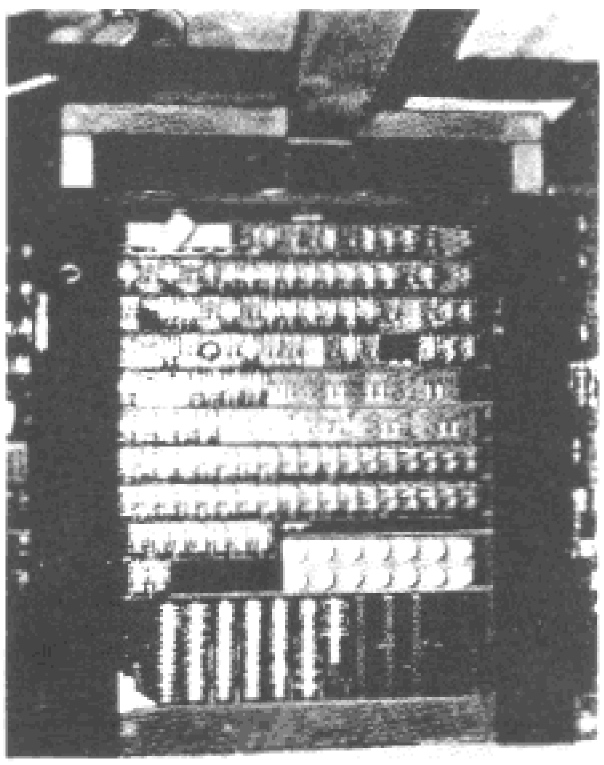
Montgomery



Seaberg



Haughton



Otis

Elevator Controllers of Five Manufacturers

4. When the mechanic believes that the planned layout does not seem to be the best possible for the jobsite conditions, he should request permission of the field superintendent before altering it. He should also determine if equipment of other trades has encroached on the space allotted to the elevators.

5. Modern practice is to place the controller as near the machine as can be conveniently arranged.

6. Where the controller is to be bolted directly onto a concrete floor, mark the locations of the holes and install self-drilling anchors at these points. Bolts of 1/2'' diameter are commonly used for this work.

7. If controllers are bolted to concrete or are mounted on sound reducing pads, the frames must be grounded. A satisfactory method of doing this is to connect the frame to a grounded conduit with #8 wire or braid, using standard ground clamps on the controller and the conduit.

8. Plumb the faces and side edges of all controllers. If they are grouped in a bank, align the front edges carefully.

9. The 1959 edition of the N.E.C. (National Electrical Code) states that one controller or controllers in a bank should have the following **minimum** clearances to walls or permanent room partitions (these clearances are to ''live'' panel parts):

One or a group of controllers — (front of panel to wall 30''
(back of frame to wall 24''
(one side of frame to wall 18''

10. These are minimum distances and greater clearances are to be obtained, if available.

11. Where control panels are mounted in cabinets with swing doors or removable panels, sufficient clear space shall be provided to open the doors or remove the panels.

12. After the controllers are installed, protect them from weather and from mechanical damage.

CHAPTER 6
Section -f1

MACHINE ROOM AND OVERHEAD WORK

Motor Generators – Exciters

Suggested:

Materials –
a. rubber pads
b. 1/2'' flat iron plates
c. 1/32'' and 1/16'' plates for shim stock (6'' wide)
d. bolts and ground clamps
e. *8 wire or braid

Tools –
a. hand tool kit
b. rollers
c. crowbars
d. electric drill
e. taps for ''ground'' wire bolts

1. Motor generator sets are, in proportion to their size, heavy and, therefore, require strong tackle for hoisting. As noted in chapters 2 and 3 all precautions should be used when hoisting them.

2. They are, despite their size and weight, comparatively easily damaged. They should not be dropped or exposed to weather or mechanical damage.

3. It is customary to ship these sets in crates or boxes. The bases of these crates usually form skids. Before hoisting, most mechanics remove the crates leaving the sets mounted on the skids. Rigging slings should not be placed under the skids when hoisting.

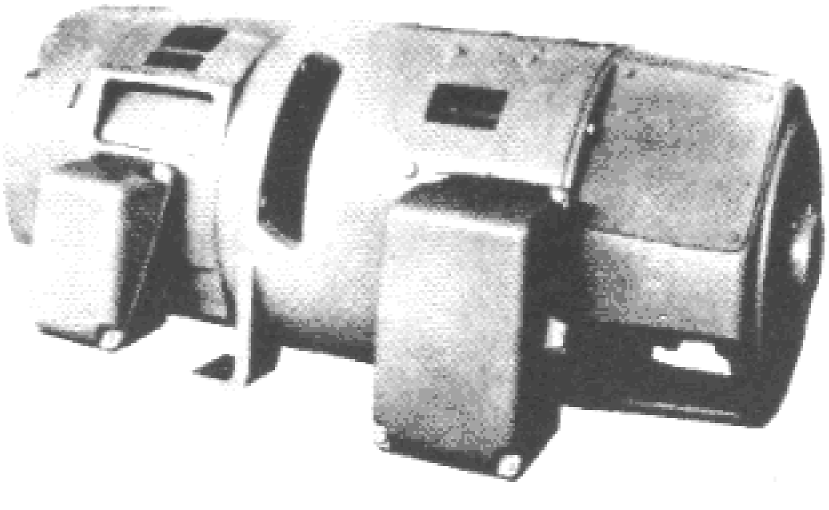
4. Planks are laid to the planned location, rollers set under the units, and then they are rolled into their locations and the skids removed at this time.

5. In present practice, the sets are often sound isolated by mounting them on rubber pads. These pads are placed directly on the finished floor or concrete pads at the finished floor line. If the concrete is rough, steel plates are used to support the rubber. Normally no kick angles or tie down bolts are required.

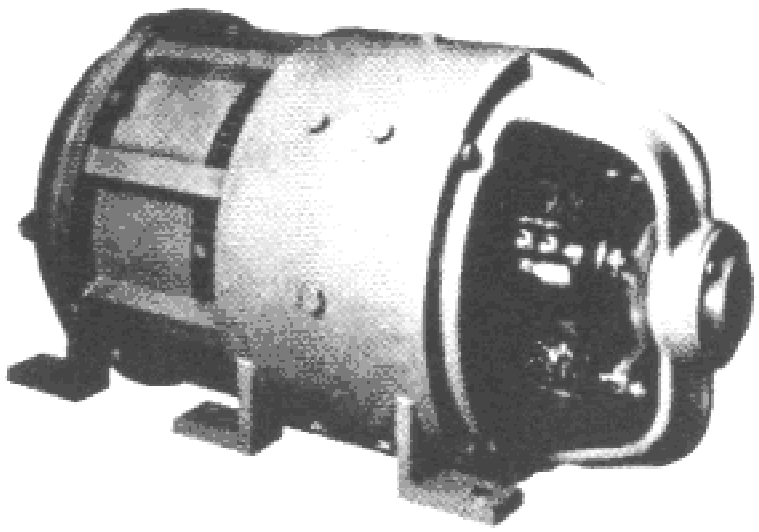
6. The machine room layout plan is used to locate the position of the set on the floor. The ''MG'' set is then rolled into place and the skids unbolted. One end of the set is blocked up and the skids are pulled out, then, this work is done at the other end in the same manner.

7. After the skids are clear, the set is again blocked up one end at a time and the flat steel plates (if used) and rubber pads laid underneath.

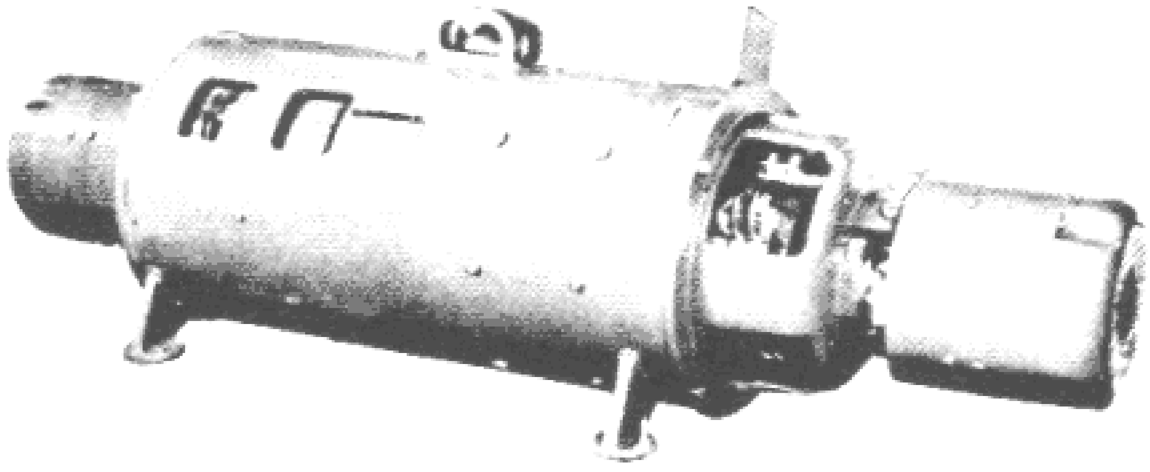
8. The generator set should be approximately level lengthwise. To check this a 3'' level is placed lengthwise on the exciter commutator. If needed, sheet steel shims about 6'' wide are set on the flat iron plates to obtain a true level. (If generator



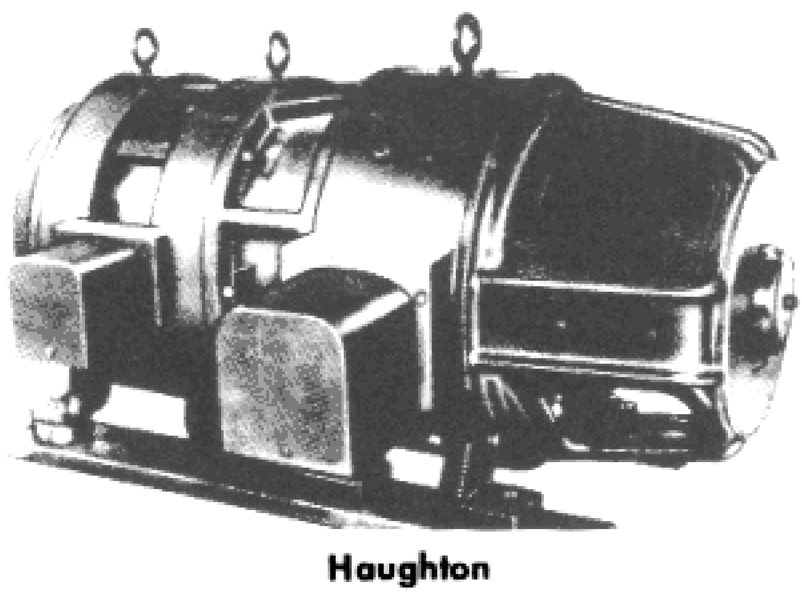
Montgomery



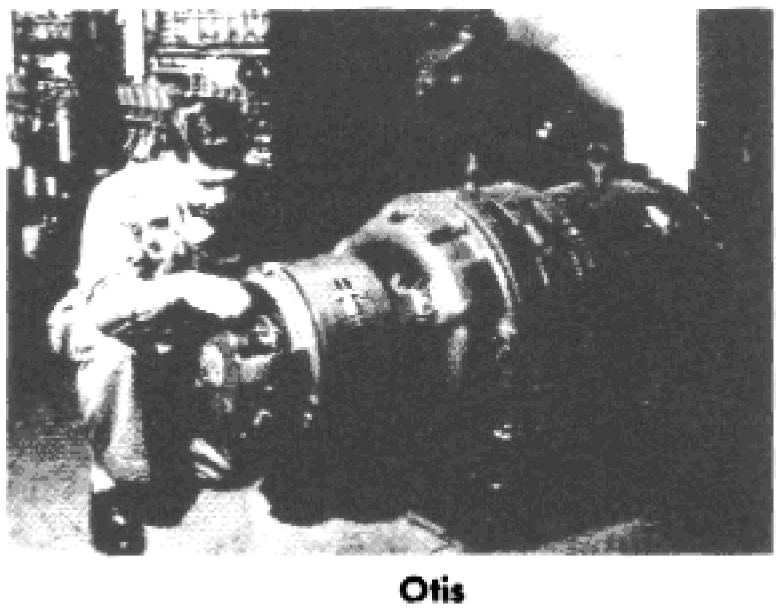
Dover



Westinghouse



Haughton



Otis

Motor Generators for Multi-Voltage Elevators

armature shaft runs much out of level it may ride a bearing or throw the dynamic center of the unit off balance. Overheating may result on some types of equipment.)

9. Generator sets are wired through raceways or conduits that terminate at the generator terminal boxes or in insulated bushings. These conduits are not secured to the set in any manner because this would destroy the effect of the sound reducing. It is advisable to place the conduit before the machine room flooring is poured. This will very often avoid unnecessary chopping. It necessitates that the conduit be placed before the generator is rolled into its permanent location.

10. Where an "MG" set is sound isolated on rubber, its frame is automatically electrically isolated. It is necessary, therefore, to install a flexible braid or *8 stranded wire from the generator frame to a ground. As a rule this is accomplished by bolting a standard ground clamp on a conduit end at the set, and running the wire or braid to the generator frame.

11. On some types of installations the wiring to the controller and machine is run through troughing rather than conduit. This will be fully reviewed in the chapter on wiring.

CHAPTER 6
Section -g1

OVERHEAD AND MACHINE ROOM WORK

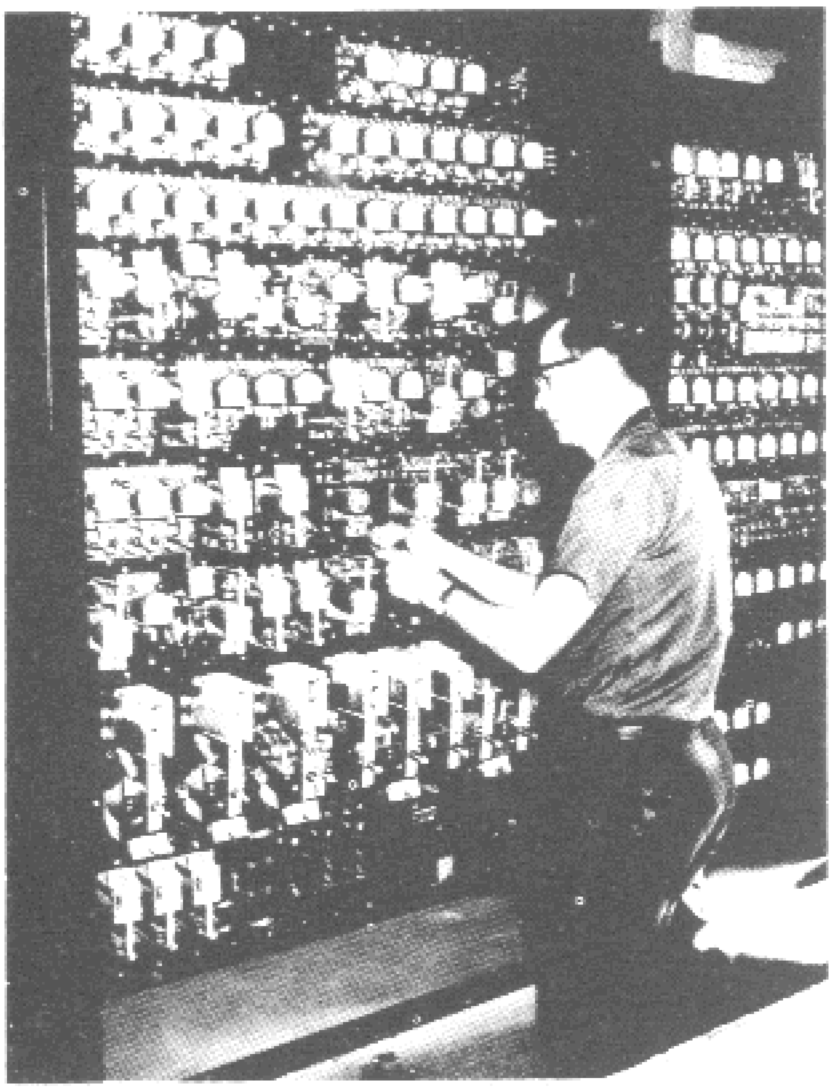
Starting Panels, Relay Panels and Scheduling Equipment

Suggested:

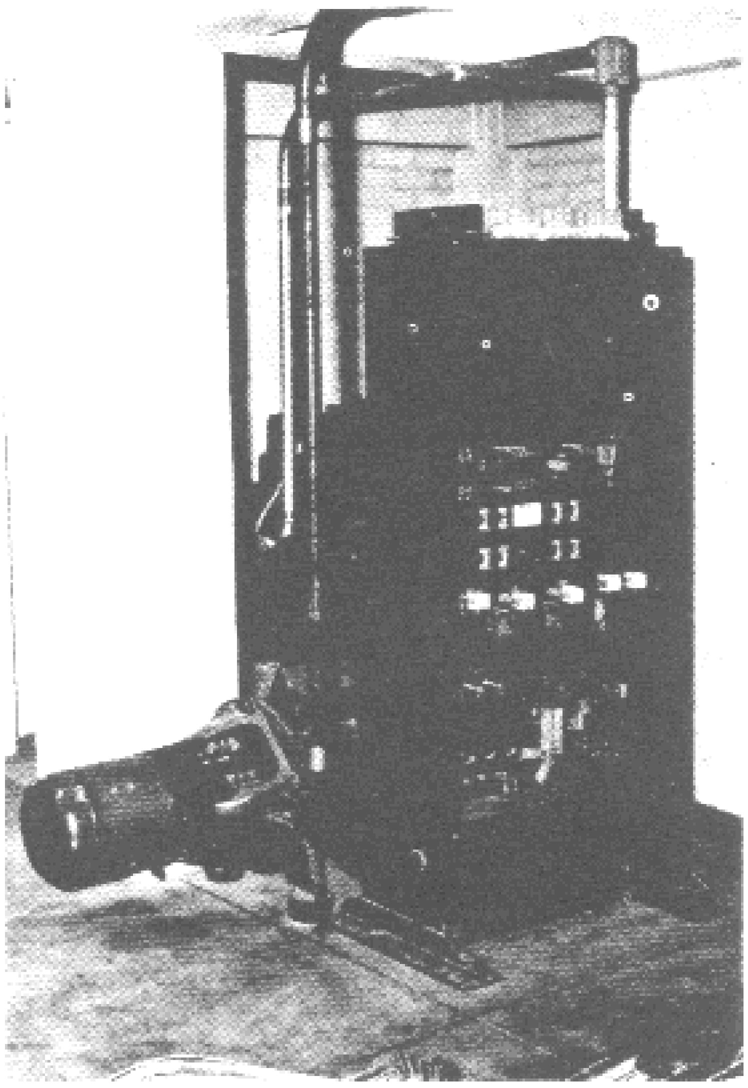
Materials –
- a. bolts and washers
- b. self-drilling anchors
- c. rubber pads
- d. sundries

Tools –
- a. hand tool kit
- b. rollers
- c. crowbars
- d. electric hammer and chuck for anchors
- e. electric drill

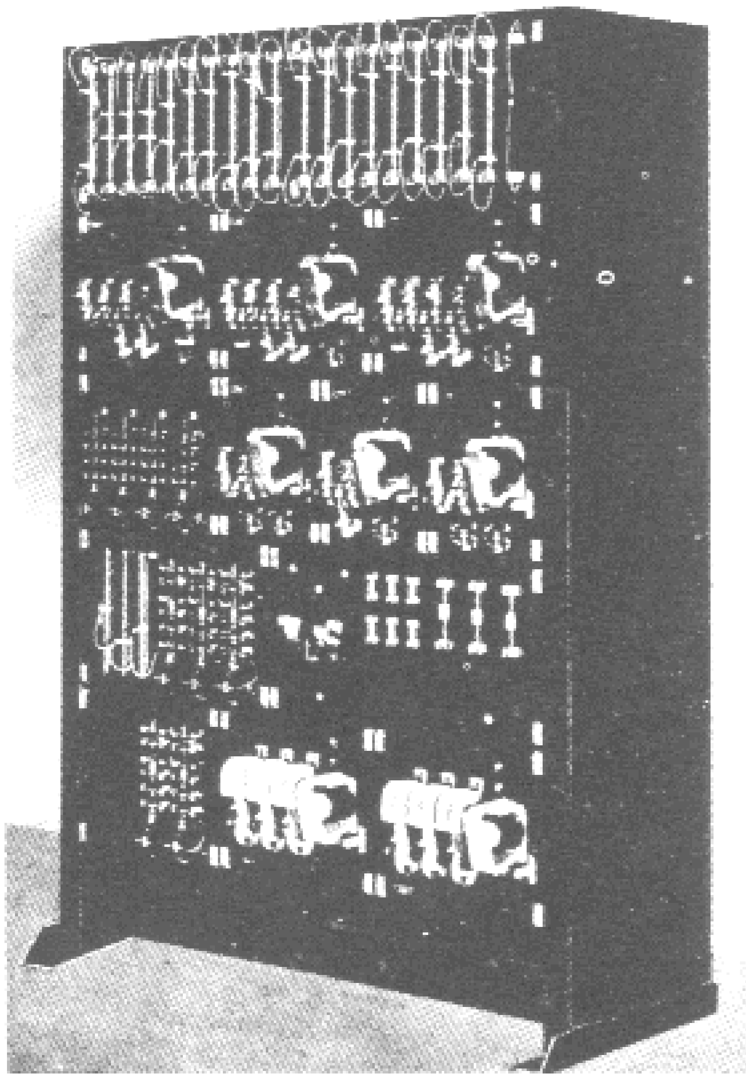
1. Modern design, in many instances, includes motor-generator starting panels with the main controller and, therefore, no special instructions are needed for their installation. Similar panels of other design are mounted on frames that are set adjacent to their respective controllers or generators. They are mounted on floor channels or concrete and plumbed in the same general manner as was described for installing controllers.



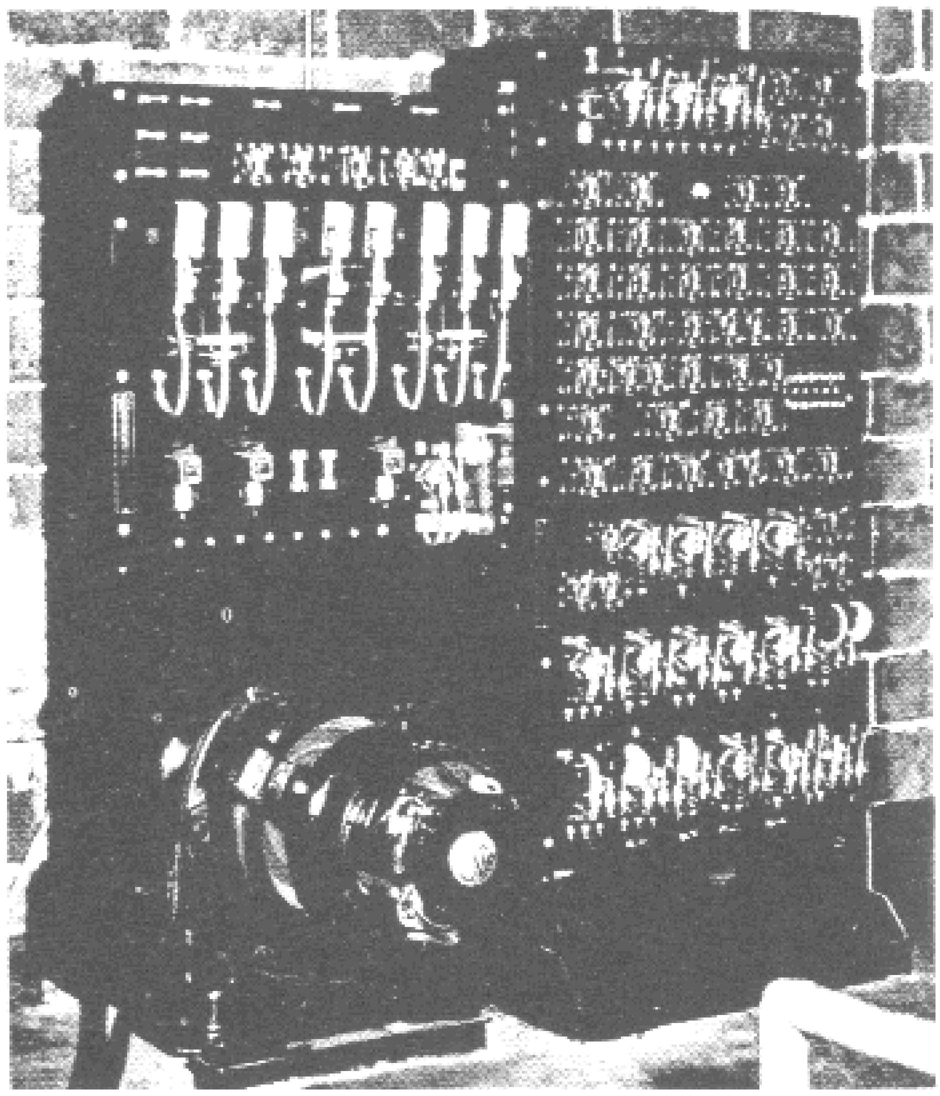
Haughton



Westinghouse



Montgomery



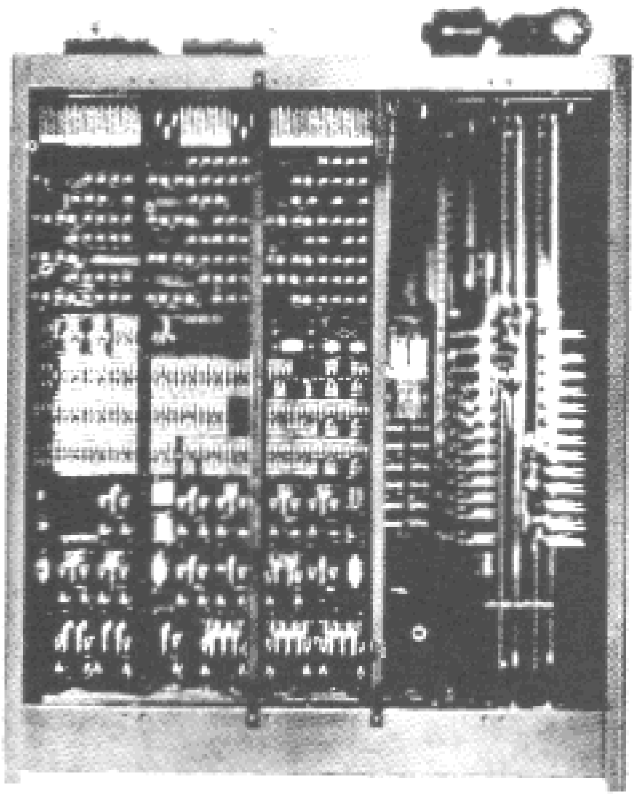
Otis

Motor Generator Starting Panels
(Some Assembled on Main Controllers)

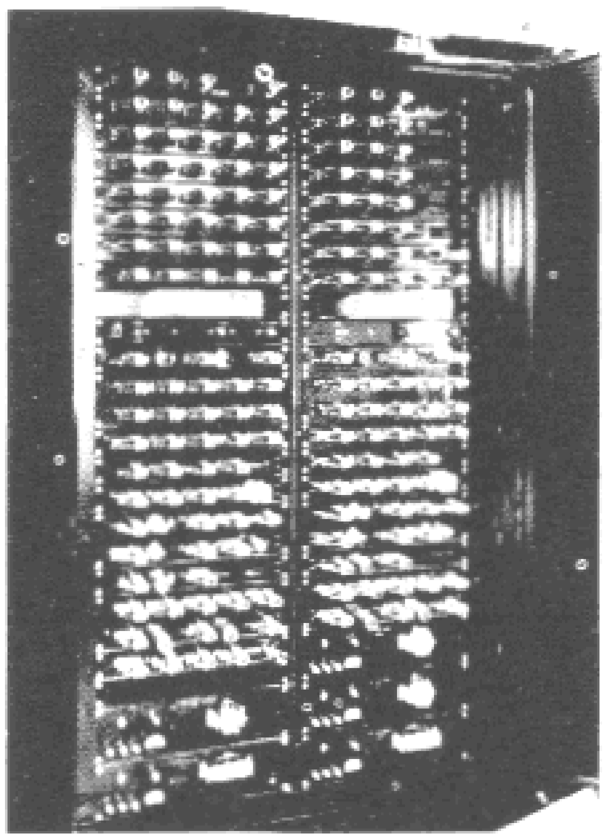
2. A number of new type relay panels are enclosed in steel cabinets. The bases of these cabinets sometimes include pull boxes that act as terminal boxes for the conduit or troughs and wires.

3. The machine room or secondary locations for these panels are determined by the elevator layout draftsmen who are guided by job specifications in the same general manner as for locating controllers.

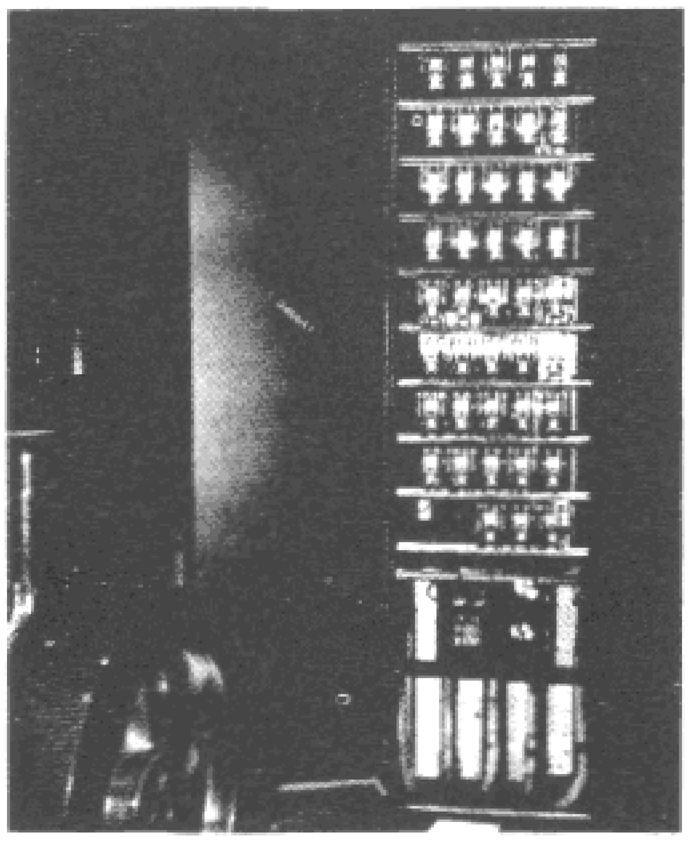
4. Panels are grounded by means of its conduit system, as for controllers and MG sets.



Combined Relay Panel and Selector

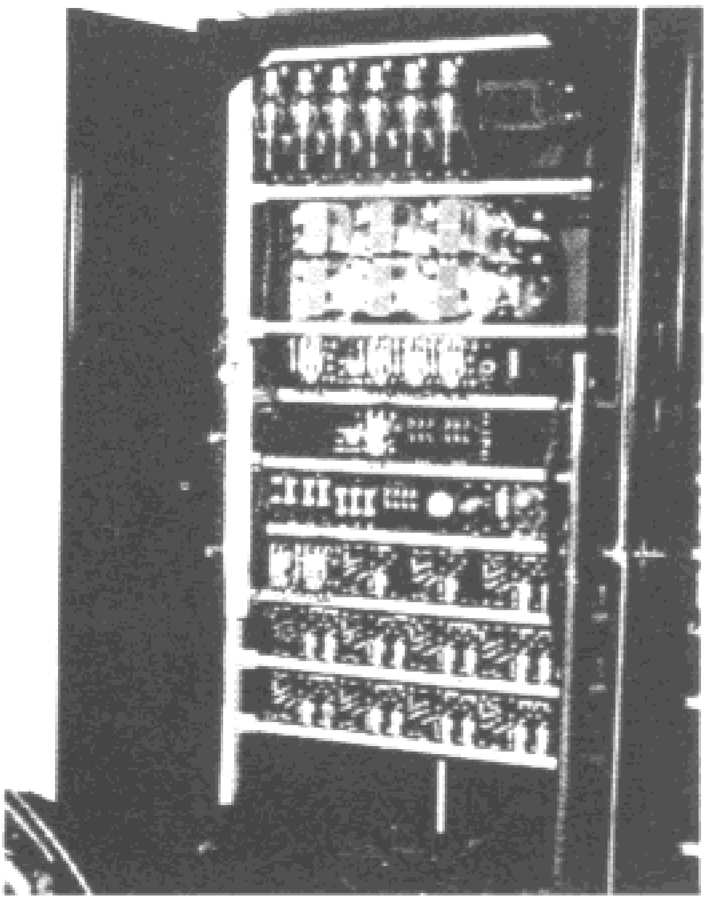


Relay Panel with "Pile-Up" Switches

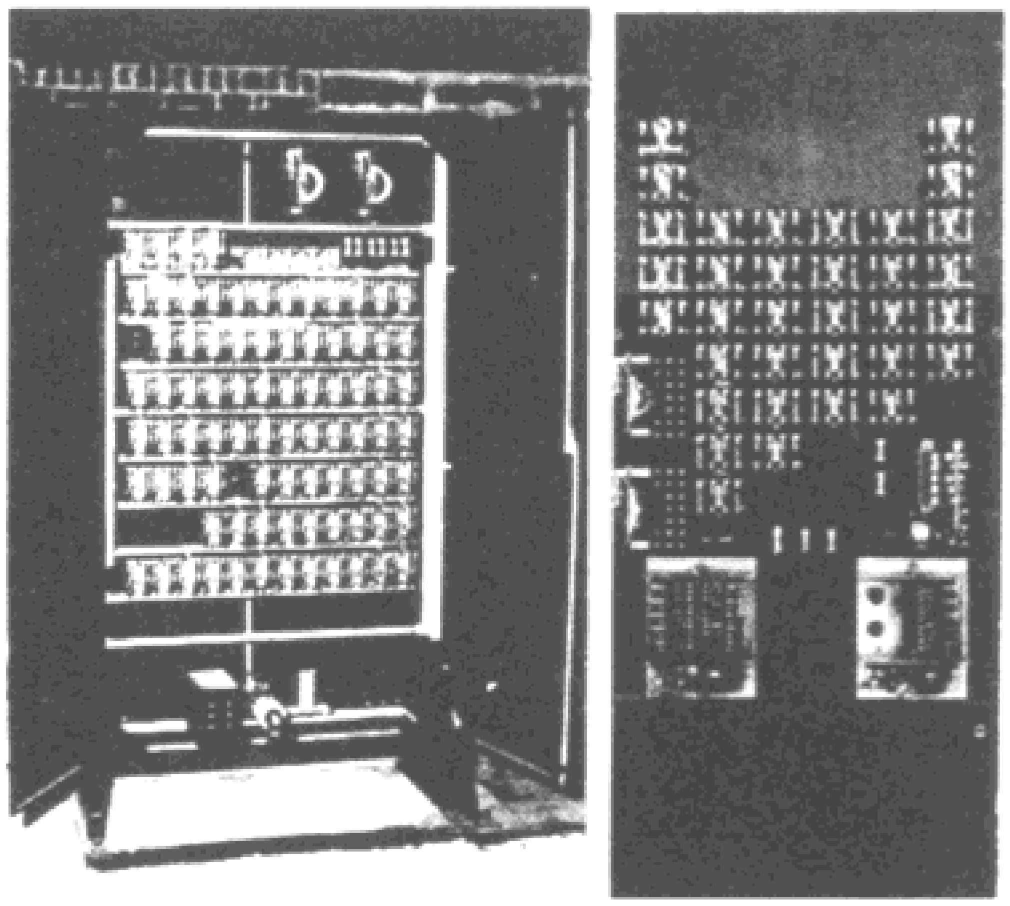


Selector Mounted Relay Panel

Types of Floor Mounted and Selector Mounted Relay Panels



Electronic Dispatching Panel



Conventional Dispatching Panels

Scheduling and Dispatching Panels

5. Some relay panels are mounted on the floor controllers, and their position is thus automatically determined.

6. The mechanic should study each individual layout and field condition. If, in his opinion, there is reason to place the relay panel in some location other than that indicated, he should discuss the subject with the superintendent before installing the panel.

7. If a base box or trough, or pull box is used, its top should be set level with the finished concrete floor line. All conduit should be run in before the concrete is poured. Temporary fastenings to beams or rough concrete can be made by means of shells, bolts, or concrete blocking. When the floor is poured, the frame is bolted to it or to the box. The panel will then be considered secure. Be sure to plumb it on the front and a side.

8. Relay panels for annunciator systems are often mounted on their drives.

9. Equipment for scheduling the operations of groups of elevators were briefly described in chapter 1. This equipment assumes increasing importance as new developments are perfected. Although the components of scheduling devices are distributed quite generally throughout each multi-car installation, most have one or more coordinating units. These may be called Autotronic panels, Selecto-matic panels, dispatch devices, scheduling panels or a combination of these terms. Their basic function is similar in that they automatically or semi-automatically select and time the operations of banks of elevators.

10. Since these devices must be electrically interconnected with all elevators in a bank and with several of the major components of each elevator, they are most logically placed in the machine room areas. In general, they are handled like contoller and relay panels. They are secured to floors or walls as indicated on the final layouts or supplementary drawings.

11. Like controllers, these relay panels are often enclosed in steel cabinets.

12. They must be plumb, aligned with other units and meet the same N.E.C. requirements as controller panels.

CHAPTER 6
Section -h1

MACHINE ROOM AND OVERHEAD WORK

Installing Governors – Vertical Centrifugal Type

Suggested:

Materials –
a. necessary bolts
b. washers
c. shims

Tools –
a. hand tool kit
b. electric drill

1. The prime function of the speed governor on a modern elevator is to initiate the application of the car or counterweight safety at a pre-determined value of overspeed. The governor can have other functions such as disconnecting the line switch (or "potential" switch) at a speed a few percent below the speed of safety application. It is also used to short circuit DC motor field resistance, directly or indirectly, for higher speed unit multi-voltage elevators.

2. Governors are driven by friction of the governor rope traveling over the sheave. The rope is secured to the arm of the safety releasing carrier on the car top. One end of the rope leads from the carrier, from which the rope passes over the governor sheave, then down under a tension sheave in the pit. From there it leads up to the car where the end is secured to the lower section of the releasing carrier arm.

3. As the car moves, the governor rope moves with it, thereby driving the governor. At normal speeds the governor clutch is dormant. At overspeed, the clutch is forced onto the governor rope by centrifugal action of weights, cams and levers. This stops the rope with relation to the car and thus "lifts" the releasing carrier arm, (relatively) setting the safety device and stopping the car. The same sequence opens the governor "pot" switch and the safety operated switch on the car.

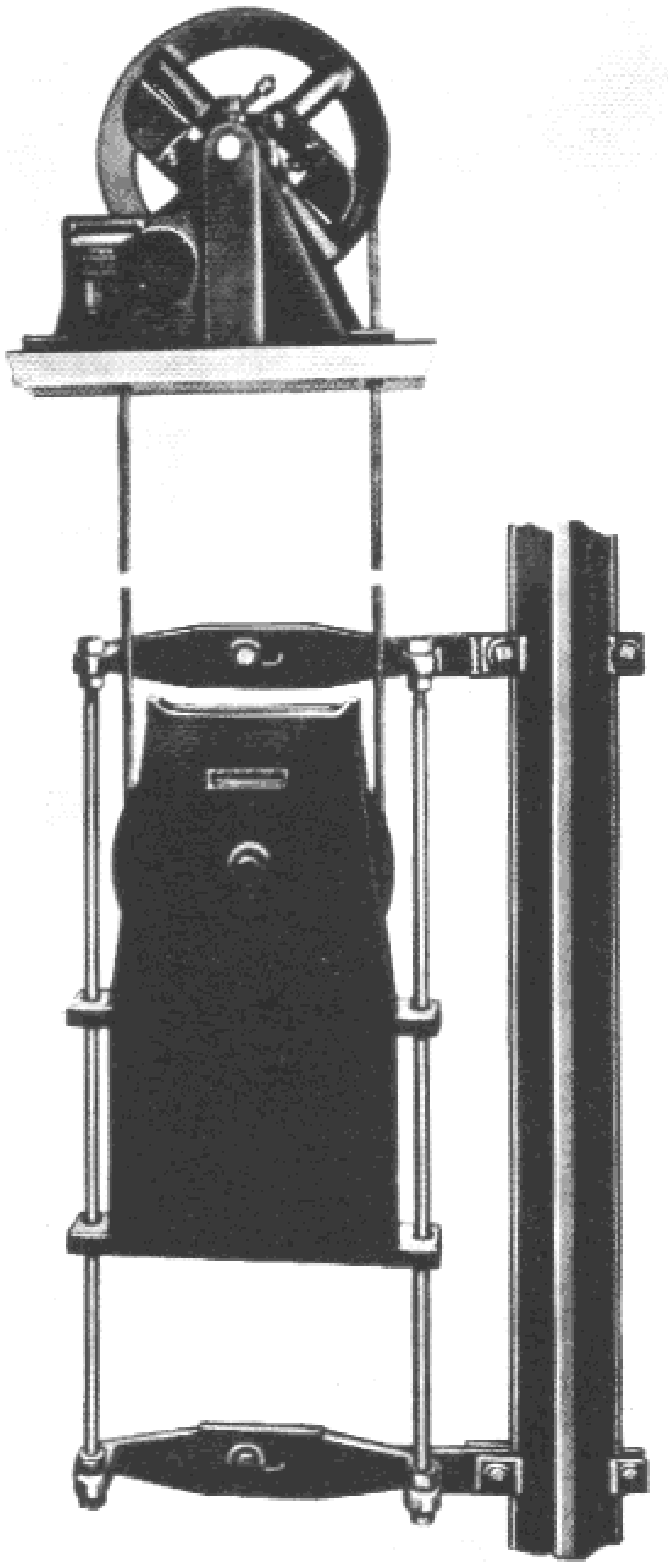
4. Rule 206 of the Safety Code details recommendations for governor locations and arrangements as well as tabulating overspeed "tripping points" as related to car speeds. It also includes supplementary information.

5. All overspeed governors perform this basic function although they differ in external appearance. This article will refer to the type which has its actuating parts vertically mounted in or adjacent to the sheave.

6. There are two general types of safety governors currently in use on modern electric elevators. These types are vertical centrifugal (or "dog") and the flyball. The vertical was formerly limited in application to car speeds of less than 151 f.p.m. but recently governors of this type have been designed for the high-speed gearless elevators.

7. The safety clutch (also called dog or cam) of slow-speed governors is ordinarily mounted on an arm and is thrown against the governor rope, if the elevator overspeeds beyond a predetermined limit.

8. Overspeed governors are installed in the machine room, secondary level, or some other part of the overhead work.

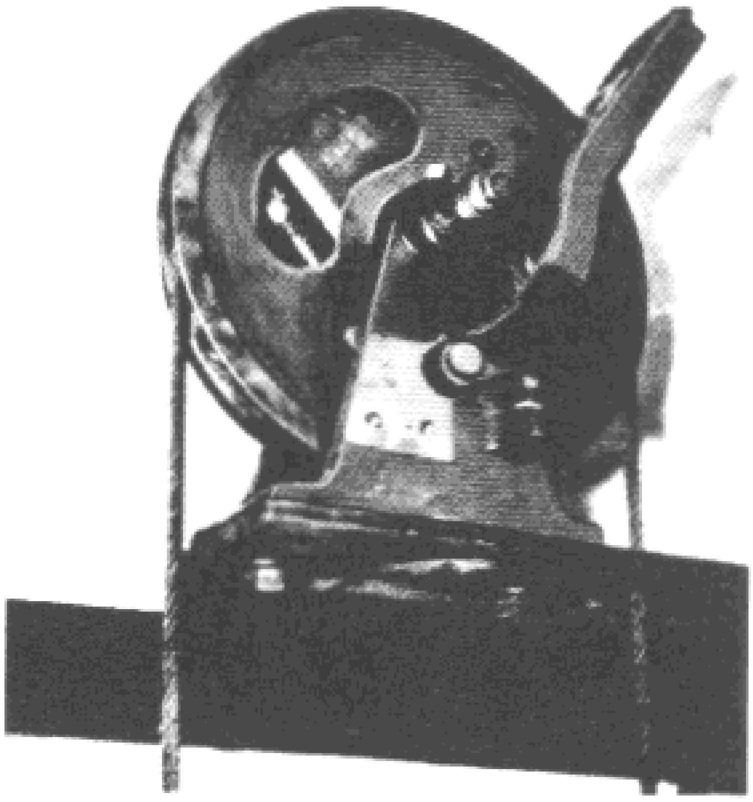


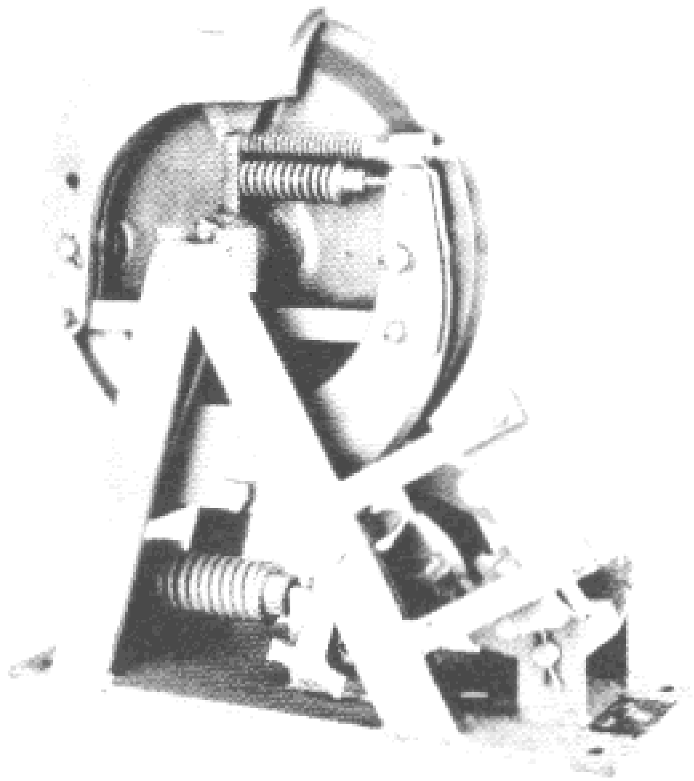
Conventional Governor Installation—The Tension Weight (or Governor Rope Tightener) Assures Positive Traction Between Rope and Governor Sheave.

9. They are set on channels, angles, special mounting brackets, or the machine room slab. It is recommended that governors of all types be mounted on steel.

10. The final layout indicates the spacing between the governor rope location and the center of guide rail line.

11. Where it is possible to drop a plumb bob from the governor sheave rope groove to the top of the hoistway, it is a simple matter to set the governor in its approximate position, plumb down, and shift the governor slightly until the correct distance between plumb bob and guide rail center line is obtained.





Governors for Low-Speed Elevators

12. A glance at the "dog" governor will show that the arm throws in the direction that the sheave will turn, when the car travels down. The plumb bob should be led from this "down" side of the sheave.

13. As an alternative to measuring between the plumb line and the guide rail, the governor may be easily and well located by plumbing from the down side of the sheave to the releasing carrier on the car crosshead. The car should preferably be at the top of the hoistway, if this method is used.

14. If no hole in the machine room slab is available for plumbing, an approximate measurement must be taken, and a hole chopped. The machine sheave center, penthouse wall, or any other convenient point may be used to obtain the mark. The final layout must include sufficient information to enable the mechanic to locate the governor position.

15. Bedplate bolts are invariably set with the nuts on top, heads down. Spring or lock washers should be used under all nuts. Self-drilling anchors can be used as fastenings, if steel is omitted.

16. If a contact is used, run the conduit and mount the switch. Ground the frame.

17. Plumb the sheave, using full length steel shims under the bedplate, if any are needed to obtain that plumb condition.

18. Inspect the governor to be sure all parts are in good condition and free of friction.

19. Lubricate the sheave (or shaft) bearings as well as the pins and springs of the overspeed mechanism.

20. Do not change the factory adjustment of the tripping parts. Be sure the data plate indicating tripping point is on the governor. The safety code requires that seals be placed on governors, once the overspeed point is established. Do not disturb this seal.

CHAPTER 6
Section -h2

MACHINE ROOM AND OVERHEAD WORK

Installing Governors – Flyball Type

Suggested:

Materials –	Tools –
a. sundries	a. hand tool kit

1. Governors of the flyball type are commonly used on elevators with a rated car speed in excess of 150 feet per minute.

2. In appearance and action, they are similar to those used on many types of engines. When the normal speed is reached, the flyballs raise slightly, but have no effect on the elevator operation. If the speed becomes excessive, the flyballs raise further and cams and crank arms actuated by the flyballs open an electric contact. This opens the potential of "line" switch on the controller and cuts off the power supply.

3. Should the elevator continue to run (down) the flyballs lift still higher and set a cam, dog, or similar device. This stops the governor rope from moving, which thereby actuates the safety device.

4. Some governors have "field" slow-down contacts as noted in the preceding article.

5. These governors are usually mounted on channels or angles in steel structures and on a channel bedplate in reinforced concrete structures.

6. They are set on the channel(s) at an exact distance from a guide-rail center line. This setting is indicated on the final layout. It varies with the type and sizes of the safeties of the various manufacturers.

7. If a channel is used as a bedplate with the web laid horizontally, it is necessary to cut holes in the web to permit the governor rope to pass through. These holes can be located approximately by measurements from the guide-rail face. They can be burned, drilled, or cut (with a circular saw). Probably burning is the most satisfactory method, if the equipment is available.

8. Set the governor in close approximate position, plumb the "jaw" side to the safety hitch on the car crosshead or to the rail face. Scribe the holes for the bolts in the bedplate.

9. Cut the holes for the bolts. If the holes are burned, use a cold chisel to cut off and smooth any rough metal. Use lock washers under the nuts.

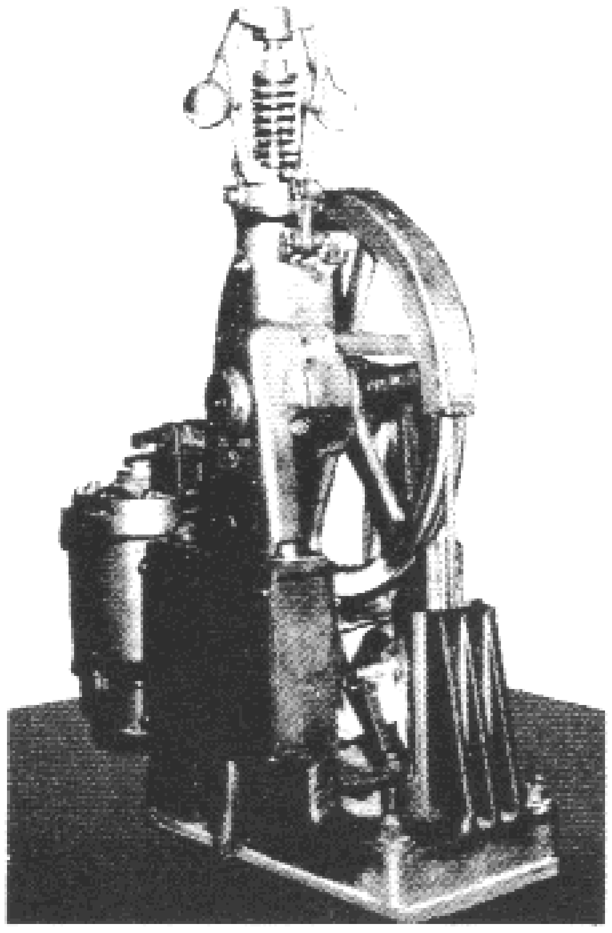
10. Set the governor in place and plumb the governor sheave. If necessary, shim under the governor base to plumb the sheave. Use shims for the entire length of the side packed. If short shims are used, the governor base may be distorted when the bolts are tightened. This may restrict or even prevent the action of the jaws.

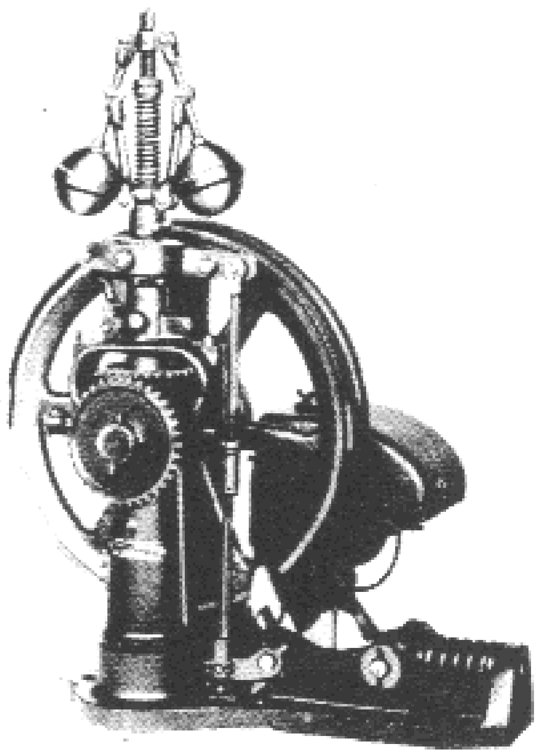
11. Keep the governor base slightly above the level of the finished floor slab, not below.

12. Examine all parts of the governor. Be sure that all cotter pins are in place, all lock nuts installed and tight, and the seals are intact.

13. Lubricate the governor. Be sure that the jaws (or clutch) close or "fall" if the latch is released by hand. If not, loosen one base bolt and experiment again. If the trouble still exists, tighten that bolt and loosen another, and repeat the process until the bolt causing friction is determined. Shim under this bolt before tightening it.

14. Unless a superintendent, field engineer or inspector is present do not change the adjustment of spindle springs or the lift-rod adjusting nuts. These parts affect the point of operation of the safety governor. Therefore, they should be reset only by an authorized man, who will use the proper meter and tools for this work. The unit would then have to be resealed.





Flyball Governors are Used on Elevators with Car Speeds as High as 1600 Feet Per Minute

CHAPTER 6
Section -il

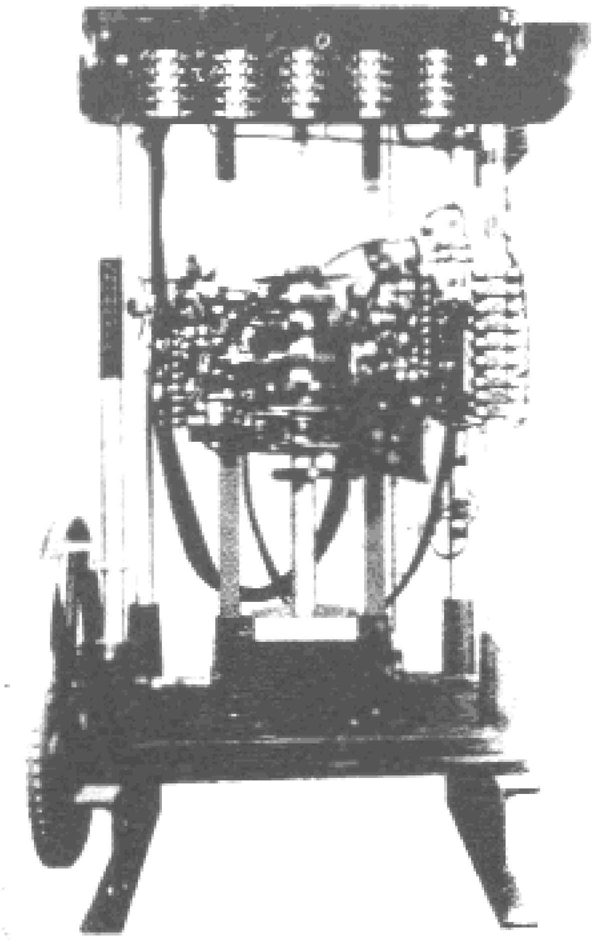
MACHINE ROOM AND OVERHEAD WORK

Installing Selectors, Floor Controller, Verniers and Tape Sheaves

Suggested:

Materials –
- a. bolts
- b. washers
- c. concrete mix

Tools –
- a. hand tool kit
- b. trowel



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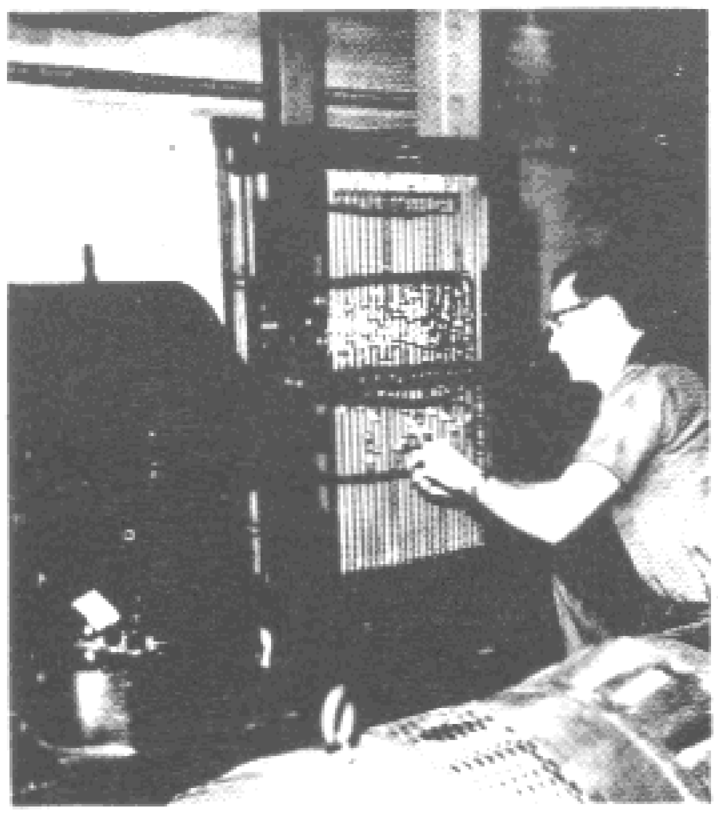
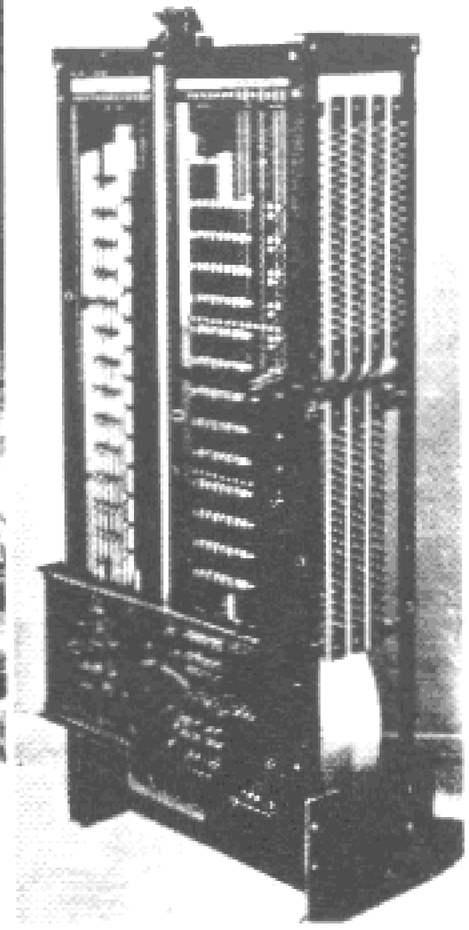


Haughton



Montgomery

Vertical Selectors of Several Manufacturers

1. With the advent of "automatic" elevators, some means of controlling the stops had to be devised. Various companies developed equipment of this nature. All types of these perform the same general function. There are many verniers, selectors, or floor controllers, as these parts are termed, in current use. Some employ a vertical shaft driven by the car through the medium of a wire, steel tape, or cable. Others are driven from machine parts. Some operate on horizontal shafts and have contacts on commutators or conductor rings similar in appearance to the slip rings on a wound rotor A.C. motor. Some of these, such as Haughton's vernier, Dover's synchro selector, and Otis' selector include leveling operation control. On other types

of equipment this function is omitted from the floor controller and handled by devices in the hoistway. Montgomery has a vertical selector for multi-voltage cars that is driven by 1/8" wire rope or "cable." It is quite conventional in appearance. Westinghouse and many other firms, of course, have selectors for all required duties. The photos in this article illustrate some of the variations.

2. Engineers design these floor controllers to operate at specific travel and speed ratios, which correspond to the travel and speed of each elevator contract. They move with the elevators at these given ratios. The selector drives are generally connected directly to the car, selector, and counterweight, but can also be driven by means of remotely located sheaves that operate a chain drive to the selector.

3. The elevator main controller is electrically tied in with the floor controllers by means of the wiring raceways, and generally in conjunction with a "relay panel," scheduling system or some similar device.

4. The final layout gives the location of the floor controller in relation to the elevator. The mechanic has to set it and the drive. He should not install the drive tape or wire until the floor controller is to be adjusted. Some companies insist that the adjustor connect the steel tape.

5. It is very important to align the drive and floor controller accurately with the car. This reduces the chance of noise, breaking of wires and tapes, or premature wear on wire rope drives.

6. Most types of floor controllers are set on a base that is either bolted to the finished floor or to beams grouted in the rough floor. It is advisable to bolt to steel whenever possible.

7. Direct-drive floor controllers, that is, those where the tape sheaves, wire rope, or wire drive drums are mounted on the same base as the device itself, show the selector arranged in its planned location over the hoistway. It is shown on the layout and could be in a secondary level or machine room.

8. The unit is blocked up to its proper height in relation to the finished floor line and placed according to the layout.

9. The drive sheave or drum is then plumbed by placing thin shims at appropriate locations under its base.

10. A plumb line is dropped from the drive at the car side to assure alignment.

11. The tape (or wire) hitch on the car crosshead is placed in accordance with the measurements indicated on the final layout.

12. The tape sheave is aligned to a plumb position above this tape hitch.

13. Where a counterweight tape, rope or wire hitch is used, this is now installed. The counterweight side of the floor controller sheave (or drum) is also plumbed to the counterweight hitch, care being exercised not to disturb the alignment of the car side with its hitch. The selector is then bolted to the steel.

14. Some drive drums cause the "lead" to travel out of plumb with the car and counterweight hitches as the elevator moves through the hoistway. This lateral movement does not affect the operation of the car or floor controller because it is predetermined and regular. Nevertheless, since the wire is seated in a threaded groove, it is important to plumb from the drum to the hitches when the car and counterweight are at the top of the hoistway. First set the car end, then run the car to the pit and set the counterweight side. This will reduce the possibility of the wires jumping out of their grooves.

15. Where the steel tape is to pass under a tension sheave in the pit and then be secured to a car hitch, the floor controller is set with a tape sheave plumbed to the car hitch. Next, drop a plumb from the lead side of the "long" tape sheave. Measure the clearance between the plumb and the rail. This measurement should correspond to the location of the tension sheave in the pit. If it does not, and the tension sheave location is fixed, shift the floor controller sheave to obtain the correct setting.

16. Where the tape or wire drives are to be remotely located, set the drives as already described for the "direct" type, and then align the chain (or other) sprockets of the drive and of the floor controller by means of a light string.

17. Summarizing the foregoing:

a. Place the floor controller in accordance with the final layout.

b. Block it up to the finished floor line.

c. Plumb the sides and sheave.

d. Plumb tape (or wire) to car.

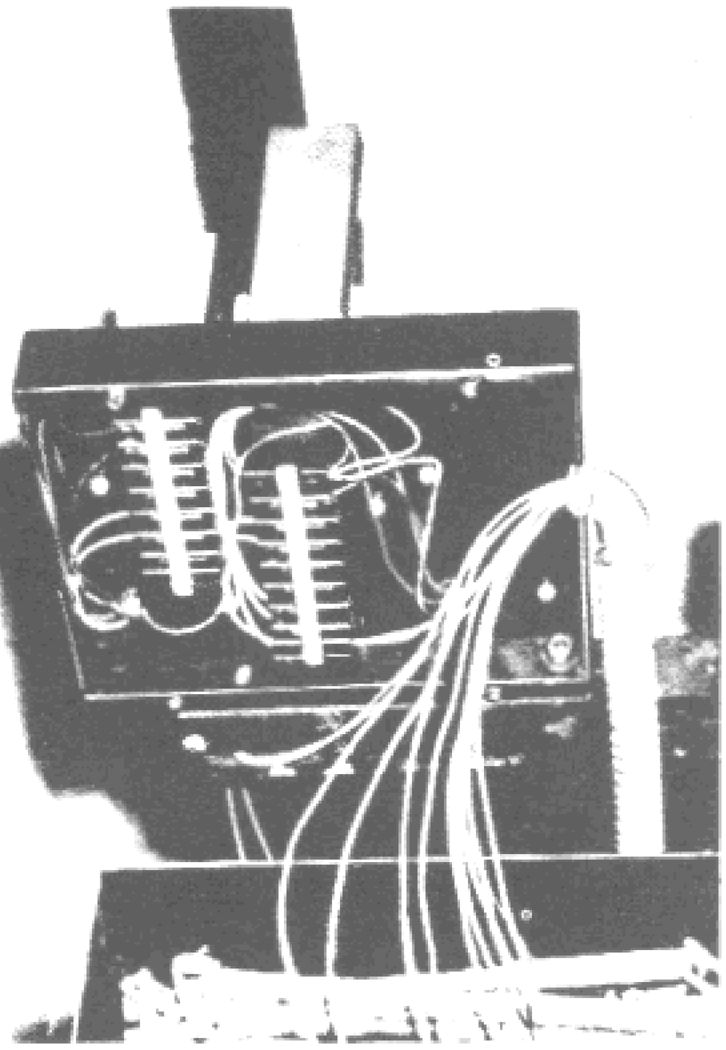
e. Plumb tape (or wire) to counterweight or pit sheave location.

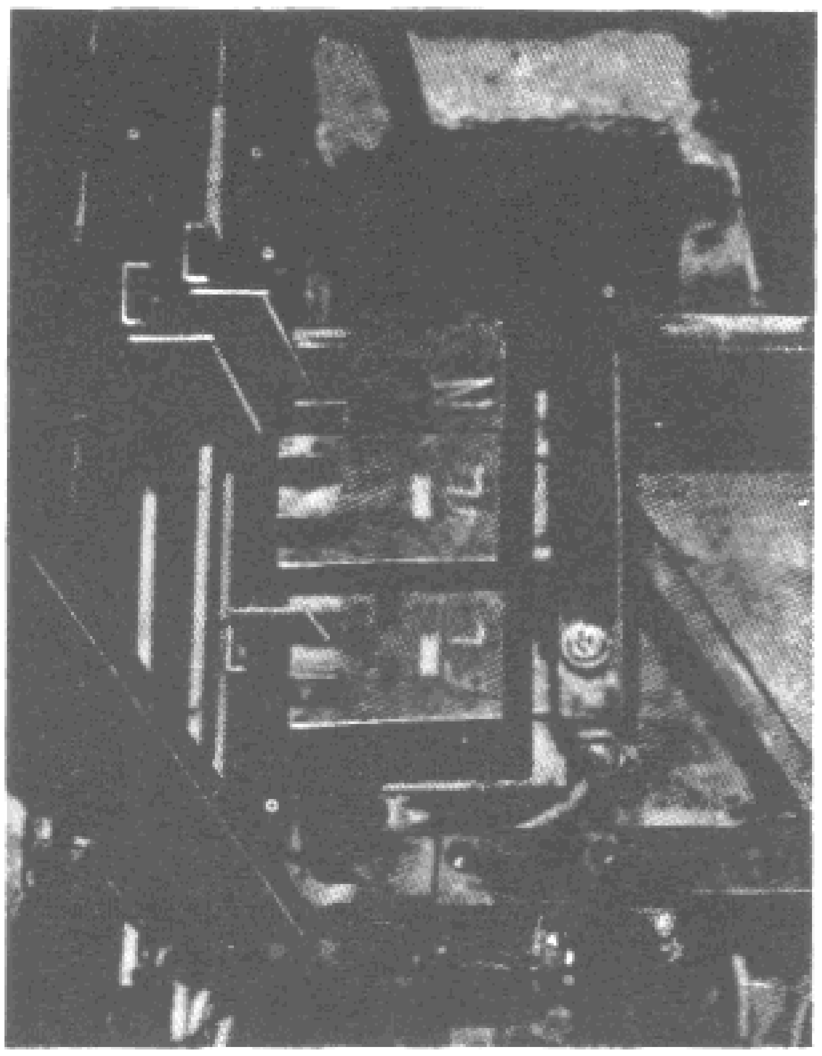
f. Bolt down floor controller.

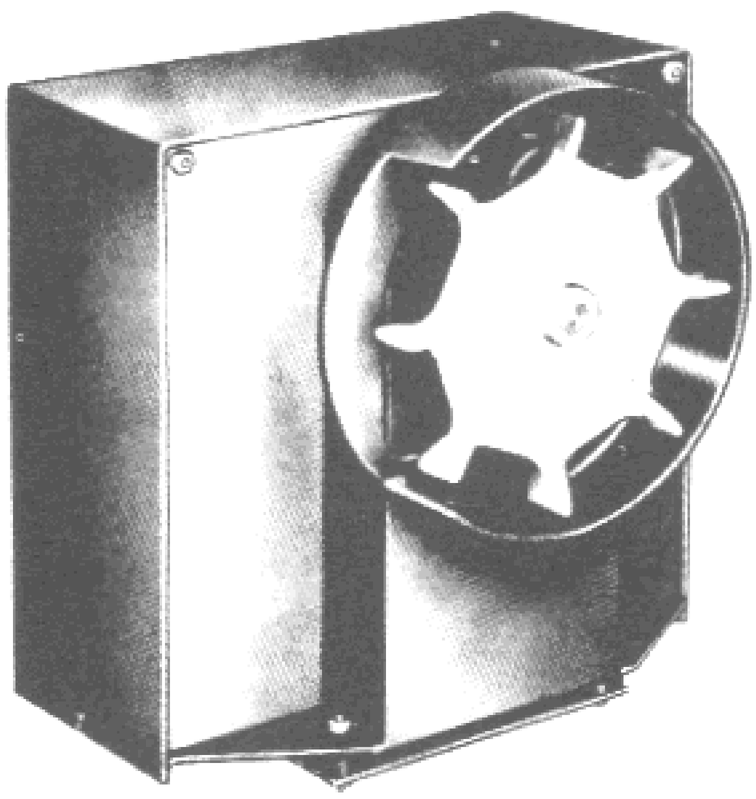
g. Final check of plumb alignment.

h. Grout base in, if necessary.

18. For some years, many manufacturers considered selectors as advantageous only on medium and high-speed elevators. Hoistway stopping and leveling switches, both mechanical and magnetic, were used for low-speed equipment. More recently modified and more simple, less expensive "stopping" or "stopping and leveling" selectors have been developed for low-speed A.C. elevators. Otis has used one in Europe for some time. Montgomery developed their so-called "star wheel selector." It is a car-top unit, sound isolated and is operated by mechanical tripping devices mounted on the rails for low-rise duties. Other companies have their own versions. All are usually limited to push button or collective control elevators.







Selectors and Leveling Devices for Car Top Installation

CONTENTS

CHAPTER 7

Section No.	*Description*	*Page No.*

PIT STRUCTURES

CHAPTER 7
Section -a1

PIT STRUCTURES

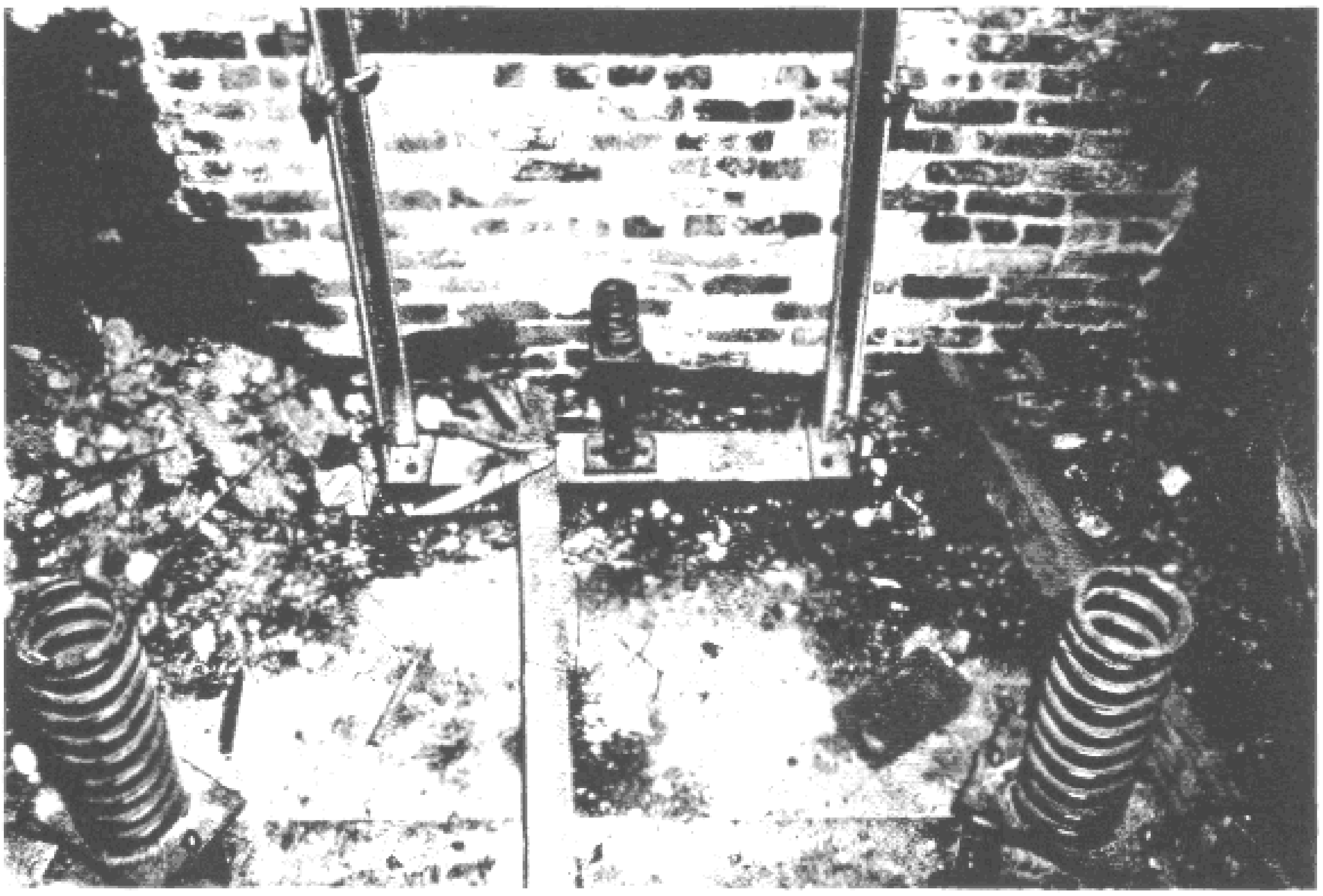
Pit Work – General

1. Pit work as related to modern elevators is a broad term that includes equipment of both electrical and mechanical functions. Most of the items are associated with the safety of elevator operation.

2. The safety code requires that all passenger and freight elevators be equipped with buffers of one type or another, with final limit switches and "runbys" (or space for overtravel of the elevator in case of emergency) to meet specific requirements. All of these items and others are related to safety in operation and in maintenance work.

3. They are among the elevator components that will be found in pits, as are other items. In summarizing we can list:

a. Buffers, which may be wood blocks, spring or oil filled piston types, under circumstances detailed by the code. Some plunger elevators have rubber bumpers.



Spring Buffers in Unfinished Pit

b. Tension sheaves for governor ropes, tape drives or wire drives.

c. Car to counterweight compensation parts. Chains are common for lower car speeds. Higher speed or quality units are equipped with rope compensation. This also requires a tension sheave in the pit. Where the elevator speed is 800 F.P.M. or higher the ''comp'' sheave gear must be ''tied down.''

d. Final limit switches, usually mounted on a guide rail.

e. Stopping switch cams can extend essentially to the pit on some types of elevators.

f. Indicator devices sometimes have weights in pits.

4. Under certain conditions special arrangement of pit equipment is necessitated by building or subsoil conditions. For example, where a new elevator is being installed in an existing building the building footings may make it impossible to obtain a pit deep enough to accommodate a standard ''oil'' buffer. Special adaptations were designed to overcome this problem. Two specific buffers for overcoming such conditions are the ''compact'' and the ''compound'' types, shown in the photos of Chapter 7 -b2. The various companies have their special designs to overcome the same problem.

5. In the original N.E.M.I. Erection Manual we noted that pit work in modern buildings is probably seen less than any other part of elevator equipment insofar as owners and passengers are concerned. This statement still holds true, of course, as related to the United States and Canada for which it was written. Our structural design engineers and architects do provide adequate pits in general and the pits are concealed. This is especially true on large commercial installations.

6. One of the interesting sidelights on this subject is that pits of old fashioned elevators were generally visible to passengers through hoistway grills and despite this they were frequently quite dirty and unsightly. Today well maintained pit areas are painted, well lighted and cleaned at regular intervals, despite the fact that they are seldom seen by the general public.

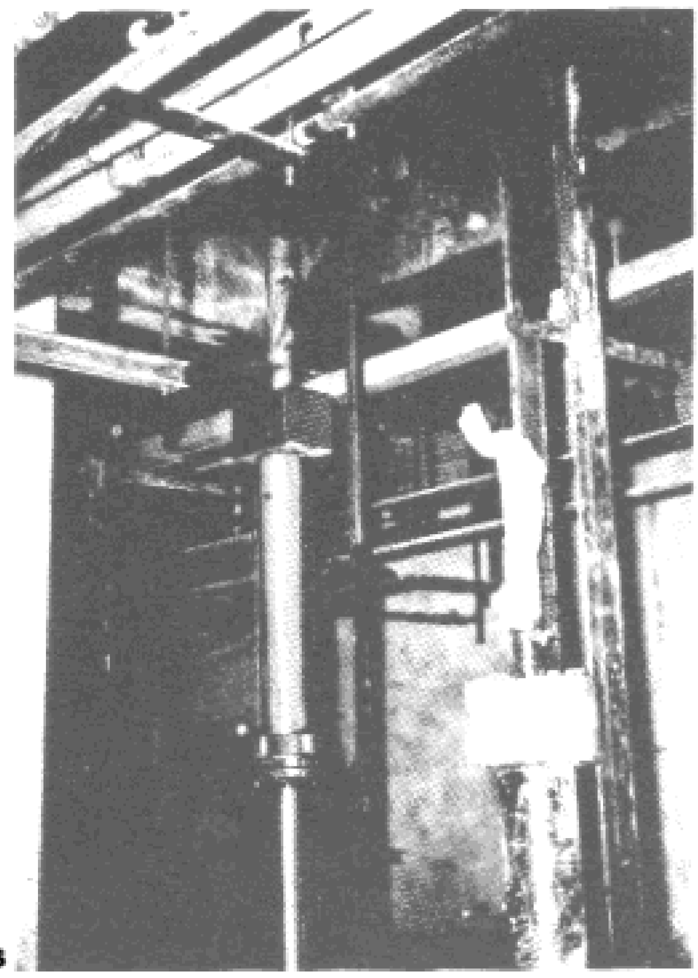
7. Code requirements, such as Rules 100, 106 and 107 of the A.S.M.E. Safety Code, define basic minimums for construction of pits.

8. It is recognized that both installation and maintenance can be accomplished better where working conditions are adequate in space, lighting and general cleanliness.

9. Wide acceptance of ''roller'' types of guide shoes has added to the improvement in pit cleanliness by eliminating the need for application of lubricants to the guide rails.

10. Architects in the Far East and most Latin American countries are inclined to follow our safety code requirements as far as pit sizes and construction are concerned, where these details are made known to them. However, in some other areas, such as the extremely competitive markets of Europe, pits and other hoistway requirements are less stringent. Very poor conditions are often permitted and they include such items as very limited runby, solid concrete or wood buffers on elevators with car speeds in excess of 100 F.P.M., no lighting and no access arrangements.

11. It is worth noting that in almost all countries the men responsible for designing and constructing outstanding buildings such as London's Shell Complex, Berlin's Telefunken, the A.M.P. Building in Sydney, the Far East's monumental buildings, and many others are all guided by details worked out in the monumental structures in the United States.



Oil Buffers are Often Placed on Pipe Struts

CHAPTER 7
Section -b1

PIT STRUCTURES

Assembling Channels for Spring Buffers

Suggested:

Materials –
- a. channels
- b. support angles
- c. bolts
- d. clips
- e. buffer stands
- f. sundries

Tools –
- a. hand tool kit
- b. line level or long straightedge

1. Rule 201, of the American Safety Code specifies that spring buffers may be used on passenger elevators with car speeds of 50 F.P.M. or more and freight elevators with speeds above 75 F.P.M. provided the speeds of either do not exceed 200 F.P.M.

2. Solid bumpers of wood or other suitable material and strength, by code definition, can be used on passenger and freight cars where speeds are below 50 F.P.M. and 75 F.P.M. respectively.

3. Buffers should be located within 2'' of the car's or counterweight's vertical center line.

4. Rule 201.3 defines construction and requirements for spring buffers.

5. Some overseas codes permit the use of spring buffers for speeds of up to 350 F.P.M. On a world wide picture, spring buffers are still the most common type.

6. Some spring buffers are attached to counterweights but in general both car and counterweight spring buffers are mounted in the pit.

7. Spring buffers, like those of the oil types, have two main functions. They are to reduce the shock of a loaded car striking the pit, if it ''runs away'' and to stop the car high enough above the pit floor so that no damage will be done to the car shoes or other under-car parts.

Rail Bracket Being Squared to Spring Buffer Channel

8. These buffers are generally mounted on buffer support channels. The channels not only support the springs but also serve to tie the bottoms of the guide rails together. The factory supplies these channels to suit the layout conditions. Buffer stands and angle rail supports are included with the material. The field mechanic assembles the parts properly as a unit. He must then align it properly with the bottom of the guide rail. The channel itself is usually factory drilled and tapped. When installing the channel, it is merely necessary to square the angle rail supports to it at the right positions, set them, allowing for the proper ''D.B.G.'' plus double the thickness of the rail, plus packing shims, then bolt them in this location. The buffer stands are bolted in place at the same time and the assembly then put into its approximate position.

9. To set the channel assembly in the pit, determine where the finished floor line location will be. This is a simple matter, if the finished floorline of the lower terminal landing (or any other floor) is known. With a rule or steel tape, measure down from the finished floor (or bench mark) the number of feet and inches as indicated on the final layout and mark a pit wall. Set the channel level with this mark. Clip the angle supports on each rail when the channel is level with mark. The rail brackets automatically locate the channel to the rail centers. (As indicated in chapter 5, section -e2, paragraph 10, it is preferable to install the buffer channels when starting the guide-rail installation. Building conditions do not always permit this, and in such cases it is necessary to install the buffer channels after rails have been installed.)

10. It was formerly considered good practice to grout the channels into the pit floor so that the top was flush with the floor line. This is no longer universally favored as the best system. Now the channel flanges are set on the finished pit floor. The channel can then be grouted in, if required. However, either method is satisfactory.

11. When the finished pit is a waterproofed shell, the channel should always be set on top of it. The waterproofing cannot take a firm hold on the sides of the channel flanges. Therefore, the pit would probably leak, if the channel were set into the waterproof floor coating. Also, the presence of standing water would eventually corrode the channel and thus cause "leaks."

12. The field mechanic should never assume the responsibility for damaging the waterproofing of pits by cutting into such concrete. If he is specifically ordered to do so by his field superintendent, he should attempt to obtain the concrete workers cooperation in re-sealing the pit. The elevator mechanic should not cut into waterproofing on anyone's orders but his own "supers."

CHAPTER 7
Section -b2

PIT STRUCTURES

Oil Buffer Assemblies

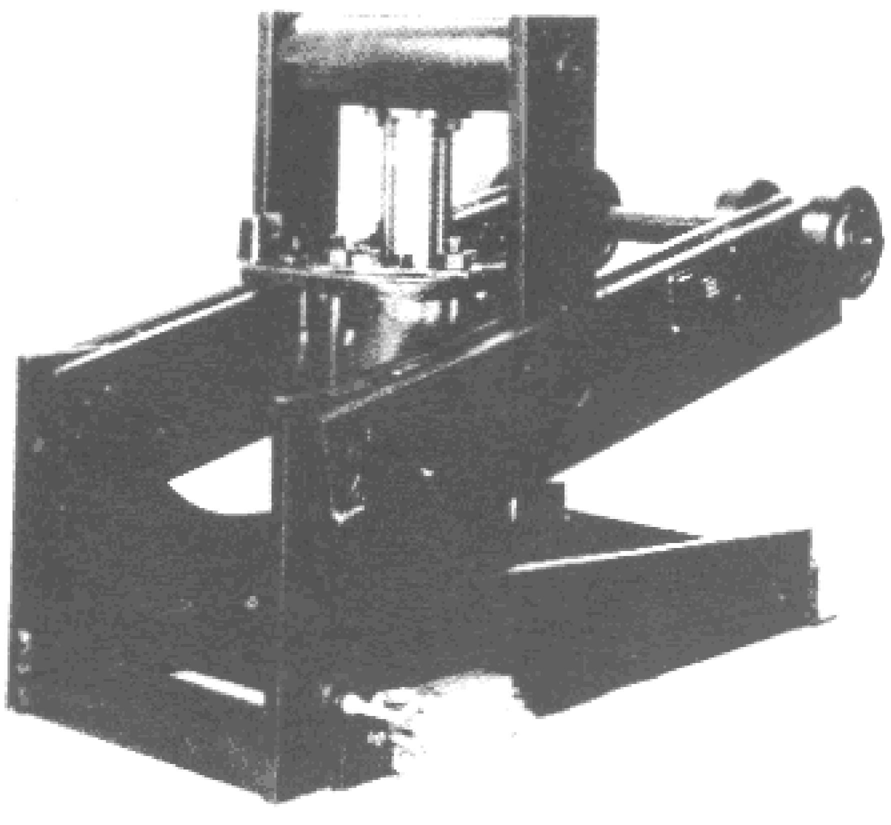
Suggested:

Materials –
- a. buffer structures
- b. bolts, nuts, washers
- c. shims or packing
- d. oil for flushing
- e. oil for buffer

Tools –
- a. hand kit
- b. chain tackle or puller
- c. slings
- d. timbers
- e. welding equipment (optional)

1. As car speeds increased, refined equipment was designed to assist in operation and to maintain an adequate safety factor.

2. One of these components was the oil buffer, which was designed to retard runaway cars gradually and to cushion the shock of striking. Under Rule 201 of the Safety Code a requirement is set up that all elevators with speeds exceeding 200 F.P.M. must (per code, "shall") be equipped with approved oil buffers. The construction of and requirement for oil buffers is described in Rule 201.4, which has several sub-sections detailing other information about these buffers. Generally the buffer is to retard a car at no greater than 32.2 feet per second per second under various conditions as described in the rule.



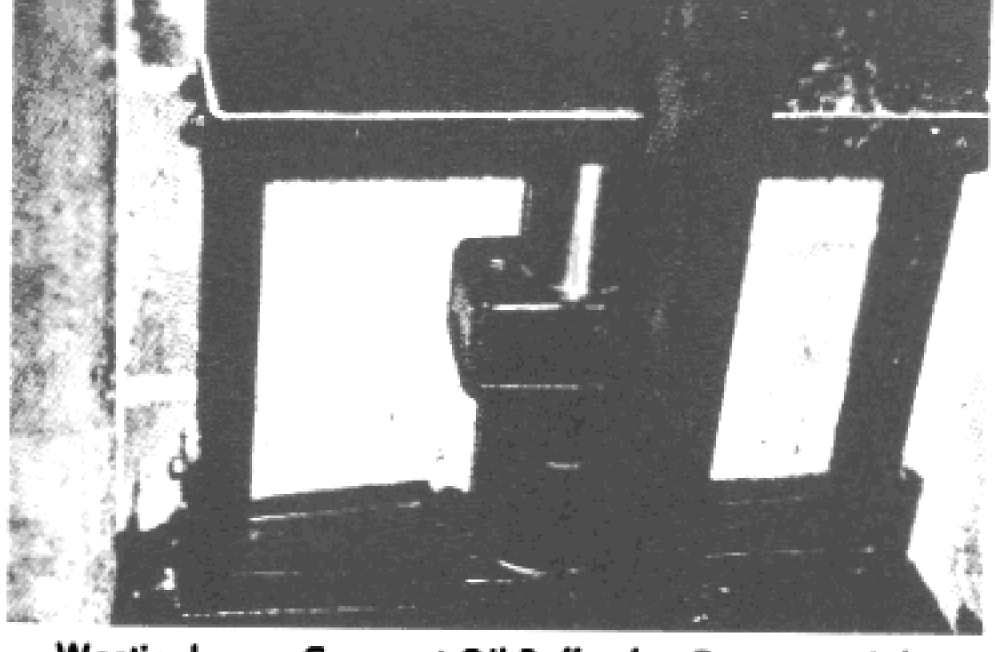
Montgomery Compound or "Lever" Oil Buffer is Designed for Limited Pit Depth

3. Oil buffers are mounted on channel bases, similar in arrangement to those used for the spring buffers. However, where there are **usually** two spring buffers, oil buffers are generally single units. The channel bases rest on the unfinished pit floor. The car buffers are cross braced to the main guides (sometimes also to the counterweight buffer).

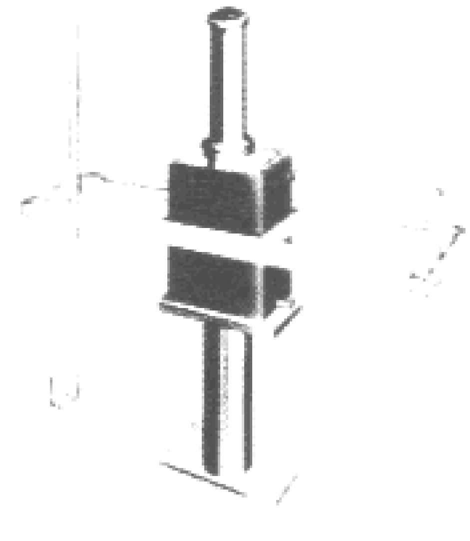
4. The oil buffer channels should be mounted on a base that will withstand the shock of the fully loaded car striking the buffer at governor tripping speed. When an elevator is equipped with a compensating sheave and ropes with a tie down device, this equipment is generally installed at the same time as the oil buffer. Such installations subject the tie down support foundations to considerable upthrust and must be designed to withstand it. The impact and upthrust differ with the capacity and speed of each elevator installation.

5. Before starting to install the buffer, the mechanic should first measure from the finished floor lines of the pit or buffer foundation to the sill or bench mark of the lower terminal landing. When he finds this distance to be correct as shown on the final layout, he can begin the actual work of assembly. One method of checking the floor-to-pit measurements is to extend a straightedge or a straight timber out from the lower terminal bench mark or sill and measure from it to the pit floor.

6. Also, before starting work, measure the length of the buffer strut and buffer. Compare this to the distance shown on the final layout.



Westinghouse Compact Oil Buffer for Counterweights



Otis Oil Buffer – Illustrating Supports

7. Rig a chain hoist or puller and lower the buffer strut into place. Plumb it and secure it. Next, lower the buffer assembly onto the strut. Bolt the two parts together. Plumb the buffer piston.

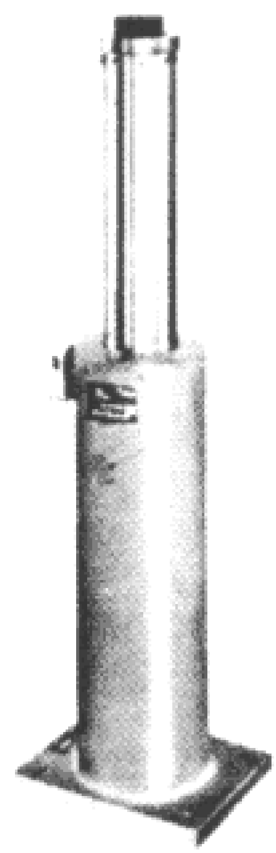
8. Bolt the buffer steadying angles on the structure and guide rails or other specified supports. Make them level, then tighten all bolts securely. Some parts of some designs, such as angle clips and braces, can be welded instead of bolting if equipment is available.

9. Drawings from each manufacturer detail the assembly of the buffers and their supports, blocking and channels. Regardless of this, a mechanic should check his work to be sure that the strike point of the buffer is within 2'' of the vertical center line of the carframe or counterweight frame.

10. The buffer should be checked to assure that the ''marking plate'' or data plate is in place and visible. This is especially important on the counterweight buffer, which in some designs, can be inadvertently turned so the data plate is toward the wall. Government and insurance inspectors check the buffer data plate, as do the maintenance men. Constructors should also check the data plate, in order to determine if the buffer supplied actually conforms with the layout and other erection data. Oil fill hole and oil level gauge locations must be kept accessible.

11. When necessary to remove a protective coating of paint or an anti-corrosive compound from the piston, remove it with *0 emery paper soaked in oil, or with steel wool. (Do this before testing the buffer.)

12. Protect the piston against rust. (Westinghouse mechanics and those of other construction and maintenance companies cover the buffers with canvas bags to reduce corrosion. The material should be treated chemically to resist flame.)

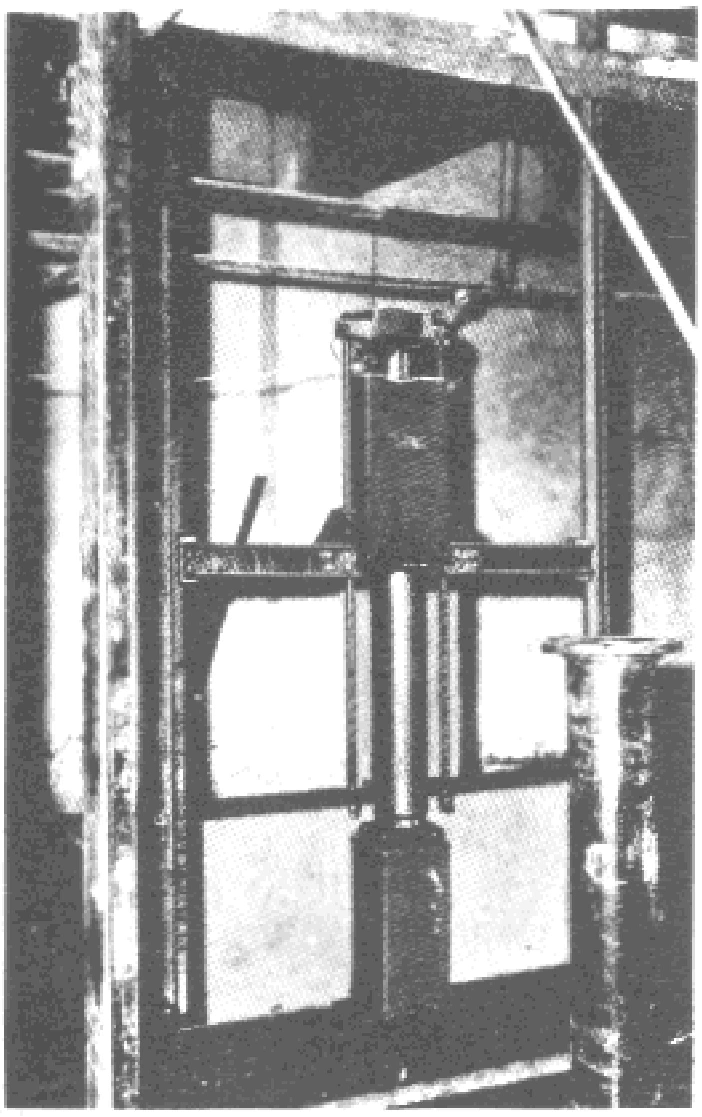


Dover Oil Buffer
with Buffer Switch

13. Remove the drain plug to clear the buffer of shipping oil, then flush the cylinder with kerosene. Diesel oil of lightest grades will generally do as substitute, if no kerosene is available, and is preferred by some men. Others use standard buffer oil for flushing.

14. Next, install the oil gauge or pet cock in the reservoir and fill the chambers to the proper level with the recommended grade of buffer cylinder oil.

15. The new mechanic should test the oil buffer under direction of his superintendent, if he does this work at all. The work is done after the oil chamber has been filled to the proper level, the elevator to counterweight overbalance established and wiring completed to the point where power is available so the car can be moved electrically from the controller.



Otis Gravity Return Oil Buffer for Counterweight

16. The important points of this preliminary test procedure are:

a) Check clearances around the perimeter of the car platform. Plumb down the close points to be sure the platform will not strike as the buffer compresses.

b) Place a contract load of test weights on the platform, distributing them over the safety plank.

c) Run the car down slowly, compressing the buffer to its maximum.

d) Raise the car quite rapidly, observing and timing the return of the buffer to its normal position.

e) The buffer should return to normal, or fully extended, position within 90 seconds.

f) If the test is unsatisfactory, corrective action will be initiated by the superintendent. This may involve either field or factory rework.

17. Further and more complete tests are made prior to the municipal test. These are generally performed by personnel trained for the work and may be mechanics in some companies or field engineers in others.

CHAPTER 7
Section -c1

PIT STRUCTURES

Governor Tension Sheaves

Suggested:

Materials –	Tools –
a. bolts	a. hand tool kit
b. washers	b. grease gun
c. packing plates	c. electric hammer (if required)
d. sundries	
e. self-drilling anchors (if required)	

1. Governor tension sheaves serve both as tension devices and as idlers. Since the sheaves are tension devices, they are set in guides and are free to move down as the governor rope stretches. Their usual position is in the pit, as low as possible so that they may be easily maintained. There are instances where the tension sheave is located a short distance above the pit floor. It cannot be as high as the car top, when the car is in the pit with the buffer compressed.

2. Actually, the position of the tension sheave is dimensioned on the final layout or a detail drawing so the mechanic only has to be sure that the pit conditions permit him to install it in the planned manner.

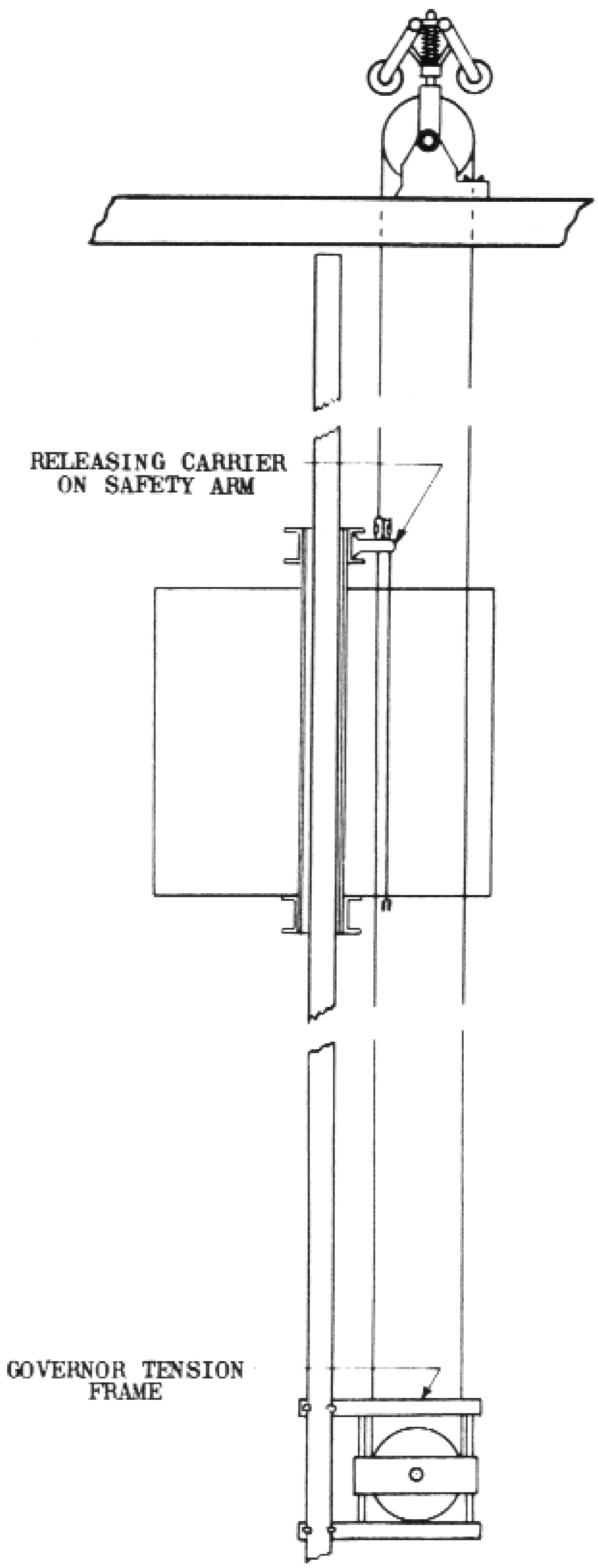
3. There are several types of these sheaves, however, they are practically all installed in a similar manner.

4. Most of these tension sheaves are fixed to a main guide rail (or counterweight rail, if for counterweight safety) by means of flat iron brackets, or secured to a pit wall with knees or flat irons.

5. Since the rail type brackets are standardized by the various companies, they automatically locate the sheave within a fraction of an inch, as indicated on the final layout, in relation to the center of a guide rail face.

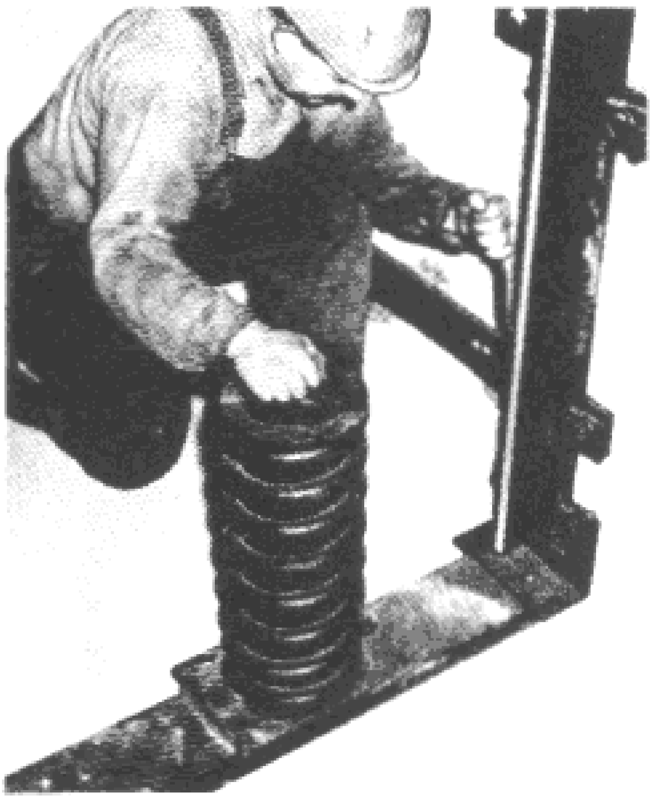
6. Bolt the brackets to the rail and then the tension frame to the brackets.

7. Plumb from the car crosshead releasing carrier to the car side of the tension sheave, and shim between the rail back and the bracket to obtain a true alignment of these two parts.

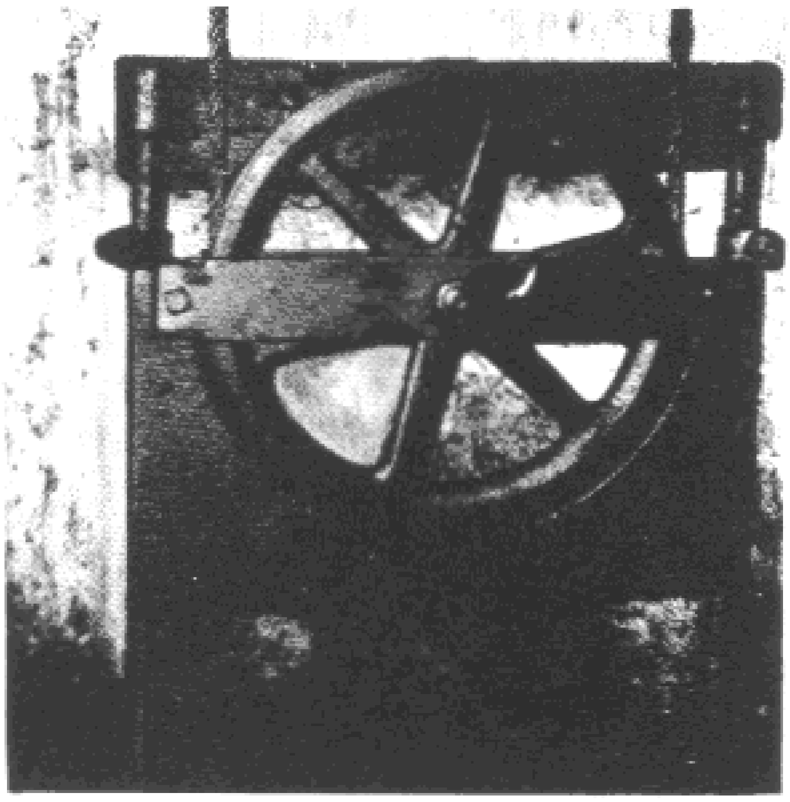


Typical Governor Arrangement

8. Next, shift the sheave to the desired distance from the guide rail center and tighten all bolts.



Installing Bracket for Governor Tension Sheave



Governor Rope Tension Sheave

9. As an alternate method, if the frame is to be fastened to a wall, measure from the guide rail face to locate the sheave as shown on the final layout. Hold the assembly in place, scribe the bracket holes on the wall. Remove the frame and drill the holes with the self-drilling anchors. Insert the anchors, install the frame, and plumb align the sheave, using packing shims, if required. Do not cut pit wall if it is waterproofed. You will need special brackets in this case.

10. When the car and governor have been roped up, run the car to the lower terminal landing. Be sure that the governor rope is clear of the car platform, enclosure, and accessories. Pack the governor tension sheave brackets further back from the guide rail, if necessary to obtain the clearance. This is more important than to hold the exact plumb alignment with the releasing carrier. As a matter of fact, the side play in the car shoes will affect this plumb, as the car loading shifts the platform.

11. In pits with spring buffers or pits with short stroke oil buffers, there is a possibility that the elevator may strike the governor tension frame or its lubrication fitting. Therefore, make the following check. Set the car at the lowest floor and drop a plumb bob from the car platform frame to below the governor tension frame. Should the line strike the tension frame, pack the bracket of the frame back to clear the line by 1''. Be sure the car shoe play is towards the tension sheave and not away from it, when making this check.

12. Some sheaves are arranged so that, if the plumb line strikes the lubrication fitting on the end of the shaft, the fitting can be removed and interchanged with a pipe plug at the center of the sheave hub. This automatically increases the clearance by about an inch.

13. Wherever possible, it is recommended that the lubrication fitting be placed in the shaft, because this makes service work a bit easier.

14. Lubricate the sheave with the recommended lubricant. Also lubricate the slides with grease, if the hoistway has been cleaned.

15. Where the tension sheave frame is equipped with rope tightener clamps, force the sheave down with a pry and tighten the clamps down securely against the sheave frame.

16. Safety Code Rule 206.7 specifies the diameter and construction of governor tension sheave rope grooves.

CHAPTER 7
Section -c2

PIT STRUCTURES

Tension Sheaves for Selector and Floor Controller Drives

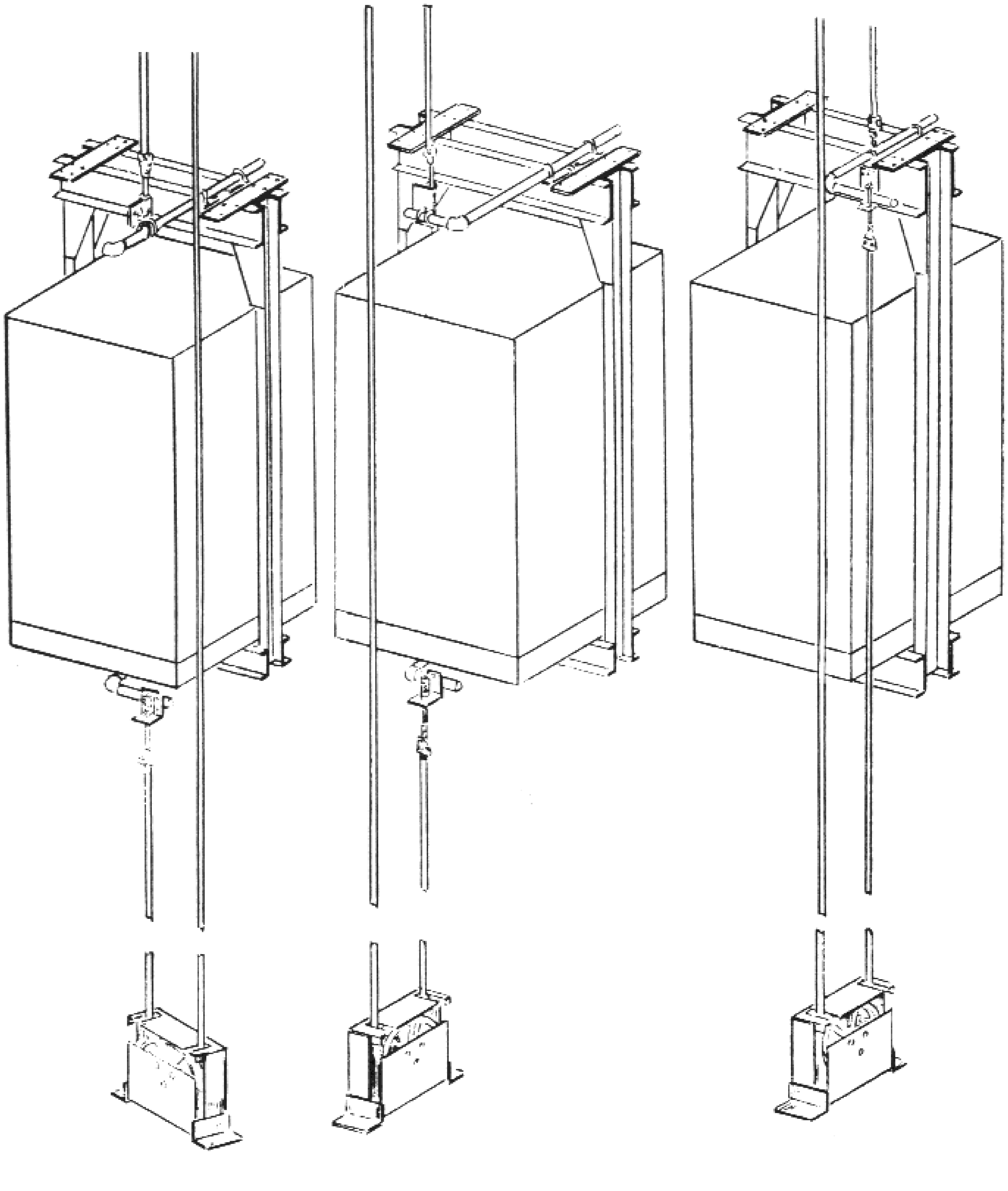
Suggested:

Materials –	Tools –
a. bolts, nuts, washers	a. hand tool kit
b. self-drilling anchors	b. electric hammer
c. packing	
d. sundries	

1. All high-speed automatic or self-service elevators and some lower speed elevators built at present employ some types of devices to interpret passengers' instructions to the system. The floor controller, vernier or floor selector, important parts of the systems, are all similar in function as noted in chapter 6 -e1. The majority of these types are mechanically driven, some by steel tape, others by wire or wire rope. Where layout conditions permit, the drives run from car top to the drive sheave or drum of the selector device, then down to a tension spring fixed to the counterweight.

2. Machine room or secondary arrangements sometimes make it mandatory for another drive system to be used. One common form is termed "car-to-car." It is often supplied where a lead to the counterweight cannot be obtained from the selector drive sheave.

3. Car-to-car drives require that from a hitch on the car top, the drive will run up to the selector sheave or drum, then down to the pit. It is next passed under a tension sheave then lead up to a second hitch on the car. Some pit sheaves ride in rails to provide tension. Others are fixed sheaves and tension is provided by other means, such as a spring at the lower car hitch.



Tape Tension Sheaves are Required
for "Car-to-Car" Selector Tapes

4. When the drive is tape or wire, such sheaves are ordinarily equipped with switches that open and stop or slow down the elevator, if the tape or wire breaks.

5. As noted in chapter 6 -i1, the physical arrangement of a floor controller in the machine room or secondary is given on the final layout. It is set in the indicated location, then adjusted to an actual plumb position over the car hitch. After this has been done, it is easy to locate the tape tension or idler sheave (if used) in relation to a guide rail in the pit by using the measurement taken from the plumb to the rail edges.

6. In general practice, the tension sheave frame is mounted on brackets that extend from the pit floor, a rail, or a pit wall. Where field conditions prohibit the use of any such method, the company layout engineer specifies some other means of fastening the sheave frame in the pit. Here again, care must be exercised if the pit is waterproofed.

7. Clip the tension sheave frame brackets to the guide rail, or fasten them to the pit with anchors and bolts. If the wall is hollow tile or some other ceramic, use through bolts. Mount the frame on the brackets and align it to the guide rail center.

8. After the sheave is aligned, check the rails or slide rods (if used) to be sure they are plumb. Shim between the frame and brackets, if necessary, to make the sides plumb. Tighten all bolts securely.

9. Bolt the tape tension frame switch and cam in place.

10. Check the distance between the cam and the switch arm. Adjust the arm or cam so that it will open the switch if the tape breaks. (It should open at least 1'' before the tension weight bottoms in the case of tension sheaves.) Shim or otherwise set the switch and/or cam to be sure the switch will open in this manner.

11. For tension weight switches, force the tension weight against its guide, opposite or away from the switch. Drop a plumb bob from the cam. Be sure that the cam will open the switch regardless of the location of the sheave and the weight in the guides. (The cam bolt holes are generally slotted to permit this adjustment.)

12. After the tape is installed and the car is operating, check the clearance between the car and the sheave tension frame, as described in 7 -c1, for the governor, tension-sheave frame. Additionally, check the running clearance between the sheave and the slide top and bottom brackets. If necessary, equalize the travel of the weight by adjusting the long tape, that is, by adjusting the tape of the bottom car hitch.

13. Many sheaves are equipped with factory lubricated bearings today. If not, lubricate the sheave with the lubricant recommended by your company.

14. Have the helper make a slow, then a high-speed trip throughout the hoistway while you watch the operation of the sheave and the drive.

CHAPTER 7
Section -c3

PIT STRUCTURES

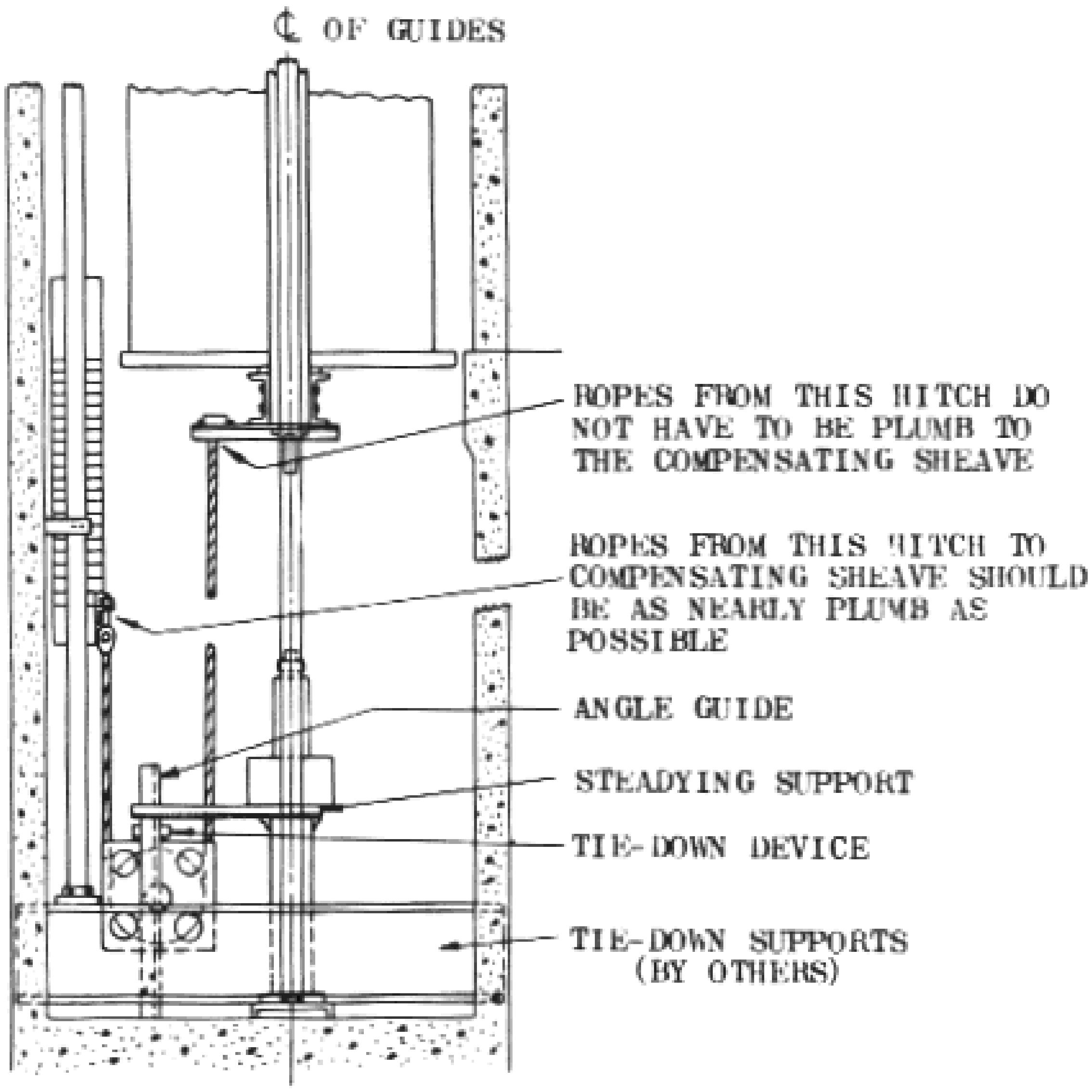
Compensating Rope Sheaves

Suggested:

Materials –
a. bolts
b. nuts
c. sundries

Tools –
a. hand tool kit
b. chain tackle
c. slings
d. electric drill and twist drills

1. Compensation is generally required on elevators with a rise of more than 100'. As the rise increases, so the need for compensation increases. The reason for this is that when the elevator is at the top of the hoistway the entire weight of the hoist ropes is "helping" the counterweight. Although the traveling cables are on the car, this is seldom enough to compensate for the weight of the hoist ropes adding to the weight of the counterweight.



Note That Tie-Down Supports are Secured in Concrete Walls, or Some Similar Manner

2. As a result, the car may lose traction. It would then be unable to start down because the drive sheave would "spin in the ropes."

3. This condition would also affect car speed as it moved through the hoistway.

4. The reverse condition would exist, when the car was at the bottom and the counterweight at the top of the rise.

5. Elevator machine drive-sheave groove design and construction obviously have definite effects on the traction developed between the sheave and the ropes. However, this is a variable in actual practice for the reasons outlined above. It is, therefore, not practical to attempt to design a sheave groove that would provide consistent traction regardless of the relative positions of the car and counterweight in the hoistway.

6. Compensating ropes or chains provide a more satisfactory solution and ensure more consistent operation, especially in leveling operations where speeds and often torque are low.

7. Originally, a set of chains were hung from the hoistway wall and the car bottom to overcome lack of consistent traction. Later the chains were "looped" at the pit and connected to the bottom of the counterweight also. Incidentally, where layout conditions are poor or other special requirements exist, chains may still be hung from the car and a wall instead of from car to counterweight.

8. Chain compensation is still used but although efficient, it is noisy and is not adapted to high speeds or high-rise elevators. For these reasons, rope compensation was devised and is now the type in use on the more refined installations.

9. The "comp" ropes are hitched to the bottom of the carframe, pass down the hoistway, under a tension sheave in the pit and up to a hitch on the counterweight frame.

10. A switch is a part of the tension sheave assembly. Its contacts are in series with the magnet coil of the potential or "line" switch on the elevator controller. If the ropes become slack or twisted and, therefore, shortened, the switch opens and stops the car.

11. The compensating sheave center or hub is located from the lead of the compensating ropes from the car and the counterweights. This can be determined by a study of the final layout or a detail drawing, and also a study of the carframe and counterweight.

12. Usually the diameter of the compensating sheave approximately spans the distance between the car and counterweight compensating rope hitches. Occasionally two sheaves are used to do this, but it is not a common way to solve the problem. Small variations are split up between the rope leads to the two hitches but it is far more important to "favor" the counterweight lead and make it almost plumb. This is important because of the small clearances between the "cwt" and back of the car.

This causes ''comp'' ropes to slap the car platform, as the car approaches the lower floors. The plumb lead to the counterweight hitch reduces this tendency.

13. The safety code requires that compensating sheaves on all elevators with speeds of 800 F.P.M. or more be equipped with tie-down devices. The object is to limit the ''jump'' or overtravel that occurs when elevators or counterweights traveling at high speed are suddenly stopped by buffer engagement or operation of the safety device. This jump can cause damage, such as ropes jumping out of sheave grooves or ''comp'' sheaves being pulled out of their guides. The tie-down device reduces the chance of such accidents to a minimum.

14. Where a ''tie-down'' is used, the building contractor must install a suitable support for the assembly. This should be indicated on the final layout or a separate drawing. Tie-down supports are generally in the form of two ''I'' beams which are secured to the building structure. They are often run from the front to the back of the hoistway, and then grouted in concrete pit walls.

15. Where the pit walls are of ceramic hollow tile or similar construction, the beams must be secured to some integral part of the building structure such as the columns or footings.

16. Compensating sheave frames have shoes or slots that ride on either angle or tee guides. These guides are bolted to the floor or the tie-down supports and are installed by measuring from the car or counterweight guide-rail center lines (see sketch #1).

17. Measure the distance from the counterweight guide-rail center line to the sheave center. Scribe the location of the ''comp'' sheave guide-rail centers on each tie-down ''I'' beam or on the pit floor. Square check the location of the two rails with each other. Drill both ''I'' beams for the rails, or drill the pit floor for expansion shells or the specified fastening. (Naturally, shells cannot be used in waterproofed pits.) Welding can be used in some cases.

18. Mount the rails in position. Assemble the steadying supports on the ''comp'' sheave and main rails. Plumb and square the rails, then tighten up all bolts.

19. Rig a chain hoist or puller and lower the sheave into place.

20. Where the tie-down is the ''block'' type, assemble it but leave the wedges and wedge springs out until after the sheave is roped. Regardless of what type of tie-down is used, leave it free on its rails until the compensating ropes are installed.

21. Install the compensating switch. Plumb and align its cams, after the switch is wired.

22. Block the sheave up about 2' above its normal position to facilitate roping.

23. Install the rope guards temporarily, pending roping.

24. Where the compensating sheave is ''free'' type, that is, with no tie-down, very little upthrust occurs on the rails. They merely serve as guides.

25. The function and action of a ''free'' compensating sheave is the same as that of one with a tie-down.

26. The method of installing compensating ropes is described in chapter 9.

CONTENTS

CHAPTER 8

Section No.	Description	Page No.

CAR AND COUNTERWEIGHT ASSEMBLIES

CHAPTER 8
Section -a1

CAR AND COUNTERWEIGHT ASSEMBLIES

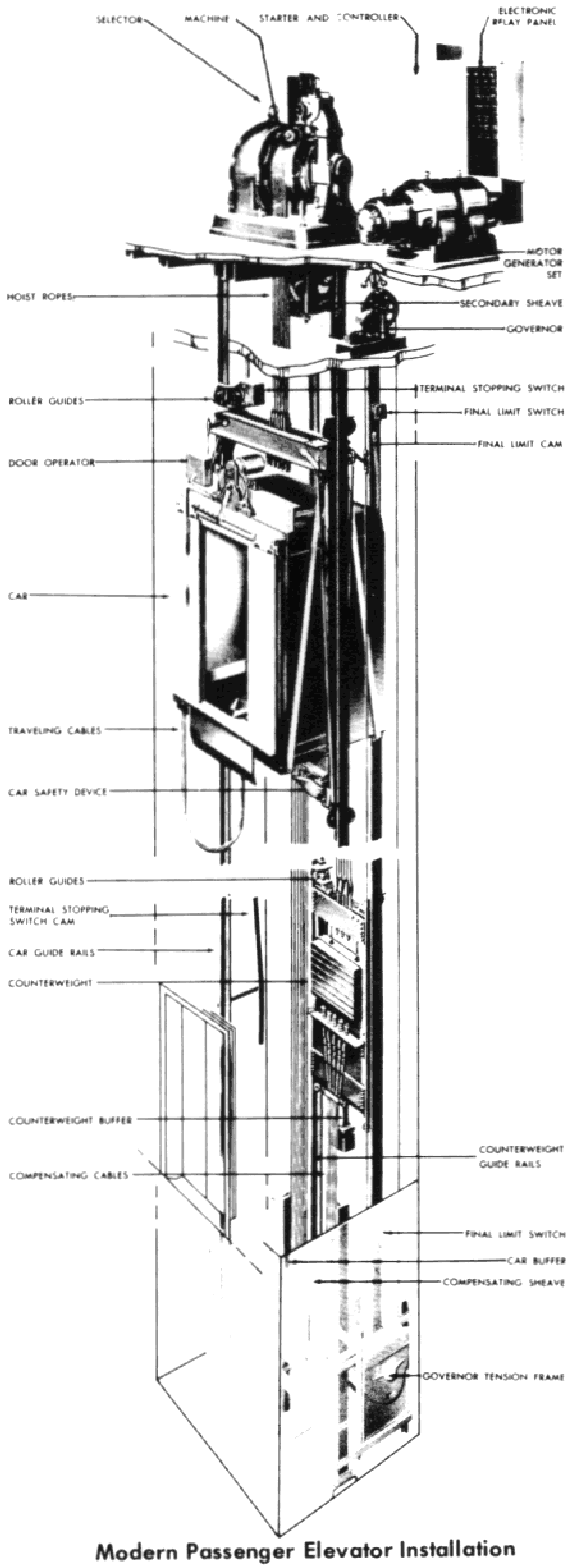
General

1. Elevator cars are divided into two broad categories of passenger and freight. Each of these classes have numerous sub-divisions ranging from luxury passenger elevators to freight units equipped with monorail "meat hook" tracks and similar specialized adaptations. As a general introduction we can consider only a few, which are described herewith.

2. Most passenger elevators consist of a steel carframe, under or in which a safety device is attached and with guide shoes at the sides of the carframe. The frame, or "sling," is comprised of four main parts: the safety plank, which forms the base of the sling, vertical stiles at each end of the plank and a crosshead. These parts are bolted together in the field as a rule. A car platform frame is commonly bolted onto the safety plank and braced to the stiles. The platform is set on it. The enclosure is mounted onto the platform and braced or "steadied" to the stiles. The dome is considered part of the enclosure. Car doors (or a gate) are hung to close off the entire entrance opening when the car is in motion. Lighting, ventilation, operating devices, signals and emergency exits are provided.

3. The car sling is conventionally suspended from the hoist ropes by means of a "hitch plate" and shackles attached to car crosshead. The governor rope is usually attached to a releasing carrier at the crosshead. The compensating rope or chain is connected to a bottom outrigger or the safety plank itself, as is the traveling cable. Tape or wire drives are attached to carframes or outriggers too. Limit cams, slow-down switches or cams, door operators and other accessory car parts are similarly attached. The reason these are normally attached to frame parts rather than the enclosure is to assure full strength and also to preserve sound reducing features of the enclosure.

4. Carframes are guided on the elevator rails by shoes held in supports that are bolted to the car crosshead and safety plank. There are two top and two bottom shoes, as a rule. (Duplex cabs and safeties may have six shoes.) The shoes are in line with the stiles. They can be either sliding or roller type.



Modern Passenger Elevator Installation

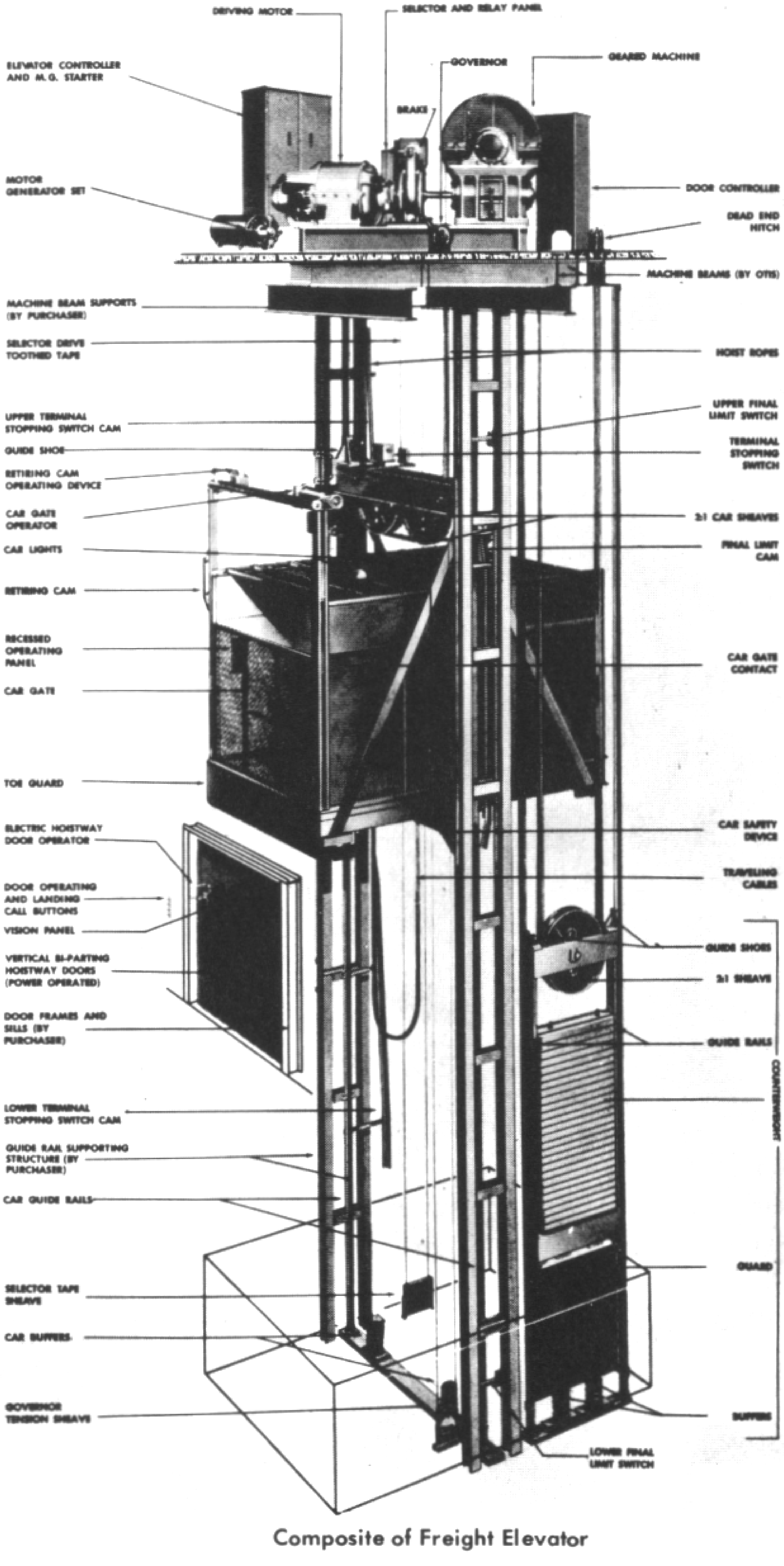
5. Slide guides range from cast iron units integral with their stands to swivel shoes in spring loaded stands. Most are equipped with replaceable gibs and the material in these varies also. Cast iron gibs are common. Wood or wood with lead (or babbitt) inserts are preferred by some maintenance men. Others use cast lead. However, all these require lubrication so the self-lubricating types such as Henrite gibs are quite popular where slide guides are supplied. Elimination of lubrication reduces hoistway dirt and fire hazard. Nylon gibs are also used.

6. Roller guides are made up of three rollers mounted on a cast or fabricated stand, which is bolted to the carframe. The steel rollers are rubber or synthetic rubber tired and have antifriction bearings. Many have a spring loaded adjustable device, such as an arm, on which rollers are mounted so proper tension can be set and automatically maintained. Roller guide shoes are considerably more expensive than slide guides so are not usually sold on low priced elevators. They are almost always part of the equipment on high grade elevator installations. Aside from the obvious advantage of cleanliness they reduce running friction, thus reducing armature currents. This is most noticeable and beneficial in the leveling areas of operation.

7. The foregoing paragraphs describe the components of an elevator with 1:1 roping. Variations include 2:1 roping, where sheaves instead of hitch plates are mounted in the car (and counterweight) crossheads. (Ropes are dead ended at the top of the hoistway.) Another is the "corner post" elevator which is required on most cars when openings (or doors) are needed on two sides. This assembly is similar to the one described except that the guide rails are at opposite corners of the car. (See chapter 5 -b4.) Because of this and the adjacent doors, the car enclosure is supported by a truss set in (and at 90° from) the sling as well as by the sling itself. Underslung carframes can be "side post" or "corner post" and differ from conventional frames chiefly in that the rope hitches are located at about safety plank level and at the car sides. These cars can be roped 2:1 also.

8. Freight elevators differ from passenger elevators primarily in that they are more crude in finish of enclosures, are not usually sound reduced and may have perforated rather than solid domes (and perforated sides above the 6'-0" height). Heavy duty cars, such as those intended for industrial trucks or railroad car loading, require special engineering to develop proper bracing of frames. Freight installations include a great number of variations and are often extremely interesting from the standpoint of engineering and field work. Roping and frame arrangements can be similar to those described for the passenger units or can be extremely special.

9. Other types of carframes and cars are used, such as those where elevators travel on inclined rails, as in the Washington Memorial in Alexandria, Virginia. These are special truss frame, as are the "wall climber" types. Seattle's "Space Needle" elevators are another example of special design.



Composite of Freight Elevator

10. Elevator cars are covered quite extensively by the safety code. Reference can be made to Rules 203, 204, 313, 314, 402, 503, 1201 and 1203 as well as others. Construction and design are held to general specifications within these rules.

11. The safety devices used are divided by code description into three classes. The type "A" is the instantaneous type and is restricted to car speeds of 125 F.P.M. in U.S.A. and Canada. The "A" safety is usually a roller type. On higher speed elevators, type "B" safeties which apply limited pressure to the guide rails are employed. The "wedge clamp" and "flexible guide clamp" safeties are two examples of this "B" type and they are used on the highest speed elevators. Type "C" is one in which an auxiliary safety plank is used in addition to an instantaneous safety. An oil buffer is connected between the auxiliary safety plank and the carframe. The safety "rollers" are in the auxiliary plank. Car speeds are limited to 500 F.P.M.

12. Details of assembly of the carframes and the safeties are provided for the field men by each manufacturer.

13. Counterweights fall into two general classifications; these are the "frame" type, where frame members similar to those of carframes are used and the "sash weight" type. The latter is not approved for elevators by the American Safety Code which requires that all counterweights be equipped with steel frames or equal. Sash type counterweights are used on dumbwaiters and for elevator installations on a world wide basis outside of U.S.A. and Canada. However, they are generally limited to low car speeds.

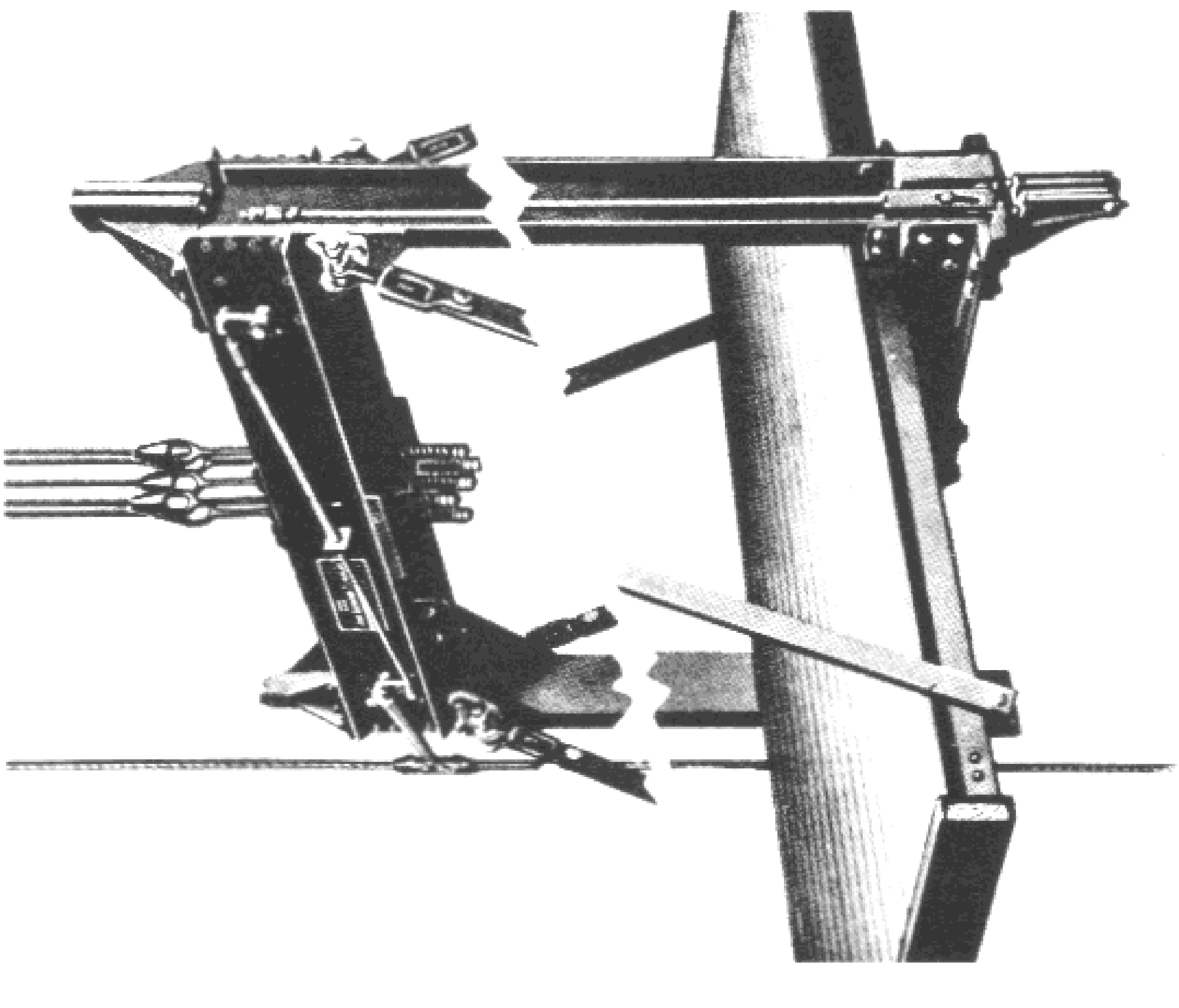
14. The counterweight frames are assembled and cast iron "sub" or filler weights installed in sufficient quantity to provide the correct car-to-counterweight "overbalance." This is usually about forty to fifty percent and the exact amount is established by the manufacturer. The percentage is related to the contract load the elevator is designed to carry. As an example, if the elevator is rated as 3,000 pounds at 500 F.P.M. and the overbalance is to be 40%, the counterweight frame plus subweights, rods and other parts will equal the entire weight of the unloaded elevator, plus 40% of 3000* or 1200*. This overbalance is established by the man who adjusts the elevator. Code Rule 202 describes counterweights.

15. Safety devices are required on counterweights when occupied space exists under the pit floor, on shipboard elevators and under some other special conditions, in the U.S.A.

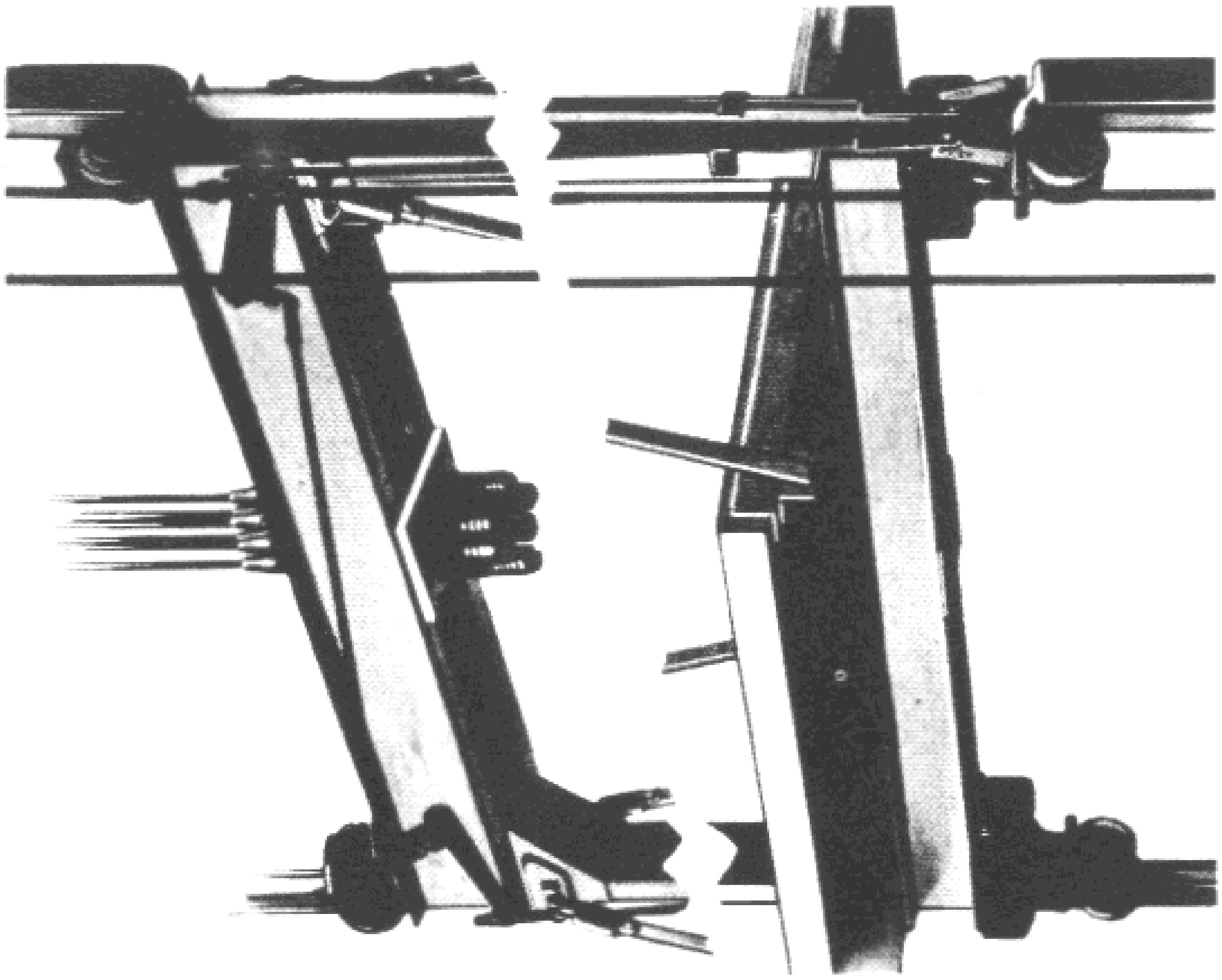
16. Counterweight shoes can be sliding or roller types. Usually they follow the type chosen for the car although this is not always true.

17. Tape or wire hitches on counterweights follow the general pattern of those on cars. However, the tape tension springs are usually at the counterweight end. Some companies supply oil buffers that are bolted to the counterweight. Spring buffers are often attached to the counterweight frames in European countries. Compensating chains connect to the bottom of counterweight frames or tie rods. Compensating ropes secure to shackles or a hitch block designed for this purpose.

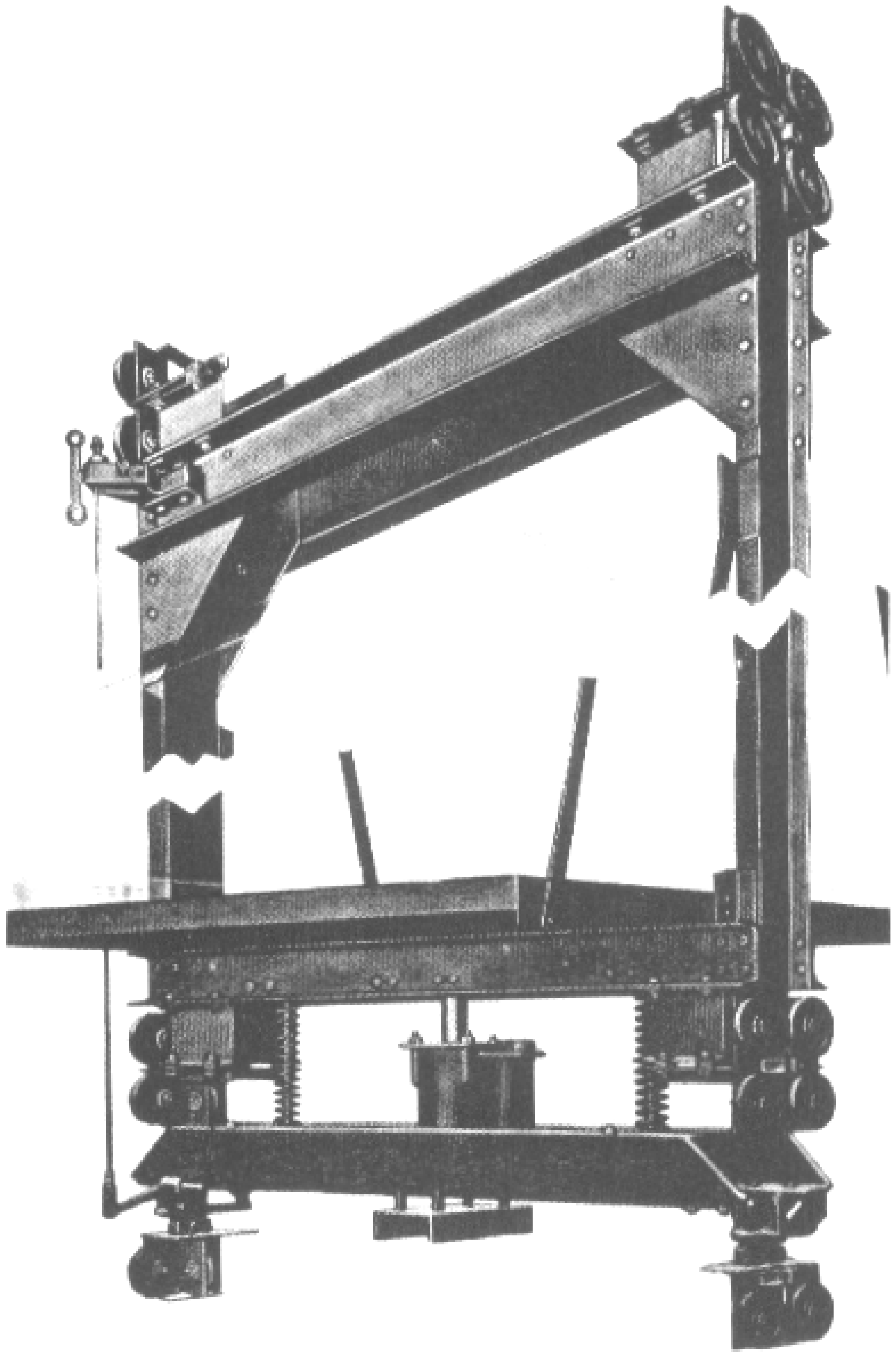
18. Outlines of methods of installing cars and counterweights follow in sections -b to -f, of this chapter.



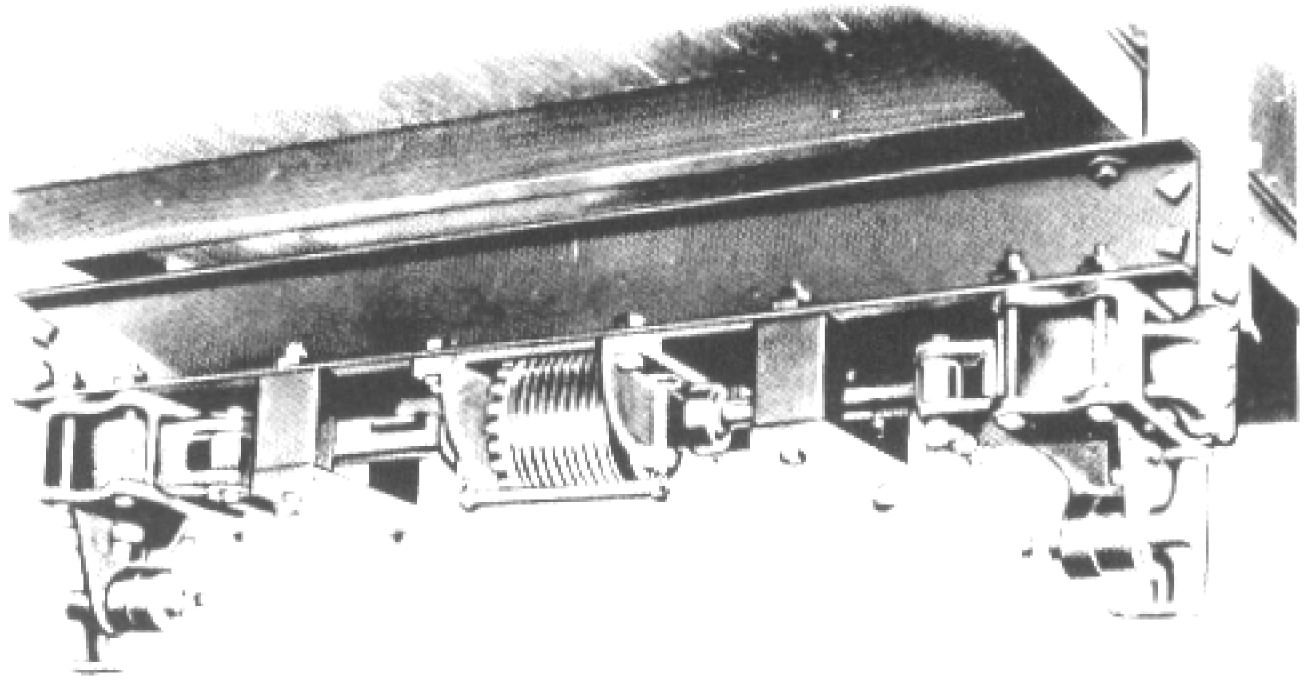
Type "A" Safety (Otis)



Type "B" Safety (Otis)



Type "C" Safety (Montgomery)



Type "B" Safety (Haughton)

Types "A," "B," and "C" Safeties
as Defined by the Safety Code

CHAPTER 8
Section -b1

CAR AND COUNTERWEIGHT ASSEMBLIES

Installing Carframes

Suggested:

Materials –
- a. bolts, nuts, washers
- b. shims or packing

Tools –
- a. hand tool kit
- b. electric drill
- c. chain puller and slings
- d. 24'' level
- e. long straightedge (equal to DBG + 3'') (optional)
- f. clamps or supports for carframe assembly

1. There are two basic methods of installing carframes, although many mechanics and companies develop special routines within one of these methods.

2. Carframes equipped with wedge clamp or some other safeties are often assembled on bolts placed in holes drilled in the main rails. After the car is assembled and roped, the bolts are removed. The holes that remain do not particularly affect operation of cars with slide guides but tend to ''chew up'' the rubber tires of roller guides. It is, therefore, customary to ''plug'' such holes.

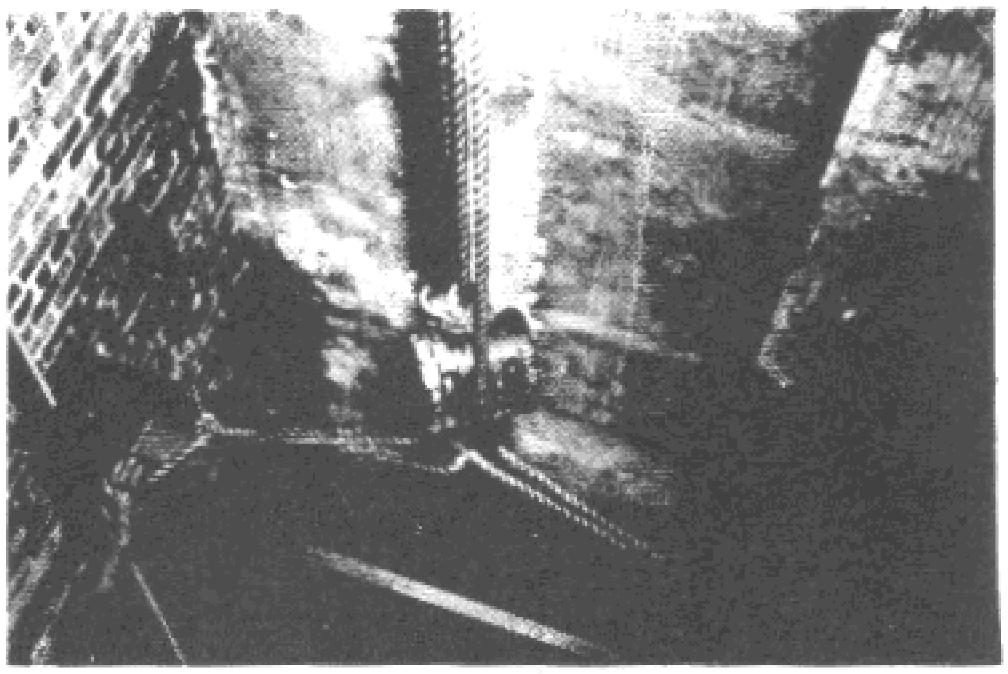
3. The fact that a great many modern passenger elevators are equipped with ''rubber'' tired roller guides has made it almost mandatory to plug the holes in the guide rails. Due to this and other conditions, most mechanics have now adopted other methods of assembling carframes. A common routine is to assemble the frame on blocking, which can be done at the bottom landing or any other convenient location in the hoistway.

4. When assembling the carframe, consideration must be given to the fact that work is carried on at two levels. If the car is to be assembled at the bottom of the hoistway and the pit is shallow, the blocking is generally arranged with three objects in mind. These are to have the safety plank low enough to work on conveniently, to keep the platform high enough for access to the pit from the lowest entrance, and to have the crosshead in a position so it can be worked on easily and safely.

5. An elementary but satisfactory method for assembling small cars is to begin by placing the safety plank on two upright 4'' x 4'' wood timbers. The 4'' x 4'' timbers should be equal in length and long enough so the car platform would be about 3' above the lowest sill when the car was assembled. As an example, let us assume that a pit is 5'-6'' deep from bottom entrance sill to the pit finished floor. If the car is to be placed 3'-6'' above the sill, we would have a distance of 9'-0'' from pit floor to car platform level. From this we would deduct the following assumed figures –

Buffer Channel Height	2-1/4''
Spring Support inside Buffer Spring	6-1/4''
Safety Plank	10''
Buffer Strike Plate	1''
Sound Isolation Frame	0-1/2''
Sound Isolation	1''
Platform	4''
TOTAL:	25''

6. This calculation shows that the 4'' x 4'' timbers must be cut 6'-11'' long, i.e., 9'-0'' minus 2'-1'' in order to have the platform 3'-6'' above the sill after assembly. This last dimension must also be used to provide accurate rope lengths when the ropes are cut.



Installing a Car Safety Plank

7. Installation is begun by rigging a rope fall or chain hoist from heavy wood planks set across the hoistway at about the third floor. At least one car shoe is removed before the safety plank is slung into the hoistway. Some men take both car shoes off. Company practice should be followed. The safety plank is then lifted into the hoistway between the car rails.

8. The two 4'' x 4'' timbers are set upright inside the car springs, resting on the supports that hold the springs in place. (Some companies secure the springs directly to the buffer channels, so no allowance for supports need be made. The timbers rest on the channels in such cases.

9. The safety plank is lowered onto the timbers and the safety device set by hand to center the plank on the rails. This is accomplished on wedge clamp safeties by pulling out the tiller rope. On roll or slide safeties, temporary blocks or hardwood wedges can hold the safeties in applied position or can be used merely to center the plank on the rails.

10. The plank is leveled sideways (postwise) and front-to-back. Shims may be required on top of a 4'' x 4'' timber to obtain the level condition.

11. The stiles can then be bolted to the safety plank, squared and tightened. Be sure they are square vertically to the safety plank. Also, be sure their flanges are parallel to the rail faces. Loosen bolts, align and square the stiles if necessary.

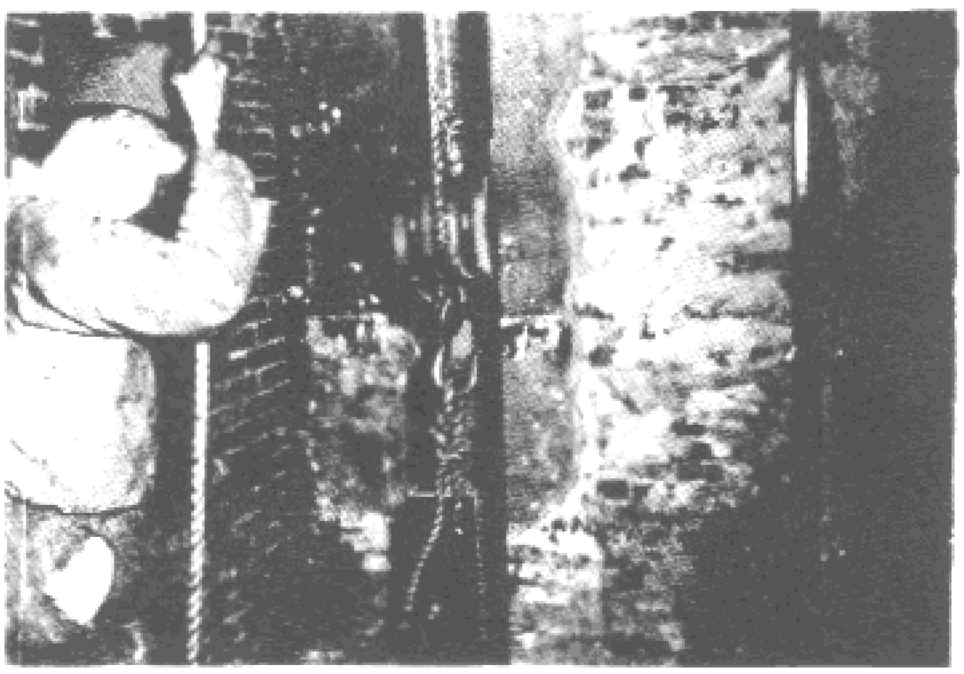
12. Hoist the crosshead and bolt it in place. Check its alignment with the stiles, to be sure it is parallel to the safety plank. Make necessary adjustment to get this square condition. Do not force frames into place.

13. Install wedge shape washers under heads of bolts in channel flange to avoid distortion of bolt body, due to pitch of channel flange. The use of wedge washers is a code requirement, and is designed to eliminate undue bolt stress. Make all bolts tight.

14. Car shoes can then be installed and squared to the frame; unless temporary wedges or blocks prevent this, in which case the shoes can be installed after the car is roped.

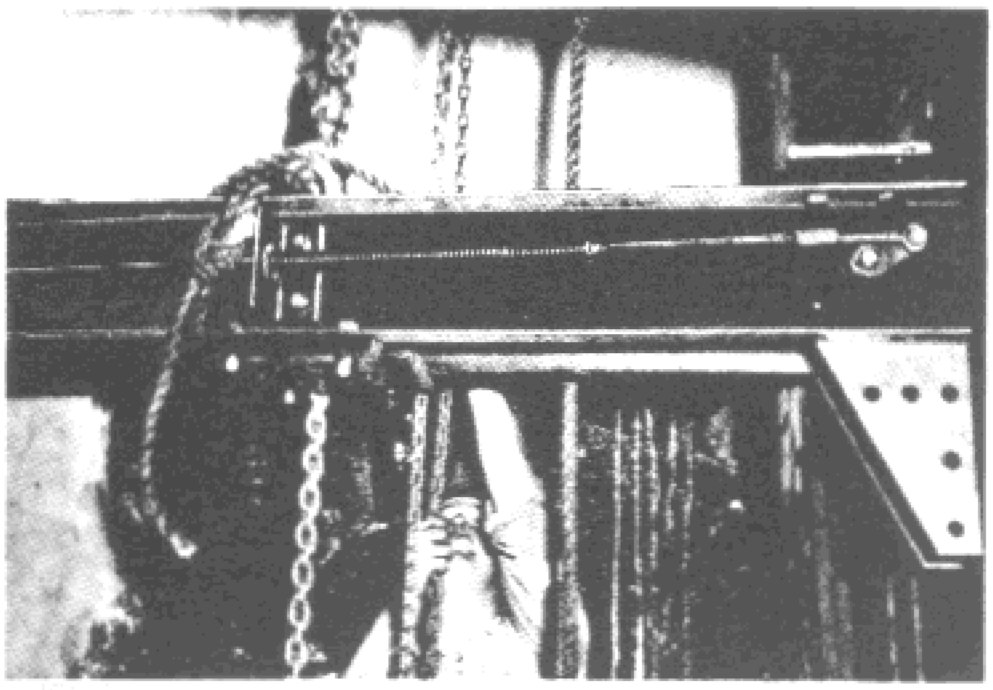
15. The foregoing method or a procedure similar to it is widely used today on low-speed, small passenger cars and on freight elevators. However, when car speeds increase to 800 feet per minute or more, the static balance of the car assembly becomes more important. This is increasingly true as rated speeds increase to approach the present limit of 1600 feet per minute.

16. The importance of obtaining the best possible static balance of the car has caused development of another approach to carframe and platform assembly, where the carframes have flexible guide safeties.



Lowering a Car Stile onto the Safety Plank

17. Originally, this involved a method of placing two 8'' channels postwise across a hoistway, having one channel on each side of each guide rail, back-to-back. The channels rested on opposite beams and were bolted together with two long 5/8'' through bolts or pieces of 5/8'' bolt stock with running thread. The top flanges were leveled postwise and to each other (front-to-back), then the two long



Crosshead Being Installed

bolts were made tight. Shims were placed between the beams and channel bottom flanges to obtain the level condition.

18. Two plates of 1/2" steel were prepared in squares about 10" x 10" in size. Slots 11/16" wide and approximately 4" deep were cut into the plates on the center lines of one edge of each plate. The plates were then laid on top of the channels with the slots located around the guide rail blades.

19. Cast iron car shoe gibs were placed on the rail blades so they rested on the plates. The safety plank, without shoes, was then lowered into its normal position and the gibs would force the car safety rollers or wedges into the positions they assume when the safety devices "apply" or operate. This automatically centered the safety plank on the guide rails. A hammer blow at each end "set" the plank securely on the safeties. If one end is slightly higher than the other, an additional hammer blow will "set" it down. The correct position must be confirmed with a level at least 24" long.

20. The method described in the preceding paragraph assured a safe, level base on which to continue carframe and car assembly. However, the need to supply a number of 8" channels of varying lengths is sometimes costly or impractical. Some areas have substituted 2" x 12" straight, clear wood planks instead of the channels. Others have made up clamps that secure to the rail backs. These can be made of steel channels, angles or other materials. The clamps, being separate for each rail, are adaptable to any normal distance between guides. However, it is very important to establish an exact level from the top of one clamp to the top of its opposite member. The long straightedge is used to establish their levels.

21. Regardless of whether the frame is assembled on wood, channels, clamps or bolts, the procedure is essentially the same, which is to:

a) Establish the height at which the safety plank will rest.

b) Install the supports and the safety plank; level, center and square it to the rails at the selected position.

c) Square the stiles to the plank and align them parallel to the rail blades.

d) Fit the crosshead to the stiles without inducing stress or twist.

e) Install car shoes in accordance with company routine.

22. When car platform sound isolation frames are used, they are installed after the carframe is squared and tightened. These frames are generally of angle iron and channel construction, and are bolted to the car safety planks. Depending on size, they can be lifted or hoisted into the frame, laid onto the plank and squared to it. Erection drawings provide the details on locating the frame, that is, the distance from the front or "sill" end of the frame to the center line of guides. The bolts (or clips) are then put into place in the frame and are snugged up. The frame is leveled, front-to-back and postwise. It is possible to use shims between safety plank channel flanges and isolation frame to overcome minor mill stock variations and obtain a level isolation frame. However, shims must be pinned or bent over so they cannot work out.

23. The brace rods are then installed. Some brace rods are fixed types and some are adjustable. Care must be used not to stress or "twist" the frame, when bolting the brace rods in place.

24. The isolation frame is cleaned of dirt and the platform hoisted into place. After this, the platform is "jacked" or pried up, one side at a time, and the sound isolation pads installed.

25. The platform is then squared and aligned to the guide rail center and hoistway sill lines. Designs of some companies require that retaining blocks or clamps be installed to prevent the isolation pads from becoming displaced. These retaining blocks are installed after platform alignment is completed.

26. Sections -c1 and -c2 of this chapter review the subjects of platform, isolation frame and their assembly more completely.

27. Car shoes are generally installed after the car is roped and all frame assembly blocking has been removed on elevators with roller guides or flexible clamp safeties.

28. Company routines, material deliveries and job conditions affect the decision on where to assemble cars and counterweights. Availability of power hoisting equipment, for instance, might make it preferable to assemble all cars and counterweights at the bottom and then hoist the cars to the top by power, when ready for roping.

29. However, we strongly recommend that governors be roped and safeties operative before taking assembled cars through the hoistways by power or chain hoist.

CHAPTER 8
Section -c1

CAR STRUCTURES AND COUNTERWEIGHTS

Installing Car Platforms – Unit Type

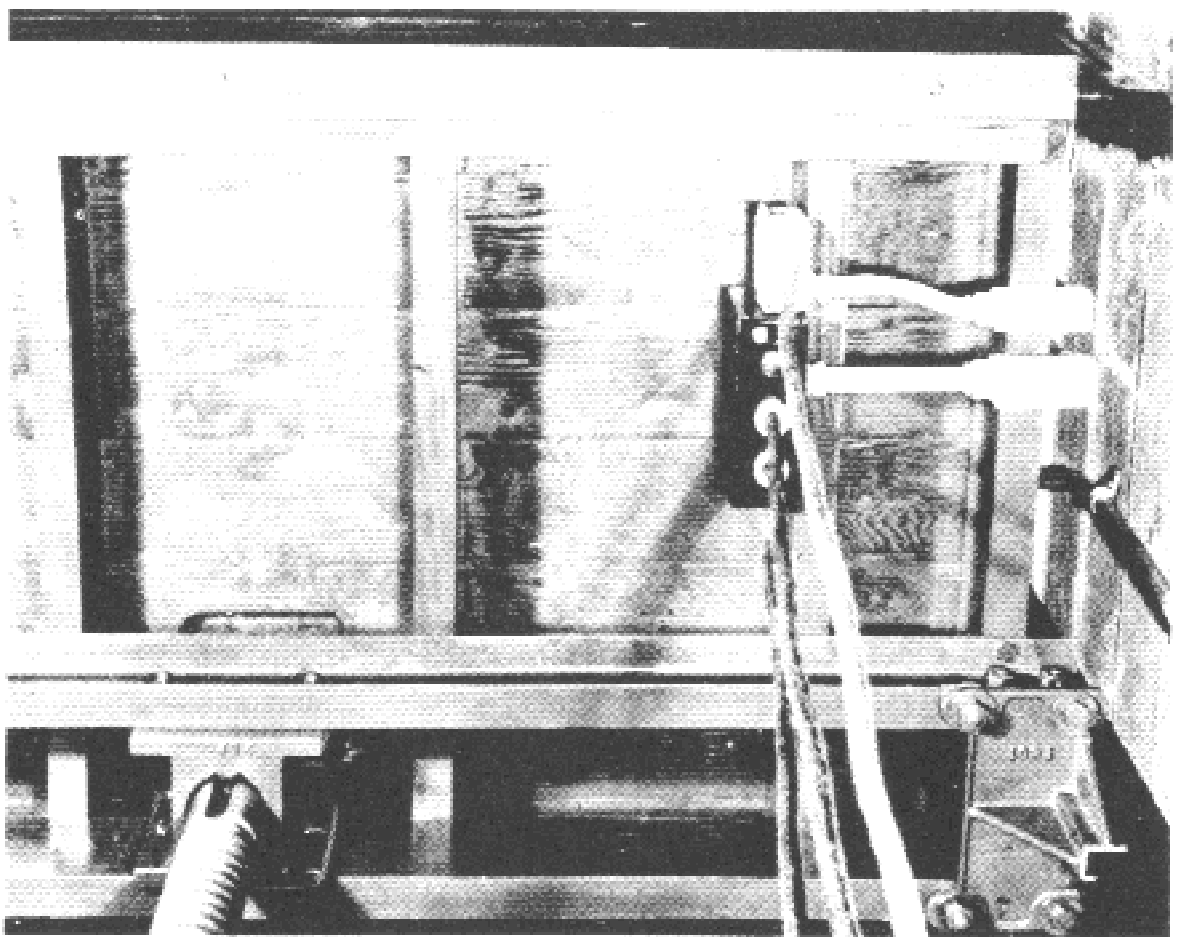
Suggested:

Materials –
- a. sundries

Tools –
- a. hand tool kit
- b. chain hoist or puller
- c. slings

1. Early platforms were made as a solid unit and were bolted to carframes. This practice held, almost universally, until a comparatively recent date and is still popular for all cars with some manufacturers, and for some installations with all companies. It is usual for freight elevators.

2. A common type of platform has a double thickness wood flooring that is set on timbers held in a channel frame. The top layer of flooring is usually hardwood or clear pine and, on passenger elevators, is covered with a rubber tile or its equivalent. Freight car floors are of hardwood, sheet steel, or some other long wearing material. The code previously required sheet metal fireproofing on the bottoms of all platforms. It now permits metal sheathing or certain fire resistant paints.



Unit Platform on Screw Drive Elevator

3. A variation of this type of platform is one where the steel plate for a freight car is welded directly to the channel frame and floor beams. This type is also being used for passenger elevators to some extent. Heavy duty freight elevator platforms are specially designed and built to meet code requirements.

4. Often car platforms without sound isolation are set on blocking. This blocking is placed on the top flanges of the safety channels. The platforms and blocking, together, are then bolted to the safety planks.

5. Most frequently the platform is made in the factory, drilled, and with its bolts and the proper blocking, shipped to the jobsite.

6. Once the carframe is assembled in place on the support bolts or blocks, extend a plank from the door sill to the safety plank. Slide the platform onto the safety plank and lay it in its approximate position. (Occasionally, heavy platforms require a chain hoist or rope fall to lift them in place.)

7. Once the platform is in place, raise one corner at a time and slide the blocking under it.

8. Install the platform bolts into the holes in the platform. Use bevel washers under the hexagon nuts.

9. Make the platform square with the safety plank and/or the entrance sill lines. Tighten all bolts. Shim between safety plank and platform or blocking to have a level platform. (Secure all shims used.)

10. Assemble the brace rods on the car stiles or frame and bolt them to the platform. Do not force the platform out of position with the rods.

11. When the car has been roped up and is hanging on the hoist ropes, install the bottom shoes. Be sure the platform is level. If not, shim on the brace rods to obtain the level. Most platforms are adjustable, but it is always possible to pack the brace rods in some manner. The main point to be careful of is to use steel shims that cannot work loose and fall out.

12. It is important to level the platform from front-to-back, but the side or postwise level is very necessary.

13. Check the clearance between the car sill and the hoistway sills. If a slight error exists and is common to all hoistway sills, it can be compensated for by loosening the platform bolts, moving the platform slightly out of square with the safety plank and then tightening the bolts a final time.

14. Where the clearance is not the same at each floor, it is probable that the fault lies with the hoistway sills. Shifting the car platform slightly will permit an average clearance, but will definitely not correct the fault.

15. Where a tile or other finished floor is to be laid, postpone this work until the last possible moment. This will reduce the possibility of damage to the flooring.

CHAPTER 8
Section -c2

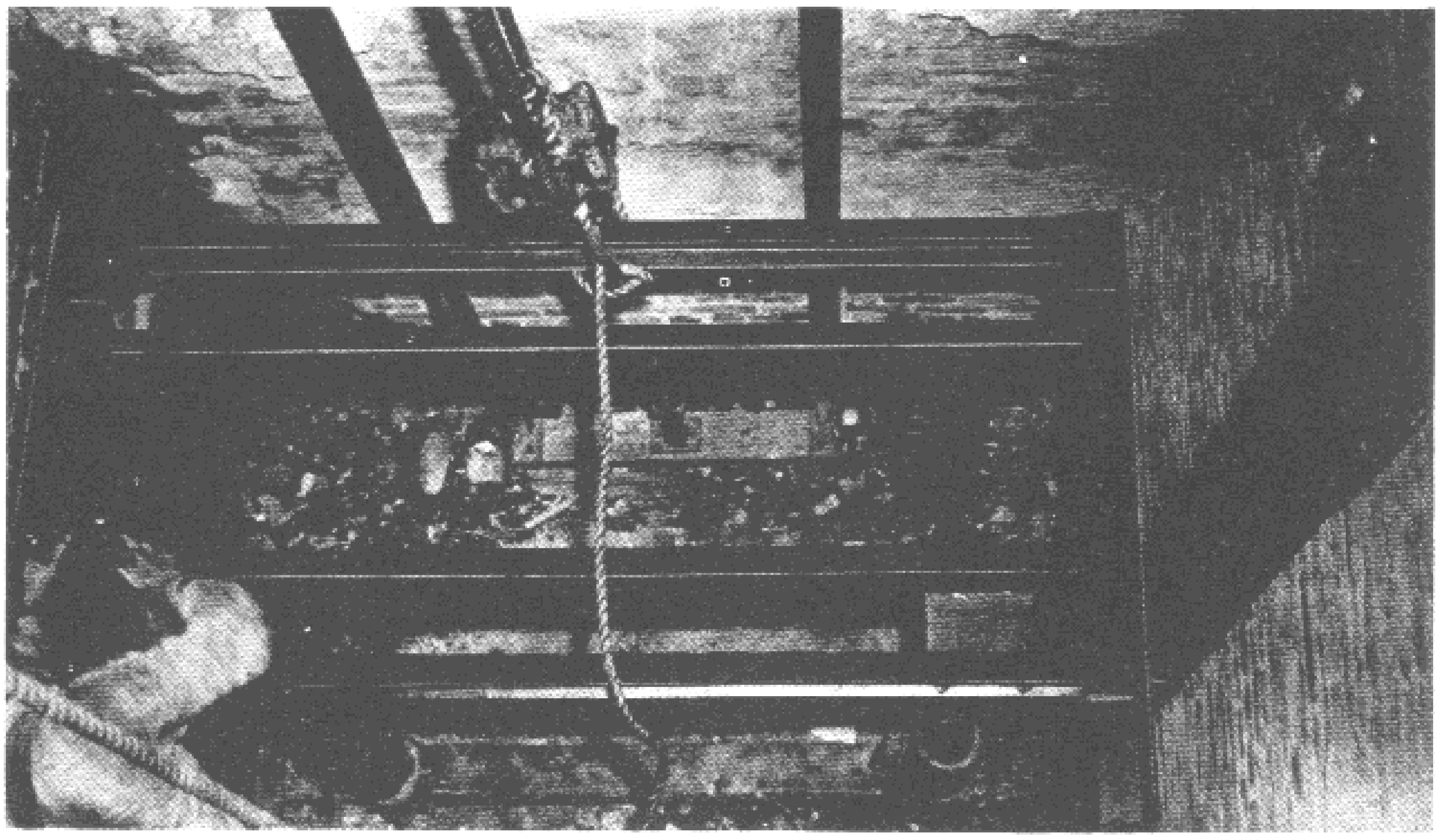
CAR STRUCTURES AND COUNTERWEIGHTS

Installing Car Platforms – Frame Type (Sound Isolation)

Suggested:

Materials –
- a. sundries

Tools –
- a. hand tool kit
- b. chain hoist or puller
- c. slings
- d. electric drill



Sound Isolation Frame for Platform

1. The isolation or "sub frame" type elevator car platform is usually installed in conjunction with "sound reducing." The common system is to bolt an angle steel frame to the car sling (car frame) with the flanges of the angles facing up. Pads of rubber or some other material that is a poor conductor are laid in the frame. The platform unit is then set on these pads, which are restrained from shifting by wood blocks or other means.

2. The car enclosure is bolted or screwed to the platform and does not touch the carframe at any point except through sound isolated clamps to the stiles.

3. All car conduit is isolated from the platform. It is also isolated from the enclosure wherever possible. Any unavoidable connections are made with flexible tubing rather than rigid conduit.

4. When installing these platforms, the first step is to set the frame on the car safety plank. It is squared up and leveled, then bolted securely. The brace rods and/or supports are installed next. Here again care must be used to assure that the brace rods do not distort the frame.

5. The sound isolation pads are set into the frame and the platform lowered onto the pads. The wood retainer blocks are installed. Shims are used between rubber and platform or frame to obtain a level platform.

6. Since most elevators having this type of platform are equipped with roller guide shoes, it is very important to square the platform (frame) with the car sling. Time spent in doing this will be gained when the roller guides are adjusted.

7. The space between the sub-frame and the platform sides should be temporarily filled with rags or covered with masking tape to keep construction dirt from entering the narrow space. Such dirt could cause noise and eliminate the sound reducing.

8. The usual checks for sill alignment are made as described in section -c1 of this chapter.

CHAPTER 8
Section -d1

CAR STRUCTURES AND COUNTERWEIGHTS

Assembling Car Enclosures — Passenger

Suggested:

Materials –
- a. sundries
- b. 2'' x 4'' yellow pine or similar lumber
- c. protective pads or heavy paper

Tools –
- a. hand tool kit
- b. chain hoist
- c. slings, manila rope

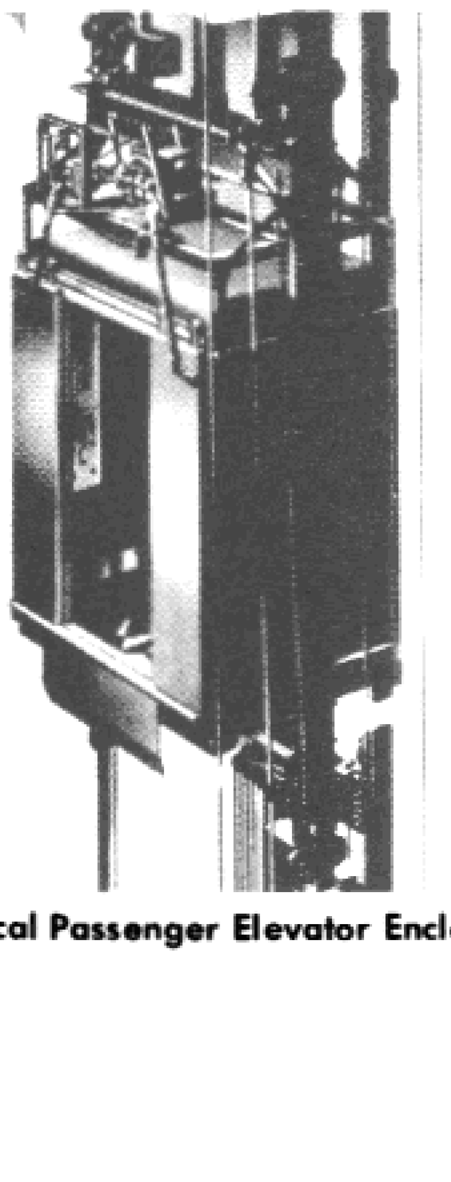
1. The enclosures of elevators are both functional and ornamental. The extent to which each of these two is carried varies with the type of service for which the elevator is designed. Also, safety and other codes have considerable influence on cab design. The ornamentation is, of course, mainly affected by the personal preference of the buyer and his architect.

2. On passenger elevators the "cab" interior is in actuality a part of the building's interior decorative scheme. It is a piece of fine furniture and should be treated as such. It may be of steel, fine woods, synthetics or a combination of these.

3. During the period following World War II and especially during the last decade, many new construction and decorative materials have been introduced. The phases of our industry most visibly affected by these are the ornamental sections, that is, the car enclosures, entrances and appliances. With respect to the enclosures, we have seen the introduction of anodized aluminum, laminated plastics, synthetic fibers on panels and imitation of fine woods in plastic. Some of these are applied directly to cab (or enclosure) panels. Others are on separate "decorator" "hung on" panels that can be varied with the change in building decorative schemes. Car trim finishes are also more varied and architects are continually demanding new approaches to cab designs.

4. The car cab should not be installed until all the rough work is completed. When it is necessary to install it at an early stage of the construction work, the interior should be protected with pads or sheathing.

5. Some companies design enclosures to be set on the thin wood strips nailed to the car platform. The cab panels have angles or knees that set on these strips. On other designs the cabs are set on the rough platform floor. The dome, or top, is designed to bolt to the tops of the panels.



Typical Passenger Elevator Enclosure

6. The first part to be hoisted into the frame is the dome. This part is the heaviest and bulkiest section of the cab, as a rule, therefore, a chain puller is used to lift it into place under the crosshead.

7. A number of manufacturers of car cabs arrange hoisting eyes around the perimeter of the dome. These are sometimes short pieces of flat iron which are welded or bolted to the dome edges. They are provided with holes in which light steel slings or rope shackles can be secured. Another method provides the holes directly in reinforcing angle irons that brace the dome. The lifting eyes facilitate the handling and hoisting of the dome and reduces the chance of damage to the finish.

8. The rigging is placed high enough to permit

easy handling. It can be hung from timbers laid across beams above the car or in any convenient manner but must be held as near to center of the car as possible. In most jobs the car dome can be rolled onto the platform and laid flat on a pair of clean 2'' x 4'' studs laid postwise and covered with paper. The sling ends can then be led outside the crosshead to avoid interference when hoisting the dome.

9. The dome should be lifted only a few inches to test the balance. If it is not hanging approximately flat, lower it onto the 2'' x 4''s and adjust the slings to make it balance horizontally.

10. Hoist the dome as high as possible. Do this slowly so as not to damage the dome or let it slip out of position.

11. Install the rear panel(s) in place and fasten it to the platform. If round head wood screws are used, be sure to have lock washers on each one.

12. Install the side panels into place, fastening them to the platform. Bolt the rear and side panels together. Spring washers are to be used on all bolts. Be sure to square and align all parts, then tighten the bolts and screws securely. They will be almost inaccessible when the job is complete, so it is very important to get them tight.

13. Install the front panel(s) in the same manner. Check the clearances to be sure they agree with the layout.

14. Clean any dirt from the panel tops. Lower the dome onto the panels. Bolt it in place and be sure that it also is square.

15. Next install the long steadying or tie rod bolts into the columns, if they are to be used. Place washers under the nuts of these tie rod bolts. Install the steadying plates on the car top. Plumb the cab side panels and then bolt the steadying plates up tight. Use lock washers on the bolts for these plates, also. In explanation, most steadying plates are made up of two or more plates in which the bolt holes are slotted to permit adjustment in two directions. On sound reduced cars these are generally isolated from the stiles by synthetic rubber. After the enclosure is plumb and the plates are secured, drill a hole through a convenient part of the two plates, and bolt them together with a 1/4'' stove or machine bolt.

16. Always be sure to isolate the wiring on ''soundproofed'' elevators. In addition, ground the conduit system.

17. Should the cab finish be damaged during installation, report this to the superintendent. He will arrange to ''touch up'' or refinish the damaged part before the car is turned over to the building management, and thus eliminate a possible customer complaint.

18. If handrails are to be installed, try to bolt them in place before the panels are slid into position because there is not much ''working room'' in back and at sides of the panels, once they are installed.

19. Base or "kickplates" should be installed last, after the finished floor is in place.

20. Test all car features such as top and side emergency exit panels, to be sure they operate properly. Lubricate hinges and mechanical locks.

21. The code requires that passenger and freight elevators be equipped with at least two light bulbs. These can be in the same fixture and supplied from the same source, of course. Exceptions are made for special usage such as personal service elevators.

CHAPTER 8
Section -d2

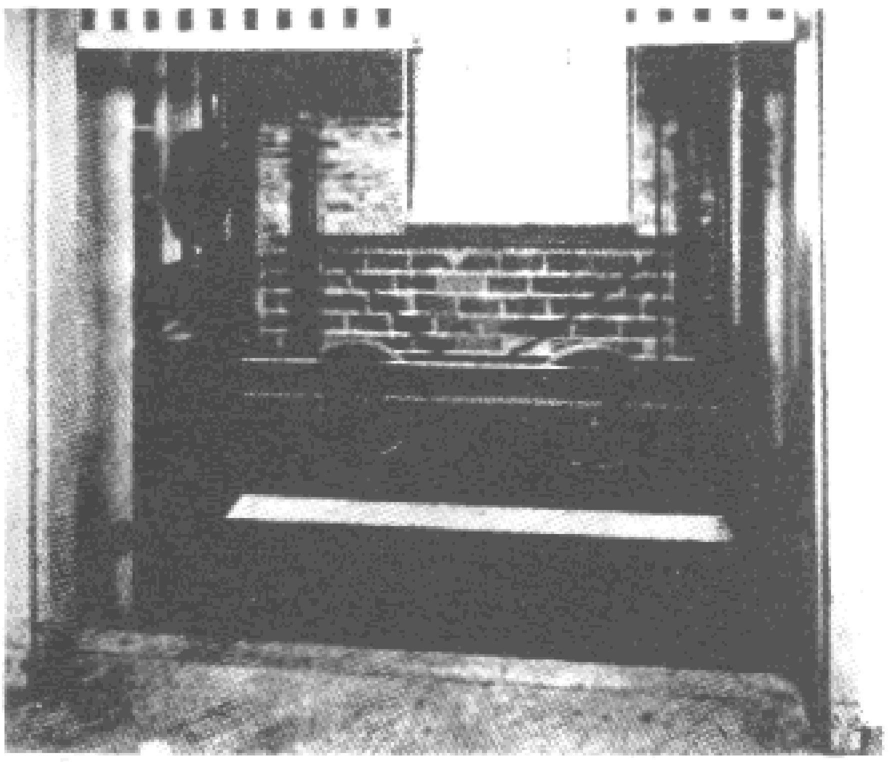
CAR STRUCTURES AND COUNTERWEIGHTS

Assembling Car Enclosures — Freight

Suggested:

Materials -
- a. sundries
- b. 2" x 4" timbers

Tools –
- a. hand tool kit
- b. chain puller
- c. slings
- d. rope clamps



View of Top Arrangement of Leitelt Freight Elevator

1. Freight elevator enclosures may be of steel, wood or other material. There are many types of these cabs but all are built for more rugged service than those designed for passenger use. Heavy guard rails are often installed to take the shock of hand trucks. Flooring is, as mentioned in section -c1, frequently steel plate.

2. Due to their heavy construction, it is generally necessary to use tackle to handle these enclosures. The usual precautions must be taken. Rig carefully and allow an ample safety factor on all slings and timbers.

3. Two types of domes are common on freight elevator enclosures. These are the solid type, similar to those on passenger cars, and the sectional type. This latter is made up of a series of narrow perforated or expanded steel panels set in angle frames. (Sometimes heavy steel wire mesh is used.) They are usually the full width of the elevator. The first (or front) and last panels are generally hinged and can be raised for access to the car top.

4. If the solid dome or canopy is to be installed, proceed as for a passenger elevator.

5. If the sectional enclosure top is supplied, install all the panels for the side and back (if used). Then bolt the top frame in place, and set the canopy panels in last.

6. In either case, all sides must be plumb. They must be square to the sill. All bolts must be tight and have spring washers installed.

7. Test all hinged panels in the top to be sure they open and close freely, and that they do not interfere with 2:1 sheaves, door equipment or any other accessories.

8. If contacts are required on such panels, be sure they are installed and tested.

CHAPTER 8
Section -el

CAR STRUCTURES AND COUNTERWEIGHTS

Laying Car Floors – Rubber Tile

Suggested:

Materials –
- a. rubber tile cement
- b. filler
- c. sundries
- d. tile cement solvent

Tools –
- a. hand tool kit
- b. wood plane or electric sander
- c. straightedge
- d. "soft" hammer
- e. trowel
- f. serrated trowel

1. The appearance of an elevator is greatly affected by its floor. Too much care cannot be used when installing it.

2. Most passenger elevators have a rubber, vinyl, or asphalt tile finished floor. These materials are customarily cemented to a "felt" paper, muslin, or a similar base that is tacked to the base wood floor. The base serves to bond the individual tiles together and to "cushion" the floor.

Completed Rubber Tile Floor – Note Kickplate at Base of Car Panels

3. This section will outline a method of installing rubber tiles.

4. Any rough or high spots on the wood floor are smoothed with a wood plane or electric sander. When the wood is smooth and a check with the straightedge reveals no high spots, the filler is tacked in place. It may be a piece of muslin, light canvas, duck or even types of building paper, such as "felt," tar or resin paper.

5. It is carefully smoothed and should not have any lapped joints. Cloth filler should always be tacked in place; paper may or may not, according to the local practice. It is recommended that all fillers be tacked in place. Some mechanics prefer to cut and fit the felt paper base, which is the most common base now used, then fasten the paper to the wood floor with the same mastic or cement that is used for the rubber tile. When the paper is "glued" to the floor in this manner, it should be ironed flat with a heavy roller to eliminate air bubbles or bulging. The only disadvantage to cementing the paper to the floor is that replacement of the floor covering is made more difficult. For this reason, some men still tack the felt to the floor. Company practice generally determines which method to follow.

6. After the filler has been laid, study the planned floor design. Check the stock of rubber tile. Set it out in place on the car floor exactly in accordance with the plan specified.

7. Where a strip border is ordered, cut this after the center design has been laid out. It can then be cut to allow for any slight differences between the plan and the actual field conditions. Kickplates are desirable because they conceal slightly imperfect joints at the panel edges.

8. When the design has been laid out and cut to fit, remove the tiles, stacking them in reverse order. Trowel a coating of cement onto the filler. Lay it about 1/16'' thick and smooth it out evenly. A serrated trowel helps to obtain a smooth even coating.

9. Set the front and side borders, checking the joints for smoothness with the straightedge. Tap the joints tight. Be sure the front border is level with the threshold plate. Pack it with strips of filler to obtain this level condition.

10. Install the design, tapping each piece of tile firmly into place with a ''soft'' hammer or mallet and a wood block. Do not kneel directly on the newly laid tile. Where it cannot be spanned, lay a light plank on it and kneel on the plank.

11. Install the rear border when all of the design tiles are set.

12. Where cars have safety wrench hole plates they usually are focal points of interest in the floor. Be sure the tiles fit well around them.

13. Make a check of the alignment of the tiles with the straightedge, tapping any high blocks to level them.

14. Lay building paper on the tiles and place planks on the paper. Place weights or bags of cement on the planks.

15. Allow 24 hours for the floor to set. Remove the weights, but leave the paper on the floor until the job is finished. However, remove any dirt or spots of tile cement, before placing the covering and weights on the floor. The tile cement solvent is best for this cleaning process.

CHAPTER 8
Section -e2

CAR STRUCTURES AND COUNTERWEIGHTS

Laying Car Floors – Asphalt Tile

Suggested:

Materials –
- a. rubber tile cement
- b. filler
- c. sundries
- d. solvent for mastic

Tools –
- a. hand tool kit
- b. wood plane
- c. straightedge
- d. ''soft'' hammer
- e. serrated trowel
- f. blowtorch

1. In the application of asphalt tile over a wood sub-floor which meets specifications for soundness and smoothness, it is necessary to use an asphalt saturated felt as a base for the tile. It adds resiliency to the floor, and is rigid enough to prevent most indentations. It is used for the most part because it helps to smooth the wood surface and also prevent moisture from attacking it. Regular asphalt building paper can be used.

2. The approved method for application of asphalt tile is as follows:

a. After sweeping floor clean of any sandings (do not use water to clean sub-floor) roll out the felt on the dry floor in sheets and fit between opposite walls. Run the felt opposite to the direction of the boards in the sub-floor. The sheets should be tightly abutted and not overlapping. Make accurate cuts along the walls, door jambs, etc. Cover the entire area first, and see that all sheets of felt are in correct position. Then roll all sheets half way back, taking care not to disturb position of felt. Thus half of the area will be open for cementing. Use a notched trowel (1/16'') and spread the cement evenly. Cover the open area with cement and then carefully place the felt in original position, rolling out any air bubbles immediately. Roll back the opposite half of the felt, cement and relay as instructed above. Use care to see that the joints of sheets abut perfectly.

b. After all felt has been relaid in cement, check over all joints and see that they have become bonded to the sub-floor, and roll out or walk out any apparent air bubbles.

3. It is necessary to have room temperature above 70 degrees F., and be sure the sub-floor is thoroughly dry.

4. During application a small amount of cement is apt to ooze up between the joints of the tile. As soon as you finish a small area, this excess cement should be removed by rubbing with a piece of steel wool and a little asphalt tile cleaner. DO NOT USE GASOLINE, NAPHTHA, BENZINE, OR SIMILAR VEHICLES IN AN ATTEMPT TO REMOVE CEMENT STAINS. Such materials are detrimental to asphalt tile and will leave a permanent scar on the face of the tile.

5. Do not use ordinary sweeping compounds, oil petroleum base waxes, strong soaps and cleaners at any time. These products all contain ingredients which are injurious to asphalt tile and liable to ruin the floors. Best results are obtained by the use of small quantities of asphalt tile cleaner and waxes. Avoid the use of lacquers, shellacs and varnish on your asphalt tile floors. They will ruin them beyond repair. The proper cleaners and waxes can be secured from any store handling asphalt tile flooring.

6. Asphalt tile can be heated without injury so that it will be quite flexible. A blowtorch can be used on the opposite side to that which will be exposed. It can be cut with a saw or, when heated, with a knife. Asphalt tile flooring is very brittle when cold and must be handled very carefully to prevent breaking or chipping. This is the reason that the tile should be warm when it is installed.

CHAPTER 8
Section -e3

CAR STRUCTURES AND COUNTERWEIGHTS

Laying Car Floors – Vinyl Tile

Suggested:

Materials –
a. vinyl tile cement
b. base paper
c. solvent for cement
d. sundries

Tools –
a. hand tool kit
b. wood plane
c. straightedge
d. soft hammer
e. serrated trowel

1. Synthetic materials such as vinyl have become popular for elevator passenger car floors during recent years. Their availability, tough wearing qualities and the rather wide choice of designs will probably tend to increase their usage.

2. Installation procedures are in line with those laid down for rubber and asphalt tiles. First a felt base or similar paper is cemented to a clean, smooth platform, then the vinyl tile is cemented to the base paper.

3. Because this and similar materials are synthetics it is important to follow manufacturer's instructions with respect to the cement or mastic used to set the flooring. Materials which are translucent generally require a white cement.

4. These floor coverings are cleaned with neutral cleansers.

5. Generally they can be polished with a water soluble wax. Lacquer or plastic waxes should not be used.

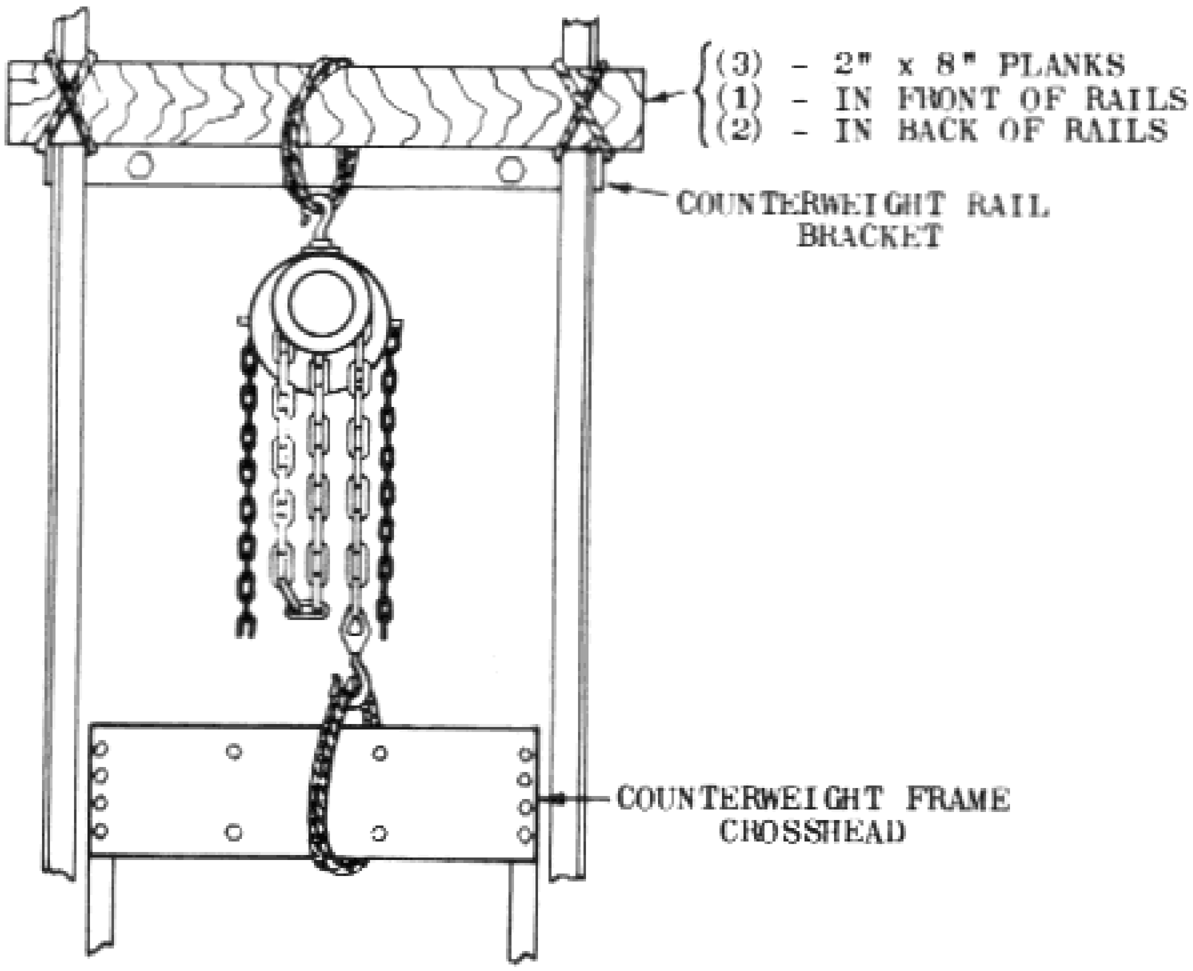
CAR STRUCTURES AND COUNTERWEIGHTS

Assembling Counterweights — Frame Type

Suggested:

Materials –
- a. timbers
- b. kerosene
- c. buffer oil
- d. Prussian blue and Japan lacquer
- e. red lead

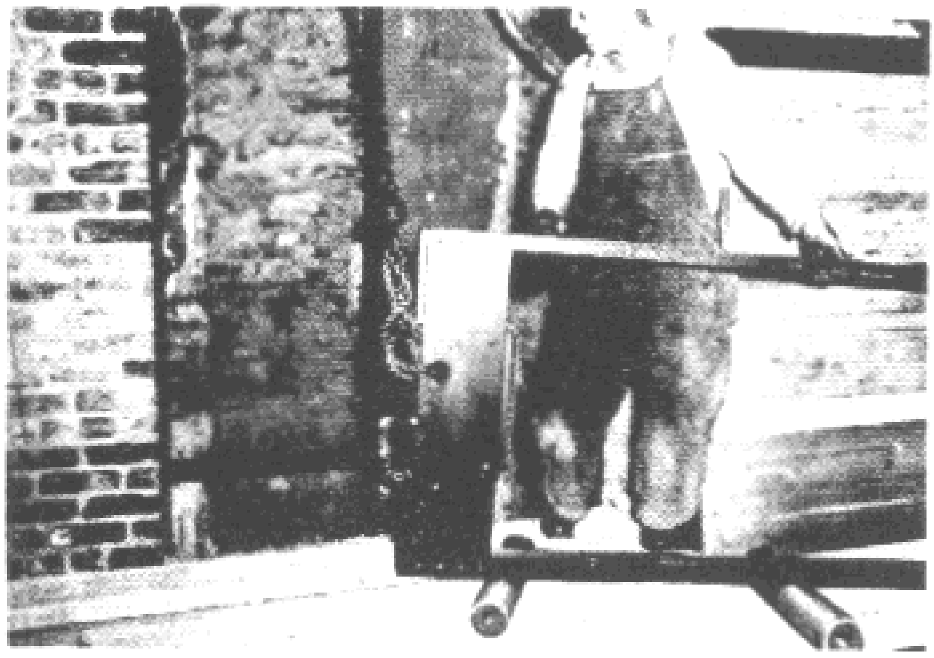
Tools –
- a. hand tool kit
- b. chain hoist or puller
- c. slings
- d. rope clamps



Sketch #1

1. Improvements in tools and methods have changed our thoughts on assembling frame counterweights, as well as other elevator components. Many "old-timers" had extreme views on whether the counterweight or the car should be assembled at the top or bottom and little could be done to change those views.

2. Job conditions can be used to determine where to assemble the counterweight, as well as the car. Where power hoists or tackle drivers are on moderate or low rise jobsites, it is probably just as easy to assemble both car and counterweight at the bottom and haul one to the top for roping.



Counterweight Frame Ready for Installation

3. Working on the assumption that on our typical job the counterweight will be assembled and roped at the pit, we would first study the drawings, material and assembly data. Tackle would be rigged from timbers set high enough to permit easy handling of the counterweight frame. Ordinarily the frame of the counterweight is shipped in one piece. Sub-weights, shoes and buffers (if suspended from the frame) are assembled after the counterweight frame has been set in place between the counterweight guides.

4. Where the counterweight is to be set in place in the pit, the frame is set up on blocks. To simplify the explanation, let us assume that a counterweight with a spring buffer is to be assembled.

5. Consider the relation of the counterweight to the car before starting to assemble the counterweight. On modern elevators the counterweight is used to provide traction and to assist in the "work" done by the motor under average conditions. It also provides a safety feature by landing on its buffer, if the elevator car travels beyond a pre-determined upper position. This causes the car to lose traction and prevents it from traveling into the overhead.

6. Because of this, it is necessary to rope the elevator so that the proper pit-of-counterweight is obtained. (Pit-of-counterweight is the distance between the counterweight buffer and its striking plate, when the elevator is level with the top terminal landing.)

7. It is obvious that the pit-of-counterweight, plus the buffer stroke (whether spring or oil type), should never be as much as the clear overhead of the car or the car could strike the overhead before losing traction. Always bear these points in mind when roping (or re-roping) an elevator.

8. If the car is assembled about 42" above a selected floor (as described in 8 -bl), this should provide sufficient rope slack for shackling. It is possible then, to set the counterweight frame at an exact pit-of-counterweight without further considerations. This position must be calculated by the mechanic.

9. The calculation is made as follows: Measure from the counterweight buffer striking plate to the spring buffer top. Add the desired pit-of-counterweight to this measurement. Cut 4" x 4" or suitable timbers to this length. For example, if the spring

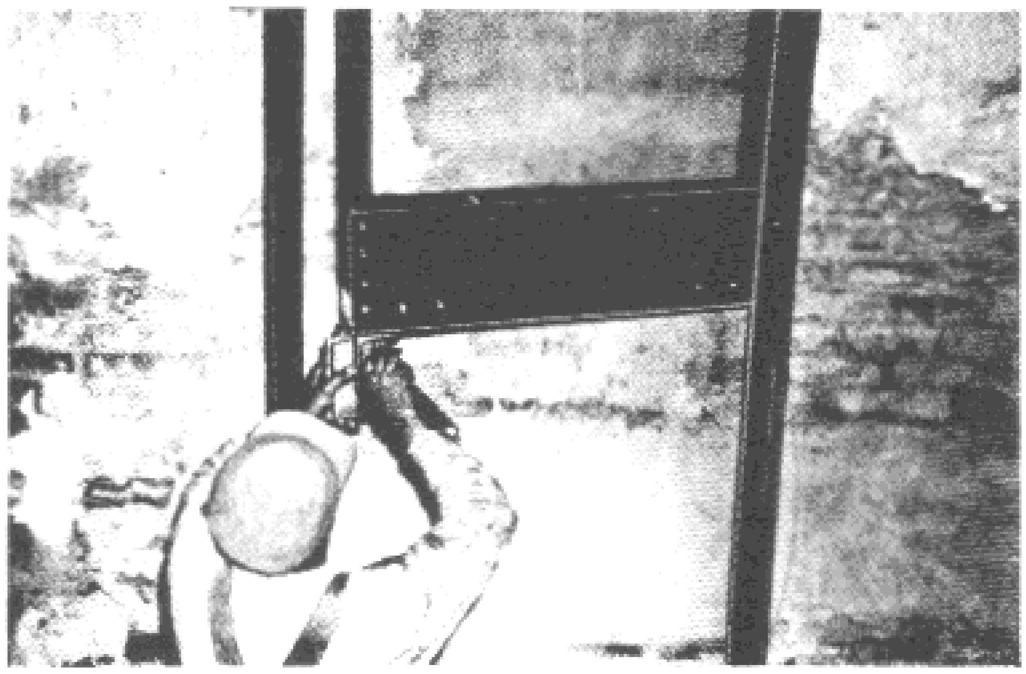
was 18'' high and a 24'' pit-of-counterweight was desired, the 4'' x 4'' would be cut 3'-6'' long.

10. Some companies follow the practice of having the layout draftsman show two dimensions for the pit-of-counterweight. The smaller is the one that is the planned pit-of-counterweight, determined by code requirements, which in turn are based on the elevator characteristics. The larger dimension is the code requirement plus the amount the draftsman estimates that the hoist ropes will stretch in service. This is primarily dependent on rope construction and elevator travel, from the drafting view-point. The mechanic would cut the wood blocks to hold the counterweight at a position above the buffer strike point to provide the larger of the two ''pit-of-counter-weight'' dimension.

11. Place the timbers upright on the buffer channel and tie them in place on each side of the spring in an appropriate position to support the frame. See that the buffer channel is resting on the pit floor or on blocks so it cannot slide down when the weight of the counterweight bears on it.

12. Pull the counterweight frame into the hoistway and lower it into place between the counterweight guide rails. Steady the wood blocks and rest the frame on them.

13. Install the shoes immediately. This secures the frame and the chain hoist can then be removed. Be sure the shoe stands are square to the counterweight.



Assembling Counterweight Shoes to the Frame

14. Install about half of the sub-weights into the frame. (If any parts such as compensating chain clevis bolts, go through frame members, install them before the sub-weights.) As each weight is placed, align its tie rod bolt holes with those already installed by inserting a short piece of 3/4'' conduit into the holes and prying the weights until the holes are lined up.

15. Only about half the total number of sub-weights are installed at this time. The counterweight must be kept light until the car enclosure is installed or it will overhaul the car and run it into the overhead when the car is moved.

16. After the frame has been installed, it is ready for roping. The elevator can be run once the ropes are over and the machine aligned. However, care must be exercised, when the car is first started, to be sure that neither the car nor counterweight is overbalanced. No heavy loads should be carried.

17. When a counterweight with a suspended oil buffer is to be installed, place the

blocking under the buffer cylinder, but make the block long enough to include the height of all the buffer striking blocks plus the piston stroke. Two 2'' x 4'' blocks, 1/2'' shorter than the buffer piston stroke, are then set alongside the piston and tied in place. This will prevent the buffer from compressing while the counterweight is being assembled. The buffer support bolts must be installed before any sub-weights are installed on this type of frame.

18. Another unusual feature of some counterweights is that certain sub-weights are ''offset'' to permit the installation of the compensating rope hitch. These weights are set in before the regular sub-weights, with the offset or ''cutout'' toward the front of the hoistway.

19. Where suspended oil buffers are used, clean out the buffer oil reservoir and cylinder by flushing it, then drain it, install the pet cock or gauge (use red lead on the thread), and fill the buffer to the level of the pet cock with buffer oil of the grade recommended by the manufacturer.

20. On all types, the specified number of sub-weights are installed when the car cab and all accessories such as door operators are in place. Also tie rods, tie down clamp and pipe spacers (if used) are installed during these completion preliminaries. An inspection is made to be sure all tie rod nuts and cotter pins are installed.

21. When final adjustments are made, the field engineer, inspector or adjustor will check the car counterweight overbalance. If this is correct, the tie down clamp will be through bolted to the counterweight frame channels. If the O/B (or overbalance) is wrong, correct it before fastening the clamp.

22. Where the counterweight is equipped with a safety, be sure to center the safety jaws on the guides, when the counterweight shoes are installed on the frame. Clean, lubricate and free up the safety parts.

23. Where the roping is 2:1, the rope guards must be installed and the sheave-shaft sleeve bearings lubricated before the elevator is operated. (Antifriction bearings are generally factory lubricated.) Be sure the guards are set close enough to prevent the ropes from jumping grooves in the sheave and becoming crossed.

24. Install the counterweight protective screen on the rails in the pit.

CHAPTER 8
Section -f2

CAR STRUCTURES AND COUNTERWEIGHTS

Assembling Counterweights — Sash Type

Suggested:

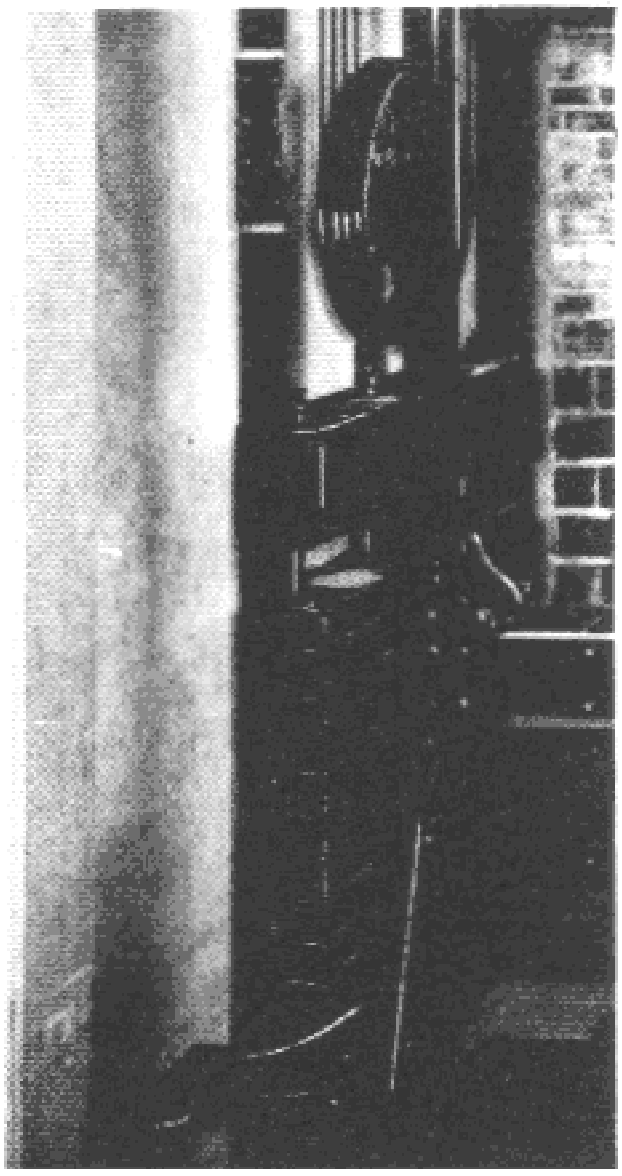
Materials –	Tools –
a. timbers	a. hand tool kit
b. sundries	b. rigging

1. The sash type counterweights, which are still used quite commonly for many elevator installations outside U.S.A. and Canada, as well as dumbwaiters in the code areas, are installed in a manner quite similar to that used for the frame.

2. As mentioned earlier, the unit generally includes two or three frame weights that are slotted at each end to ride the counterweight rails. The sub-weights are placed between the top, center, and bottom frame weights and held together with tie rods.

3. On small units, the weight sections can be handled by hand or rope block and fall. Heavier sections might make it more practical to use a chain hoist.

4. Set the lowest frame weight on wood blocks at the distance above the counterweight buffer channel needed for the "pit-of-counterweight." Install all four rods and lower the pipe spacers (if used) in place on the block on the outside rods. Level the weight.



Sash Type Counterweight

5. Add the specified number of sub-weights to reach the middle weight. Next, lower the middle frame weight onto the sub-weights. Install the top pipe spacers on the outer tie rods.

6. Lower the balance of the sub-weights into place, then set the top frame weight on the pipe spacers. Bolt the entire assembly securely with all tie rods. Be sure to install lock nuts and cotter pins at each end of each tie rod. This is common practice with most companies.

7. Since the entire counterweight must be assembled at one time in this type of installation, it is necessary to add weight to the car platform, if the elevator is to be operated before the enclosure is installed. This is a very important precaution.

8. Adjustment of overbalance is difficult and inefficient.

9. Most codes require a short iron screen to be installed in front of the counterweight rails in the pit. The location of the screen is indicated on the final layout. As a rule, it is clipped to the counterweight rails by flat steel brackets. Install it at any convenient time, after the counterweight is roped up. Be sure to maintain proper clearances between the counterweight, screen, and elevator car.

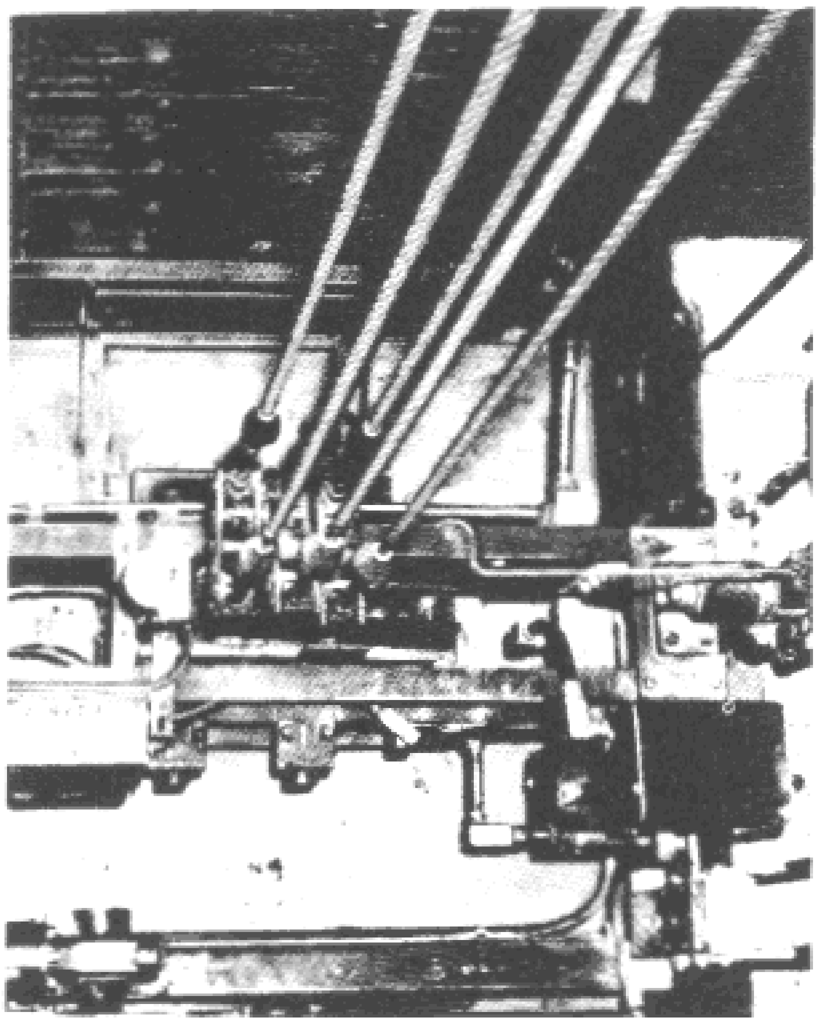
CONTENTS

CHAPTER 9

CHAPTER 9
Section -a1

CABLES AND ROPES

Rope – General



Hoist Ropes Hitched in Equalizer at Car Top

1. A New Standard Dictionary describes rope as, "a thick heavy cord made up of twisted and intertwined fibers as of hemp or the like."

2. The wire rope used on elevators is obviously a product of the evolution of rope from the twisted sinews and vines of primitive times to the present high standard of technical knowledge and skills in the rope manufacturing industry.

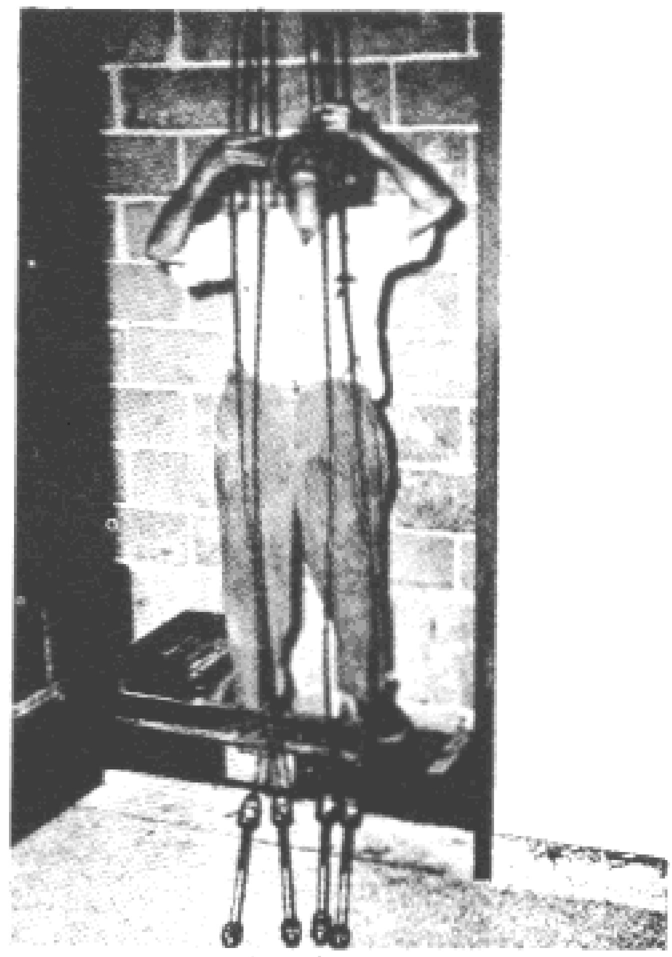
3. Present standards of finished product are high in both hemp and metalic ropes in most of the Western World and in Japan. Since modern power elevators are always equipped with steel wire ropes for hoisting, we are primarily interested in that type. Iron ropes (low carbon steel) are sometimes used for compensating ropes and occasionally for governor ropes. However, even this usage is decreasing. Manila hemp ropes are used only on hand powered dumbwaiters and elevators so they can be considered insignificant in our review. However, manila rope still remains one of the most important tools in a mechanic's tool kit.

4. Wire rope is manufactured from three major components, which are metalic bar stock or billets, a lubricant and a hemp for the center core. (Manila is the best to this date.)

5. The manufacturing facility is centered around the modern equivalent of the rope walk, which is essentially a long, narrow area of factory floor space where ropes can be formed by twisting.

6. Open hearth steel ingots are rolled into billets, then into rods. The rods are hot rolled and are finished about 1/8" in diameter for elevator ropes. The rods are cleaned with a dilute acid and washed with water spray and lime water, then drawn to the proper size for the particular rope to be made. The "drawing" process is

''continuous'' with larger manufacturers. The rod is forced through a die or drawplate slightly smaller than the rod diameter. The die opening is basically conical in form with the larger opening toward the feeding reel or stock. As the wire passes through the first die it is fed into a second and as many others as needed to reduce the rod to the desired diameter or ''gauge.'' Lubrication is applied during the drawing process. The amount of reduction in diameter that can be accomplished by drawing through one die varies greatly according to the material properties. It can be as high as 40% or as low as 10% for steel. The speed of drawing can be as fast as 1,000 feet per minute for soft steel. The physical properties of steel are changed by drawing and the tensile strength is actually increased. Dies can be one or more of any of a number of materials but tungsten carbide is widely used at present.



Mechanic Checking for Clear Rope Leads Before Installing Thimble Rods into the Rope Hitch

7. Once the wire has been drawn it is placed on bobbins of a stranding machine that is set up to form the wires into strands. The arrangement of the strands is determined by the rope specifications, such as Seale traction, ''Lang'' lay or ''regular'' lay.

8. The strands are then put on reels and placed in rope laying machines. These units which wind the required number of strands into the final rope are formed around a hemp center. Here again the ''make-up'' varies according to the rope specifications which are commonly 8 strand or 6 strand in our work. Rotative speed of the rope laying machine can vary from 30 to 2,000 revolutions per minute, depending on the kind and size of rope being manufactured, as well as the material being worked.

9. Modern methods of wire rope manufacture date from about 1870 when reasonably reliable rope stranding and laying machines were developed and practical consistency in drawing wire was achieved.

10. The 6 x 19 regular lay construction was a popular hoist rope for many years. Development of the 8 x 19 provided somewhat more flexibility while retaining strength. Seale traction and other combinations of wires of different gauge in each strand produced a rope more resistant to deforming. Seale rope is more flexible than regular and having the heaviest gauge wires on the outside, or wearing surface, it provides good rope life.

11. Lang lay is one in which the individual wires run (or twist) in the same direction as the strands. In ''regular'' lay the wires run opposite to the strand. Preformed rope is a type where the wires are formed into strands and the individual strands are twisted or ''formed'' into the shape they finally assume. This forming is done prior to the twisting of the strands into ropes on the rope laying machine. It has

some definite advantages, such as retaining its form if wire seizings become loose or are omitted, greater flexibility and less tendency to kink. A disadvantage is that inspection for wear or breaks is more difficult. Special mention of this is made in the safety code. Some companies use preformed whereas others standardize on the older forms. Shipping tags and erection data should contain information as to the type of rope supplied.

12. Incidentally, it is general practice to seize all ropes, whether preformed or not. The code requires one seizing at each end of preformed rope and three for non-preformed rope. Your own company's practice may require two or three on preformed, therefore, follow the ''super's'' instructions.

13. Ropes are made in right-hand or left-hand lay. The hand refers to the direction of twist of the strands. The rope core serves to support the steel wire strands and, also, acts as a lubrication reservoir.

14. Rope diameter is measured across the greatest dimension, that is, from the outer extremities of two opposite strands.

15. Rule 212 of the Safety Code is devoted to hoist and counterweight ropes and their fastenings. Hoist ropes in code areas must be 1/2'' in diameter or greater. European codes permit metric sizes equal to about 5/16'' to be used for small passenger cars.

16. Governor rope requirements are spelled out in Rule 206 and must be 3/8'' or greater in diameter as against 1/4'' to 5/16'' (approximate) in non-code territories. Tiller rope is not permitted to be used for governor rope.

17. Compensating ropes can be iron or steel.

18. Elevator ropes, whether hoist, governor or compensating, are secured to car and counterweight frame members, by means of some form of ''hitch.'' These may be forged individual thimble rods set in a hitch plate or a one piece hitch block for several ropes, such as is used by some companies for compensating hitches. Thimble rods (or shackle rods) may be of one piece that includes the rod and the rope socket or of separate pieces. The rope ends are ''turned in'' and babbitted.

19. Probably every experienced mechanic has devised his own ''short cuts'' for rope work. As field conditions and local shipping facilities vary, it is impossible to set up any one system as the best. For instance, some localities have an ample supply of reels available. There the custom is to ship all wire rope on reels. In others, such as in small cities, it is often difficult to obtain extra reels and, therefore, ropes are coiled for shipment to the jobsite.

20. It is evident that reels and coils cannot be handled in the same manner. Because of this, no attempt is made in this chapter to state that the given methods are the best. The methods are suggested in the belief that they are basically sound and, if closely followed, will result in unkinked, evenly installed, and well socketed elevator rope work.

21. General practice in most companies is to supply ropes for any one elevator from a single reel of ropes. There is sound reasoning for this since the stretch factor is the same for all such ropes and rope diameter will tend to be more consistent on all the ropes. Difference in stretch factor or appreciable diameter variance can cause rope slip with its resultant sheave groove wear.

CHAPTER 9
Section -b1

CABLES AND ROPES

Ropes – Handling and Seizing

Suggested:

Materials –
a. none

Tools –
a. none

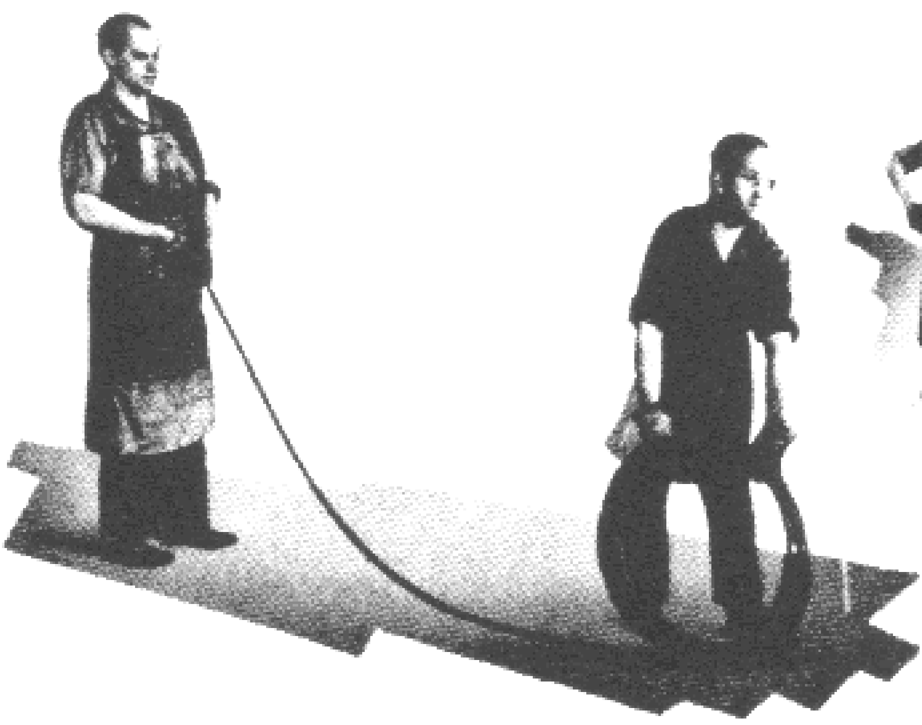


Photo 1 – Correct Method of Unreeling Ropes

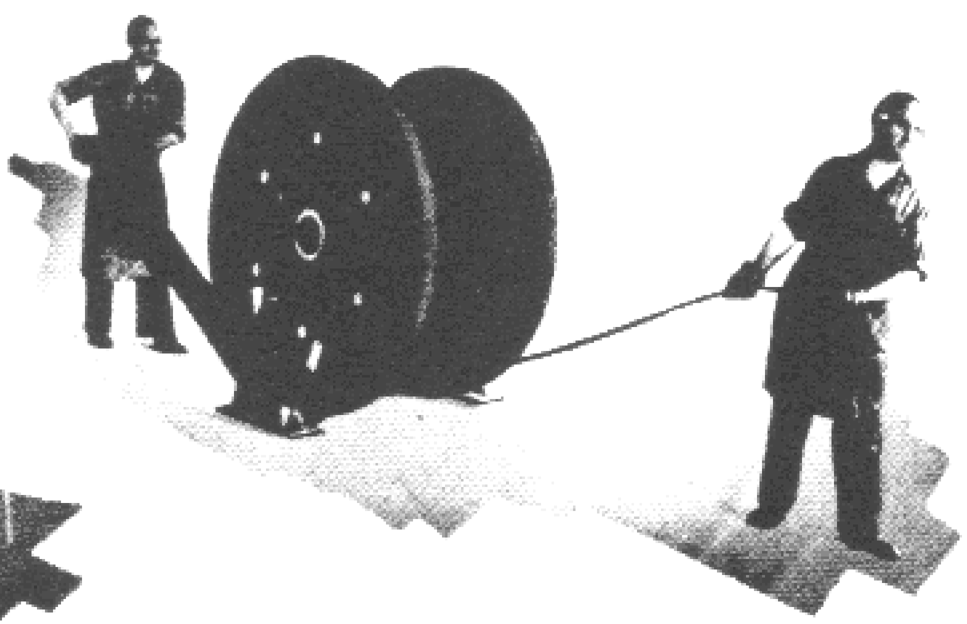


Photo 2 – Correct Method of Uncoiling Ropes

1. All possible care must be exercised in the handling of elevator rope. Careless handling, seizing, and socketing result in a short rope life. Full rope life can only be obtained when the greatest care is taken, not only in warehouse and in shipping, but also in the field.

2. The methods described here have been found by long experience to produce satisfactory results, and have been considered as standard practice.

3. Wire rope used for elevators consists of a number of strands twisted around a hemp center, each strand being made up of numerous small individual wires. The ultimate strength of the rope is equal to the combined strength of the individual wires. In order to obtain the greatest aggregate strength it is essential that the original twist of the rope in its entirety be preserved as nearly as possible in the same condition as it was when manufactured. That is, care should be exercised to prevent injury in handling prior to actual operation in service.

4. Short lengths of rope with diameters up to 5/8'' are usually shipped in coils. Longer lengths or those with large diameters are shipped on reels.

5. Photos 1 and 2 illustrate the proper methods of handling both coils and reels of rope.

6. Improper methods of handling result in twists and kinks, and although the kinks may be straightened, they leave a permanently damaged and weakened spot.

7. To avoid injury to the rope in handling, care should be exercised to uncoil the rope as shown in photos 1 and 2.

8. Ropes should not be wound directly from a reel to a drum, especially if the rope is of "preformed" construction. The best practice is to unwind the rope from the reel entirely, letting it lay in a straight line, and then wind the rope on the drum.

9. Preformed rope requires even more careful handling than other types of ropes. Experience has shown that excessive handling will damage it, as evidenced by the fact that when such rope is transferred from one reel to another several times it becomes "cranky and wild," and after a number of transfers, it may even "bird cage." If the entire length of rope is pulled off one reel before winding on another reel, this trouble will not be experienced, for the rope will readjust itself before rewinding. When a rope is unwound from one reel to another, the entire readjustment is concentrated in the distance between reels, with the result that when the loose end of the rope comes off the first reel, it rotates violently a number of times in order to take up the adjustment.

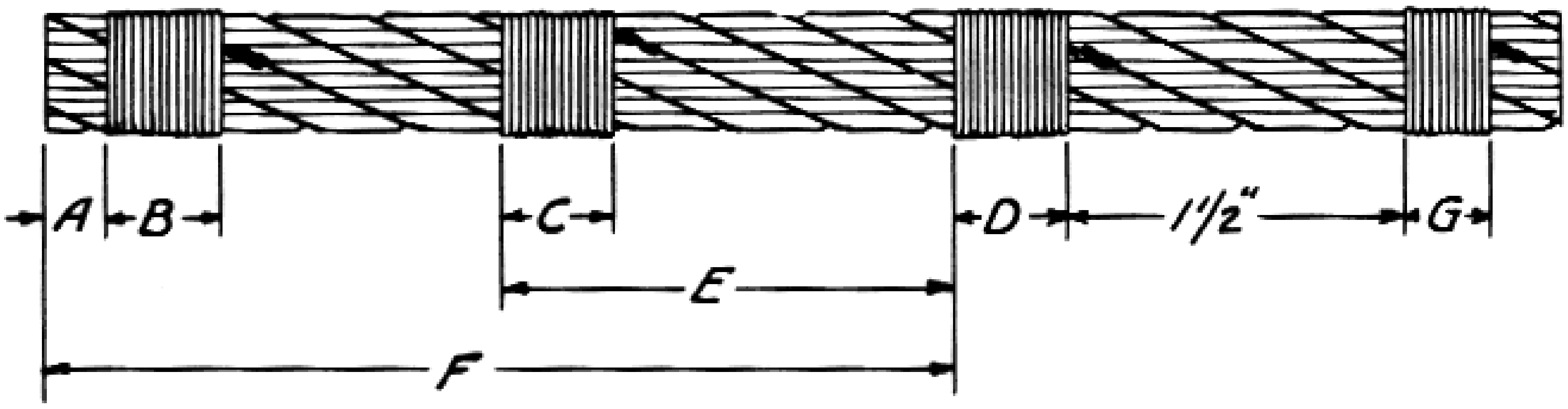
10. It is very important that the proper seizings be applied before shipping the rope to the field, and before socketing the ends into the thimbles.

11. All possible precautions should be taken so as to prevent loss of rope lay in the sockets. In many instances, field inspections have revealed that the strands run practically straight for about six inches from the socket. This indicates that proper seizings were not applied before socketing, thus resulting in serious injury to the ropes, with consequent loss of strength and shorter life.

12. In many cases of rope failure, broken wires have been found in one strand, thus indicating that this strand was overstressed before babbitting. The overstrain may have been caused by pulling the new rope into position by one extended strand while the seizings were insufficient.

13. If an insufficient number of seizings are applied, or if they are loosely made, invariably some of the strands untwist more than others, usually resulting in premature failure.

WIRE ROPE SEIZING & SPACING CHART



APPROXIMATE LENGTH OF SEIZING & SPACING IN(")							
ROPE SIZE	A	B	C	D	E	F	G
3/8	1/4	1/2	1/2	1/2	2	4	3/8
1/2	1/4	1/2	1/2	1/2	2	4	3/8
9/16	1/4	1/2	1/2	5/8	2 1/2	5	3/8
5/8	1/4	1/2	1/2	5/8	2 1/2	5	3/8
3/4	1/4	1/2	1/2	3/4	3	6	3/8
7/8	1/4	5/8	5/8	7/8	3 1/4	6 1/2	3/8
1	1/4	5/8	5/8	7/8	3 1/2	7	3/8
1 1/16	1/4	5/8	5/8	7/8	3 3/4	7	3/8

SEIZING WIRE TO BE 1/32" DIA. (APPROX. #21 GA.) ANNEALED IRON WIRE. NO OTHER WIRE TO BE USED.

Sketch #1

14. Whenever it is necessary to pull the rope into position by attaching the new rope to the old rope, such as when reroping an elevator under maintenance, the connection should not be made to a single strand of each rope. Two diametrically opposed strands of the new rope should be looped and connected to one extended strand of the old rope, both properly seized. If only one extended strand was used in the new rope, it would compress the hemp center and pull the rope out of shape, which, when seized and socketed would result in unequal loads on the strands.

15. The safety code recommends that in preparation for socketing all ropes should have THREE EFFECTIVE WIRE SEIZINGS ON EACH END. These are shown in sketch 1 as B, C, D. Each seizing should consist of 1/32'' diameter ANNEALED IRON WIRES WOUND TIGHT AND EVEN. All seizings should be spaced as per dimensions on the chart appended to sketch 1. The twisted ends of the seizings must be so placed that they fall into valleys between strands and away from the end of the rope, otherwise the seizings will not pass through the end of the socket. The opening in the latter is only about 1/16'' larger than the diameter of the rope, and may in some cases be found too tight when slipping over the seizings. This, however, can be overcome by slightly smoothing the inside of the socket by means of a round file. Some mechanics use a fourth seizing so that two visible bindings remain when the rope socketing is complete. See ''G'' in sketch #1.

16. UNDER NO CIRCUMSTANCES IS TAPE TO BE USED AS A SUBSTITUTE FOR THE 1/32'' DIAMETER ANNEALED IRON WIRE SEIZING.

17. Photo 3 shows the properly seized rope end pulled through the socket a sufficient distance for manipulating.

18. After removing seizings B and C, the strands are opened up and the hemp center is cut out as close as possible to seizing D, as shown in photo 4.

19. All grease should be wiped off the extended strands and they should be washed with a solvent.

Photo 3

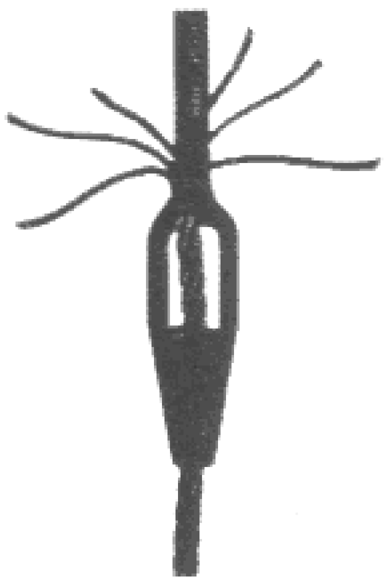


Photo 4

Photo 5

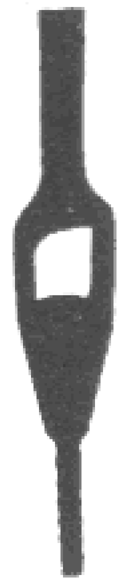


Photo 6

20. The ends of the strands are then bent as shown in photo 5 and bunched close together. The end of each loop should be crimped with heavy pliers to "set" the loop permanently and reduce the chance of pulling out under load. The rope is then pulled back as far as possible so that the stands rest in the basket, with the seizing marked "C" partly projecting outside the mouth of the socket. Tension is held on the rope, and the socket hammered to seat the rope well, as in photo 6. The socket is then heated with a torch, after which it is ready for babbitting. See photo 7.

Photo 7 –
Pouring Babbitt into Rope Socket

21. When pouring the babbitt, it is necessary to hold the prepared rope end and socket in a vertical position. If necessary, tape or waste may be wound around the rope at the base of the socket to prevent the molten babbitt from seeping through, but it must be removed after the metal has cooled off. Only pure babbitt, free of dross, should be used. It should be heated to a temperature just sufficient to char but not burn a soft pine shaving.

22. The babbitt should be visible at the small end of the socket, if the work is well done. The tops of the looped strands of the rope should show, but no entire loop of any strand should be above the babbitt surface. As stressed in earlier paragraphs, no loss of rope lay should be evident at the small end of the socket.

23. After all the ropes have been socketed in the previously described manner, they are assembled in their respective hitches. The tension on each rope is carefully adjusted, so that each carries as nearly as possible an equal part of the total load.

24. The adjusting of rope tension cannot usually be done with an ordinary wrench. Socket wrenches, fitting the nuts on ends of thimble rods, should be furnished for this purpose. Under no conditions should the thimble rods themselves be turned as this will cause twisting of the ropes. This could either unlay the rope or effectively shorten it.

25. Rope tension will remain reasonably constant for quite some time after adjustment, but eventually will change due to core compression, stretch of material, and the twirling tendency of the ropes when winding over sheaves or drums, causing creepage. The amount of this creepage varies with changing loads. Therefore, it is not enough that the rope tension is properly adjusted at the time the ropes are installed but this tension must be continually maintained in equalized condition and adjusted at regular intervals. The adjusting of rope tension, thereby becomes one of the prime duties of maintenance men. Unequal rope tension not only shortens the life of the ropes, but will also cause unequal wear of sheave grooves.

26. Another, and not to be considered as an unimportant factor regarding the life of rope is lubrication. Ropes moving over sheaves are continuously bending and straightening out, causing a continuous rubbing of the wires and strands upon each other. These rubbing surfaces, like any other, require lubrication. Wire rope has its hemp core saturated with lubricant at the time of manufacturing. This, however, will eventually dry out unless replenished. Lubrication also prevents moisture from getting into the rope, as well as lessening the friction between the wires and thereby materially increasing the life of the rope. The lubricant to be used should not merely cover the outside surfaces, but be of such consistency as to penetrate each strand and cover the inside wires. This result cannot be obtained from thick, heavy, or sticky compounds and greases. Neither is there much value in a lubricant which is so thin that it will flow easily and drop from the ropes.

27. Wire-rope lubricants possess the required special qualities that have been developed by tests and experiments. However, development of new materials and processes make it necessary to re-evaluate our practice at reasonably frequent intervals. Furthermore, the rope manufacturers are also experimenting with new ideas on lubrication, so we must be prepared to accept new ideas. Another important factor is that a lubricant that is excellent for Northern Canada probably will be poor for Key West. The product must suit the area in which it is to be used.

CHAPTER 9
Section -c1

CABLES AND ROPES

Hoist Ropes – Single Wrap Traction, 1:1 Roping

Suggested:

Materials –
- a. socketing babbitt
- b. annealed iron wire
- c. gasoline or tank of gas

Tools –
- a. hand tool kit
- b. wire-rope cutters
- c. rope fall
- d. blow torch or gas furnace
- e. rope clamps
- f. reel jacks or horses

1. In chapter 7, the location of the carframe, during its installation, was described. This has a definite bearing on the installation of the hoist ropes.

2. Where the elevator is assembled on blocks or bolts at the top landing, the car can be roped in that position.

3. If, instead, the counterweight is assembled at the top and the car at the bottom, the elevator can be roped in that position, also.

4. When both the car and counterweight are assembled at the bottom of the hoistway, as is often done in low-rise installations, one of the two must be hoisted to the top.

5. Let us assume that both were at the bottom, and a hoist was rigged in the overhead to lift the car. Before raising the elevator, the governor rope must be installed and the safety device made operative.

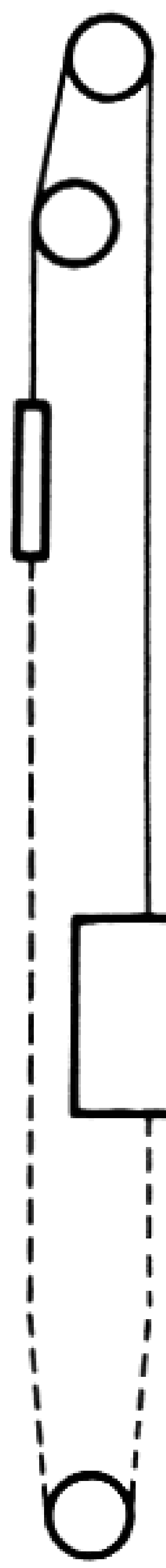
6. Details of installing a governor rope will be found in section "d" of this chapter.

7. After the governor rope is on, hoist the car up to a position 42" above the top landing (assuming no car enclosure is installed and the overhead clearance is sufficient to allow working space).

8. Set the safety governor jaws as a precautionary measure.

9. Go to the pit and inspect the location of the counterweight. Since the elevator car is 42" above the top landing, this provides the needed "slack" in the ropes for shackling.

10. As an example, let us say the normal pit-of-counterweight is 6" (not including an allowance for rope stretch) and the spring buffer is 20" above the pit floor. This makes a total distance of 26". The counterweight could be on wood blocks exactly 26" above the pit floor and the ropes installed, allowing 42" extra length so the car could be lowered to the top landing without disturbing the pit-of-counterweight.



Overhead Type One-to-One Single Wrap

11. Theoretically, this would be a satisfactory way to rope the elevator. However, since the hoist ropes are new, they would begin to stretch immediately. This would reduce the pit-of-counterweight.

12. Rope stretch must, therefore, be taken into consideration. One manufacturer suggests that the following allowances for stretch be made when installing steel traction ropes:

for 6 by 19 – allow rise times (1/2 of 1%)

for 8 by 19 – allow rise times (3/4 of 1%)

This is about the same as the rule of thumb system of 6" per 100' for 6 x 19 and 7-1/2" for 8 x 19.

13. Let us say our rise is 76' and the ropes are 1/2'' —6 x 19. 76' x (1/2 of 1%) which equals 76' x .005 or .380' (.38'= 4.56'' or say 5'').

14. Therefore, instead of setting the counterweight 26'' above the pit floor we could add the 5'' to make a total of 31''

15. Leave a helper in the pit to install the counterweight rope shackles. Have him screw on the nuts and lock nuts just enough to permit the installation of the cotter pins. (Install springs, if used.)

16. Go to the top of the hoistway. Set the rope reel(s) up on a pipe and roping reel jacks or on pipe and horses. Lead the rope from the bottom of the reel.

17. See that the rope end is properly seized in accordance with the chart in section -b1 of this chapter.

18. Send the rope end up through the overhead, over the car side of the drive sheave in the first rope groove and down to the counterweight. If necessary, tie a weight, such as a 12'' wrench on the rope end, to start it down straight.

19. Have the helper hold the first counterweight shackle up to a full thread. Then, hold the bottom of the third binding even with the top of the shackle. (The third seizing is ''D'' on the chart.)

20. Pull back the slack on the rope at the car end. Install the first car shackle, and hold it up to a full thread.

21. Hold the rope against the shackle and mark it with chalk. Release the shackle and measure down the rope an additional 42''. Mark it at this point, which will be the position of the third or ''D'' seizing at this end of the rope.

22. Install this and the other seizings, then install similar wire bindings in the opposite directions, just 1/2'' below the ''B'' or first binding.

23. Cut the rope between the two ''B'' bindings. Turn the car end of the rope into the car rope shackle.

24. Have a helper start the gas furnace and begin to heat the babbitt in the pot.

25. Meanwhile, send the second rope over the sheave and down to the counterweight. Let the helper hold the two ends even at the car shackle. Seize it the same as for the first rope, then cut and turn it in.

26. Repeat this for the balance of the ropes. Be careful not to cross or twist the ropes. Tie them apart between the rails, if necessary.

27. On moderate rise jobs, a temporary tie can be made to the crosshead as the ropes are turned in; or the shackles can be placed in their respective holes in the rope hitch, until all ropes are over, turned in, and ready for socketing.

28. The babbitt is heated until it will char a pine sliver and the dross is then ladled out. It is advisable to heat the shackles until they are uncomfortably warm to touch. Then, holding them straight, with the mouth of the "basket" up, ladle the clean babbitt into them, one at a time.

29. A sizeable handful of waste should be soaked in water and kept handy. As each socket is poured, wrap this waste around it to "set" the babbitt. Do not spill water into the molten babbitt. This can cause an "explosion" that might result in serious burns to you or your helper. Be careful not to touch the ladle with a bare hand. A serious burn might result. It is advisable to wear canvas gloves when doing this. Safety goggles are also recommended.

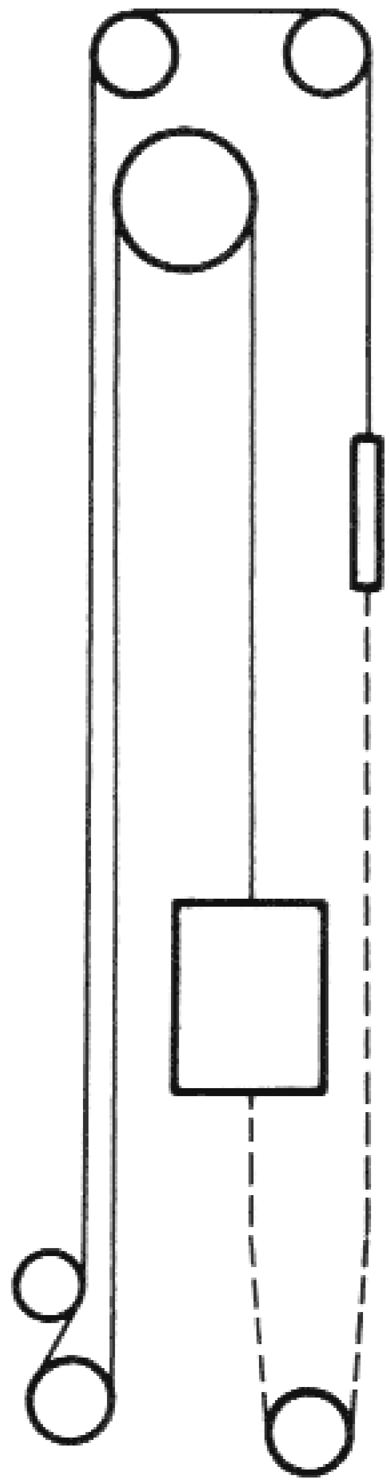
30. After all shackles are babbitted, install them in the proper holes in the rope hitch. Be careful to maintain a proper rope lead to the sheave. If in doubt, have your superintendent check on this.

31. Go to the lowest terminal, extend a plank or ladder to the top of the counterweight and examine the rope ends. All of them should be approximately even. (Slight variations can be taken up on the shackle or thimble-rod threads.) Be sure to pull down all slack on each rope, before checking the lengths.

32. If these lengths are all correct, turn the ropes in and babbitt them. Install each in its rope-hitch hole.

33. Do not turn or "twist" any rope to make it shorter. If it is too long, put new seizings on and cut it.

34. If one or more ropes are too short, send a helper to the machine. Have him inspect the sheave to be sure all ropes are in the proper grooves. Cut all the others only as a last resort and **only** where the overhead clearance permits this to be done.



Basement Type
One-to-One
Single Wrap

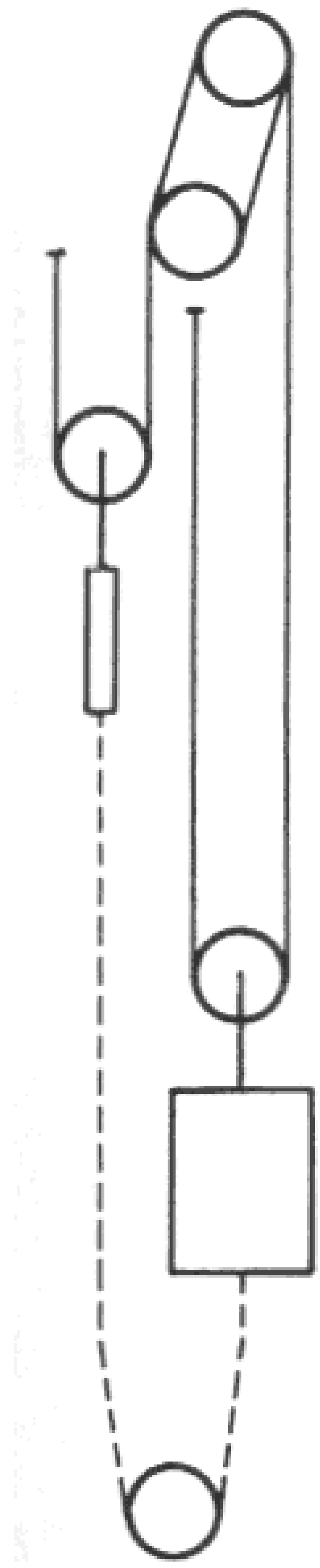
35. When all ropes are in order, clear the hoistway of men, release the safety, and lower the car until it is hanging on the ropes.

36. Next, leave a helper on the car top with a shackle-nut socket wrench and go to the center of the hoistway. Rig a plank or scaffold to the counterweight guides. Go out and hand check the ropes for tension. Have the helper tighten or loosen thimble-rod nuts until the cables are all under about the same tension.

37. Install all lock nuts and cotter pins in the thimble rods at both the car and counterweight hitches.

38. Crank the car until it is level with the top landing. Go to the pit and check the pit-of-counterweight to be sure no mistake has been made.

39. Check all overhead clearances to be sure they are correct.



Overhead Type
Two-to-One
Double Wrap

CHAPTER 9
Section -c2

CABLES AND ROPES

Hoist Ropes – Traction, 2:1 Roping

Suggested:

Materials –	Tools –
a. same as 1:1 roping	a. same as 1:1 roping plus a single-whip manila fall

1. When an elevator is arranged for 2:1 roping, the installation of ropes is done in a manner very similar to 1:1 cars. The chief difference is that a fall or free end of a manila rope must be dropped to the bottom of the hoistway to pull the end of hoist rope to the hitch at the machine beams.

2. This is necessary because on 2:1 roping the ends of the ropes are secured to "dead end" hitches in the overhead, whereas for 1:1, the rope ends are hitched to the car and counterweight, respectively.

3. With the car set at the top of the hoistway, it is suggested that you proceed in the following manner.

4. Set the wire rope reels up at the top floor on horses or jacks.

5. Send one hoist rope end over the drive (and deflector, if used) sheave(s). Lower it to the counterweight.

6. Pass it under the first rope groove in the counterweight sheave.

7. Drop the end of the manila rope fall. Secure the rope end to it, and haul it to the top floor. Turn it in the thimble and install it in the first rope hole in the counterweight hitch.

8. Haul back all the slack in the hoist rope. Determine the length needed to pass under the car sheave and up to the car end hitch-plate in the overhead. Seize and cut the rope, being sure to deduct for the length of the thimble rod. Install the thimble rod in the first hole of the car hitch-plate.

9. Follow the same procedure for the other ropes.

10. Where the car is at the bottom and the counterweight at the top of the hoistway, install the car hitch shackles first, pull back the slack to the counterweight hitch, then seize, cut, shackle, and mount that end.

11. Observe all precautions in relation to babbitting, clearances, rope tension and safety as outlined in section -c1.

CHAPTER 9
Section -d1

CABLES AND ROPES

Governor Ropes — Installing, Car at Bottom

Suggested:

Materials —
- a. socketing babbitt
- b. annealed iron wire
- c. gasoline or a gas tank
- d. sundries

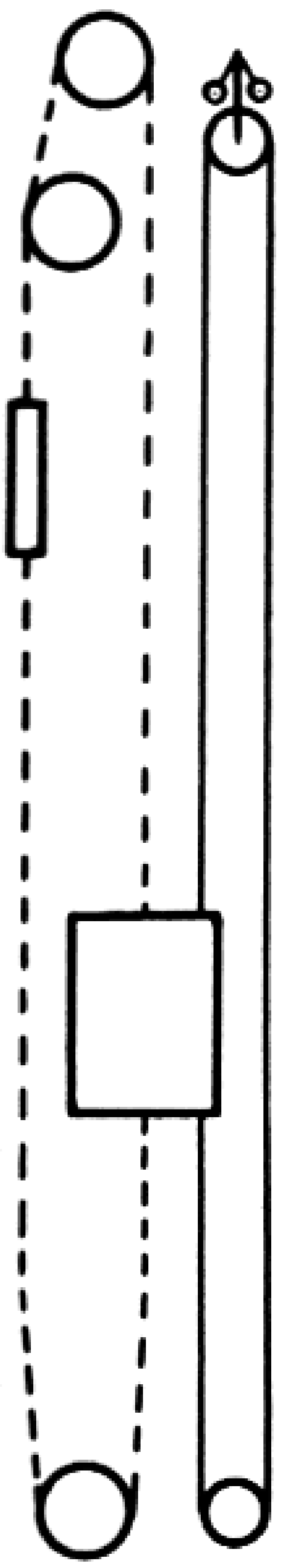
Tools —
- a. hand tool kit
- b. rope chisels or rope cutter
- c. blow torch or gas furnace
- d. safety wrench
- e. single-whip rope fall

1. There are several ways in which a governor rope can be installed. Two of the most common methods are: first, with the car at the bottom of the hoistway without hoist ropes; second, where the car hoist cables are on and power is available to run the elevator.

2. In this section we will take the first condition as our example.

3. Since governor ropes are comparatively light in weight there is no special problem to installing them.

4. One point of importance is to check the type of governor rope supplied to the field against the data plate on the governor. The type of rope must conform to that specified on the data-plate marking because the governor jaws are set for one type of rope, such as 6 x 19 or 8 x 19. One type of jaw cannot be used for all ropes, because the rope cross sections are not the same. This is very important for high-speed governors.



Governor Rope Arrangement

5. If the rope is not of the type specified, do not install it. Notify the field superintendent to send the proper type of rope, or have him arrange to change the safety jaw or its setting.

6. Begin the rope installation by rigging the rope fall in the overhead and setting up the reel of rope on a pipe and horses, at the bottom landing. Haul the governor rope end over the governor sheave. Pass it down through the jaws, and down the hoistway to the car top. If necessary, tie a weight on the rope to lead it down.

7. If the rope is coiled, instead of being on a reel, the procedure is the same, except that the coil need not be set up on a pipe. It can be rolled out, as it is hauled up and lowered. (Never lay a coil of rope down and "pull" the rope off sideways.)

8. When the rope end reaches the car top, secure it and unreel or uncoil the balance of the rope, being careful not to twist or kink the "bight." Send this second rope end down to the pit at the opposite side of the governor sheave from the jaw.

9. Go to the pit. Block the governor tension sheave as high in its frame as possible.

10. Pass the rope's "long" end (i.e., the rope from the side of the governor opposite the jaw) under the tension sheave and up on the "rail" side. Haul it up to the car top.

11. Heat the babbitt and rope shackles in the normal manner.

12. Make up the short end of the rope in the top half of the shackle thimble and, holding it with the mouth of the basket up, babbitt it.

13. Turn the shackle right-side up, pull the slack out of the rope, seize, cut and socket it in the thimble in the lower half of the releasing carrier. Babbitt this end also.

14. Clamp the releasing carrier in its holder on the car top.

15. Go to the pit, remove the block from under the tension sheave and tighten the clamps down so that the rope is taut.

16. If the safety is the "drum" gradually applied type, tighten the rope on the drum. If the drum rope is too long, shorten, re-socket, and re-babbitt it at this time.

CHAPTER 9
Section -d2

CABLES AND ROPES

Governor Ropes – Installing, Car Running

Suggested:

Materials –	Tools –
a. socketing babbitt	a. hand tool kit
b. annealed iron wire	b. rope chisel or rope cutter
c. gasoline or a gas tank	c. blow torch or gas furnace
d. sundries	d. safety wrench

1. Section d-1 notes that there are two common methods of roping governors. The second method mentioned, that of roping the governor after the hoist ropes are on and the machine is ready to run, is described herewith.

2. Assume the car is at the top landing. Set the governor rope reel or a coil on the car top.

3. Send the end of the rope over the governor sheave. The free end should be on the jaw side. Seize, turn in, and babbitt this rope end on the top half of the releasing carrier (the top socket).

4. Run the car down at low speed, holding the reel or coil of rope vertical and turning it to "unreel" the rope without kinks. This not only provides a convenient means for unwinding the governor rope but also provides a real safety factor. If the elevator should start to run away, the safety can be set by hauling down hard on the governor rope at the reel (or coil) side.

5. When the car arrives at the bottom landing, uncoil the balance of the rope and pass it to the helper in the pit.

6. Place a block under the governor rope tension sheave, in order to hold the sheave at the top of the frame.

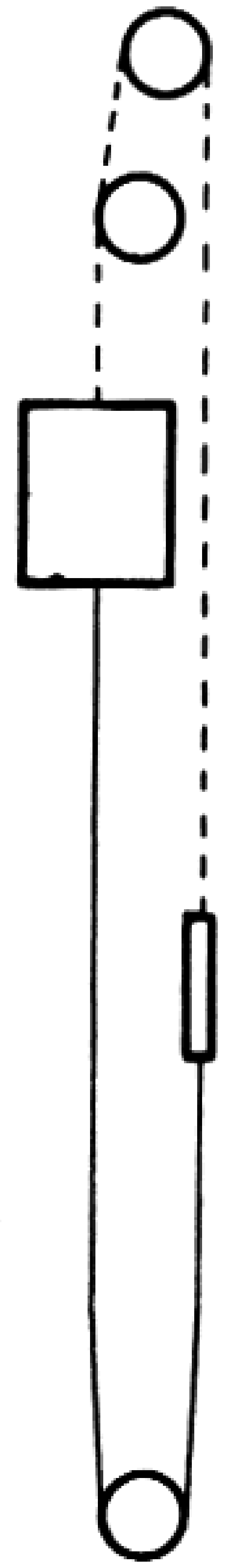
7. With wedge-clamp safeties the releasing carrier can be lowered to the pit. Then, pass the governor rope end under the tension sheave and up to the releasing carrier.

8. Babbitt the rope in the lower thimble.

9. On other types the rope is usually passed under the tension sheave, then up the side of the car to the releasing carrier, and is babbitted in the thimble.

10. Remove blocking from the tightener sheave, and tighten down the clamps to make the rope taut.

11. Reset the releasing carrier in its holder. Tighten the tail rope on the drum (if used), and have the helper make a trip through the hoistway while you inspect the rope for damage.



Compensating Rope Arrangement

CHAPTER 9
Section -e1

CABLES AND ROPES

Compensating Ropes

Suggested:

Materials –	Tools –
a. babbitt	a. hand tool kit & rope cutter
b. annealed iron wire	b. blow torch or gas furnace
c. gasoline or gas tank	c. babbitt pot and ladle

1. Compensation of some sort is generally conceded to be required on most elevators with a rise of more than one hundred feet. Low or medium speed elevators are often equipped with compensating chains. High-speed cars almost invariably have rope compensation.

2. These ropes are installed after the hoist ropes are over, and when the car is in condition to run. Generally, each rope is shipped to the jobsite on a separate reel.

3. Check the type of cable supplied against those specified on the final layout, before starting to install the ropes.

4. If the rope size and type are correct, set all of the cable reels up on pipes and horses in front of the lowest landing entrance. Where the pit has an entrance door, set the reels up in front of this door instead of the lowest landing.

5. Many compensating ropes have a "solid" (or block) hitch at one end and adjustable thimble rods at the other. As an example, let us say this solid hitch is on the car.

6. Place the car at the lowest landing and make up (socket and babbitt) all ropes in the hitch block on the car. Heat this block as you did the shackle rod rope sockets.

7. Take the car to the top of the hoistway at slow speed, unreeling the cables, but not allowing excessive slack rope. Be careful to keep all rope "bights" about even.

8. Raise the compensating sheave up to the top of its guide rails by placing wood blocking under it.

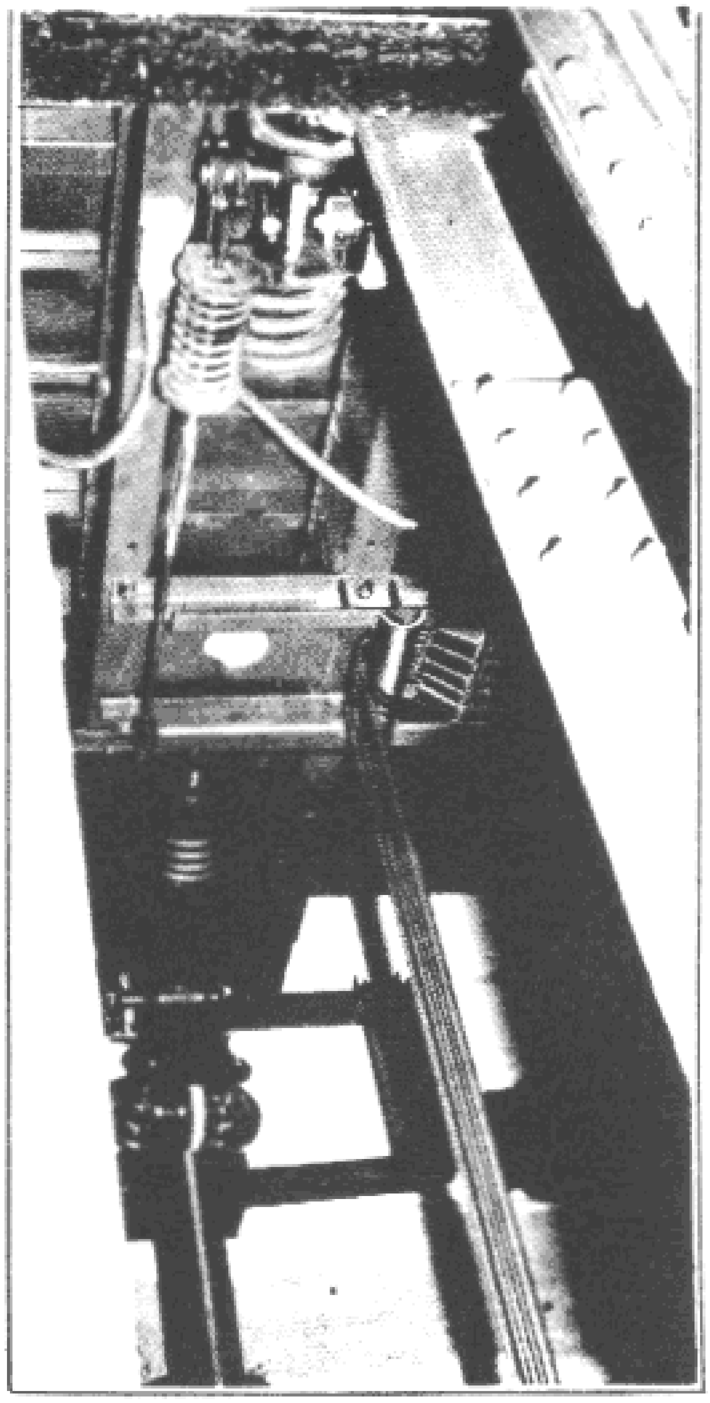
9. Install the rope thimbles in the counterweight hitch, allowing a full thread for adjustment. Feed each "comp" rope through the compensating sheave and measure each to its thimble.

10. Seize, turn in, and babbitt all ropes. Install the thimble rods into the hitch. Install one nut on each rod.

11. Take the blocking from under the compensating sheave.

12. Estimate the rope tension by hand (working from a plank at about the center of the rise) and have the helper take up or slack off on the thimble rods at the counterweight hitch.

13. Make a round trip with the car and check the rope tension again. When it is satisfactory, install the lock nuts and cotter pins in the thimble rods.



Westinghouse Car Hitch for Compensating Ropes

14. For installations where the ropes are supplied in coils or on very high-rise jobs, it is often routine to install the ropes individually.

15. Where the tie-down wedges and springs or tension devices are used, install and adjust them immediately after the compensating ropes are completed.

16. Most installations have a compensating sheave switch. This switch and its tripping cams are installed and adjusted when the rope and tie-down work is in order.

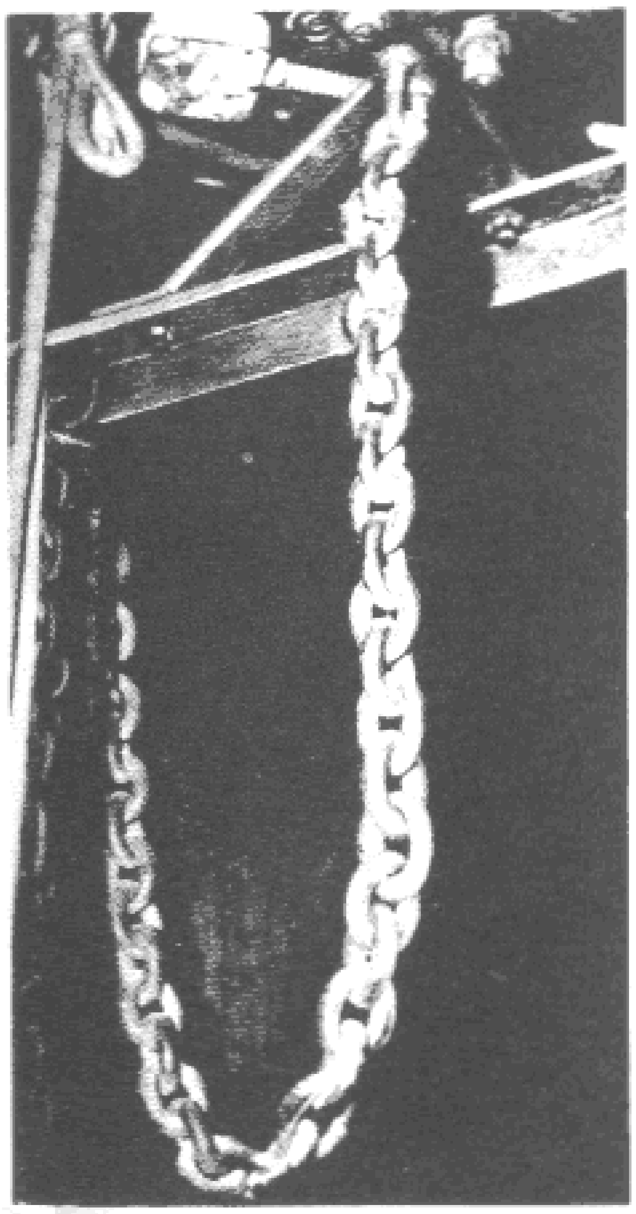
CABLES AND ROPES

Compensating Chains

Suggested:

Materials –
- a. binding wire
- b. cotter pins
- c. chains

Tools –
- a. hand tool kit
- b. two hammers
- c. wire-rope cutters



Compensating Chain Connection at Car End

1. Compensating chains, like compensating ropes, are installed after the car can be run. Either one or two chains are installed as a rule in the United States and Canada. Cotton sash rope is woven through the links of the chain to reduce the noise. (England's "lift" firms enclose the chains in canvas hose to reduce the noise.)

2. The chains are usually shipped in kegs. Take these to the pit.

3. Angle iron brackets are extended from the safety plank in accordance with the layout. These are arranged to support the chains in a set of "U" bolts and "S" hooks.

4. The opposite ends of the chains are connected to the counterweight by means of clevis devices. These are screwed onto the bottom of the tie rods on some counterweights and fastened to the frames on others.

5. Run the car to the top of the hoistway. Insert the first links of the chains into the counterweight clevis and bolt them in place. Install cotter pins in the bolts.

6. Run the car down at slow speed. The chains will pay out of the kegs but be sure to watch for kinks or twists. Correct them if they occur, even if it is necessary to bring the counterweight down and take a chain off to straighten it.

7. At times a car may lose traction because of the addition of the weight of the chain to the counterweight. If this happens, bring the counterweight down, remove one chain, and install one chain at a time or add a moderate amount of weight to the car.

8. When the counterweight is at the top and the car at the bottom, remove the rest of the chains from the kegs.

9. The car hitch has two ''U'' bolts for each chain. Hold the chains at the ''U'' bolts nearest the counterweight so that the ''loop'' is about 6'' off the pit floor. When this condition is obtained, insert one side of each ''S'' hook in those chain links nearest the ''U'' bolts. Hook the other side into the ''U'' bolts themselves.

10. Have the helper run the car up and down, while you watch the action of the chains. Remove any kinks or twists by taking the chain off the ''S'' hook and untwisting it.

11. When the chains ride satisfactorily, cut, saw or burn off the excess chain ends so only about 6' remains hanging from the ''S'' hooks.

12. Install these 6' ends, so they hang in a loop between the ''S'' hook and the inner ''U'' bolts.

13. Hammer the openings in the ''S'' hooks closed to a gap smaller than the chain stock diameter. Put a single wrap of binding wire around each opening of the ''S'' hooks.

14. With this arrangement, if the chains ''hook-up'' for any reason, or if the car or counterweight go to the overhead, the ''S'' hook will open and automatically drop the loop of the chains. This will lengthen them approximately six feet.

15. A roller or guard is supplied to be installed across and slightly in front of the counterweight guide rails. It is held to the guides by flat steel brackets and is placed inside the chain loops about 18'' above the pit floor. (This distance, as well as the height of the chain loop above the pit floor, is variable, dependent on field conditions.)

16. Have the helper make a slow, then a fast trip to the top and bottom while you watch the travel.

17. Correct any faults, then install cotter pins in all ''U'' bolts and pins.

18. Tie an overhand knot in each end of each cotton sash rope.

CHAPTER 9
Section -f1

CABLES AND ROPES

Rope Tension

Suggested:

Materials –	Tools –
a. none	a. planks or scaffolds

1. There are several reasons why rope tension is very important. To mention two; if almost all the strain is on one rope, the "fatigue" of that rope is greater and excessive stretch would occur on it; secondly, in the opposite condition, if only one rope is loose, that rope will "saw" in its rope grooves and cause wear. This will necessitate premature sheave regrooving or renewal at an early date.

2. The question of how to equalize elevator rope tension satisfactorily is very controversial. Although there have been a fair number of good instruments and methods devised for checking rope tension, the fact remains that, to date, there has been no method devised that has met with the complete approval of even a majority of the engineers or field men of all elevator companies.

3. In addition, it is very seldom that the field mechanic has at hand any meters, gauges, or similar devices for testing rope tension. There is, however, a happy medium to the various ideas on the subject as far as practical results are concerned.

4. Therefore, until a more convenient method of checking rope tension has been devised, and unless special conditions exist or orders are given, it is suggested that rope tension be carefully hand-checked as outlined in -c1, of this chapter. The car should be run a few minutes after the first adjustment and a second check made, and the tension readjusted if necessary.

5. The first photograph in section -a1, of this chapter, illustrates a commercial hoist rope "equalizer."

CONTENTS

CHAPTER 10

CHAPTER 10
Section -a1

CONSTRUCTION WIRING

General

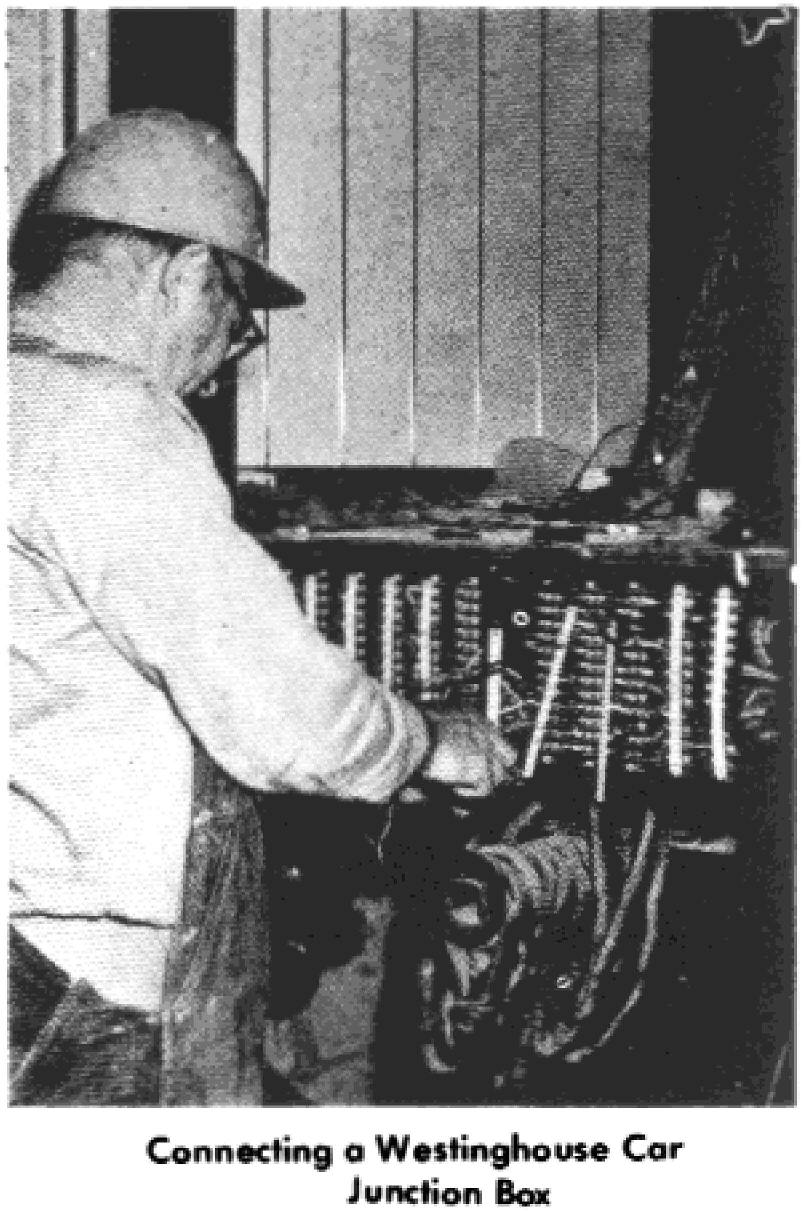
1. The word "wiring" as applied to our trade has a broad range of meaning. It includes the entire electrical system that is installed by the field mechanics and implies completion of all raceways, their wires and their connections between the component parts of an elevator or a group of elevators.

2. Wiring is the nerve system of an elevator installation. It routes the power needed to operate signal and schedule devices so that they all function as they are intended to. The primary source of power is from the main line switch, which is fed from the building main power source and supplies the motor or motor generator and controller. There are other sources of power used on many elevators. For example, power for elevator car lights is generally taken from a source independent of the "main switch." This assures that passengers would have light in the car if an elevator were shut down between floors because of a blown main fuse or other power failure. Signal and dispatch circuits are often taken from separate supply sources and so is the emergency alarm bell, when used.

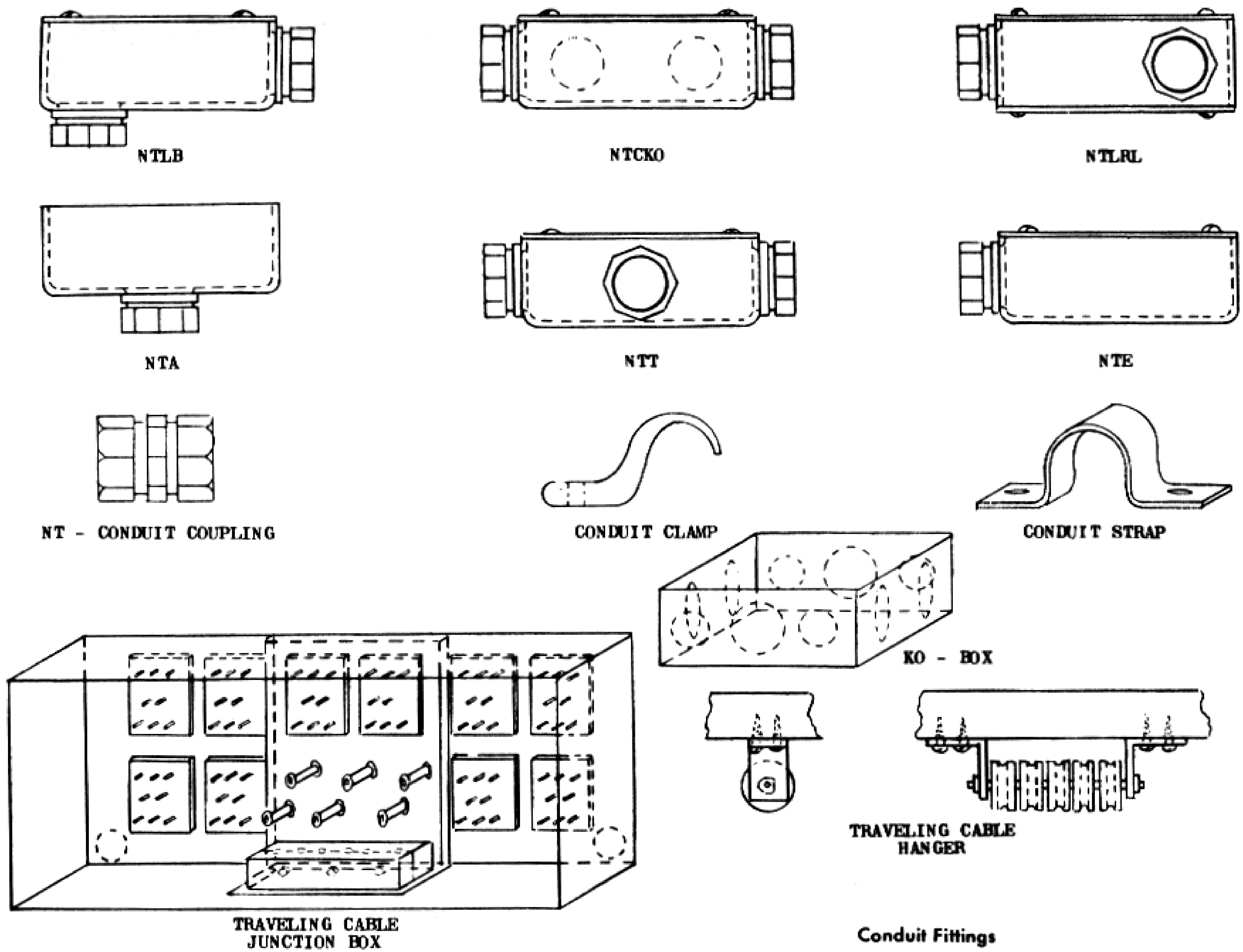
3. All elevator electrical work in the United States must be installed in accordance with the Elevator Safety Code, the National Electrical Code, which is the standard of the National Board of Fire Underwriters and any applicable local codes which have authority in the area where an elevator is being installed. Specifications of individual purchasers may affect the material requirements but do not supersede the codes.

4. The work of wiring on elevators can be broken down into three general classes. These are the raceways, the wires and the traveling cables.

5. The raceways are the protective shells in which the elevator wires are run. Raceways can be of rigid conduit, of E.M.T. (i.e., electrical metallic tubing or "thin-wall" tubing), sheet metal troughs or a combination of all three. On most contracts some flexible metal tubing is used to connect the raceway with limit switches, door contacts and similar auxiliary equipment. Patented connectors of various types are used on all systems.

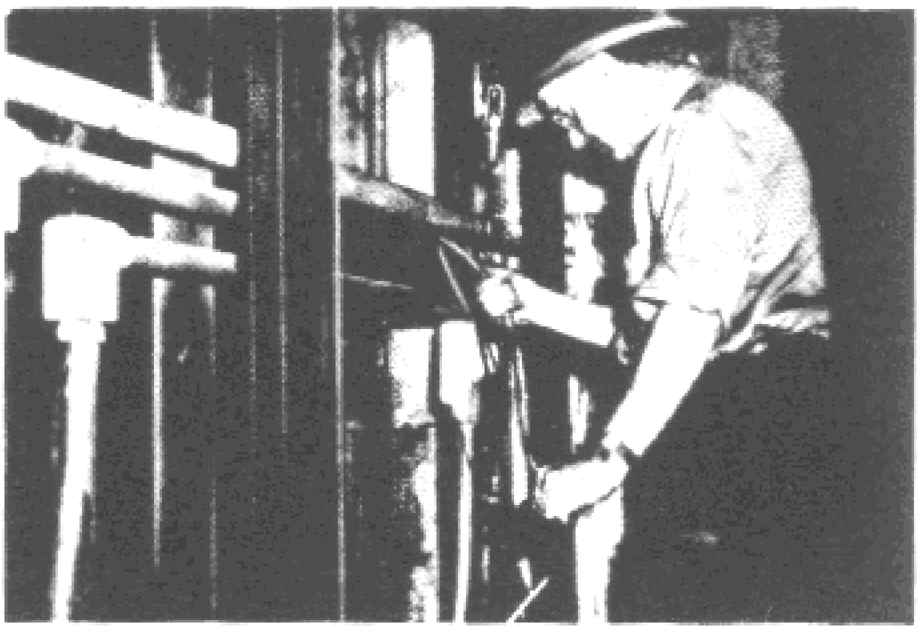


Connecting a Westinghouse Car Junction Box



Conduit Fittings

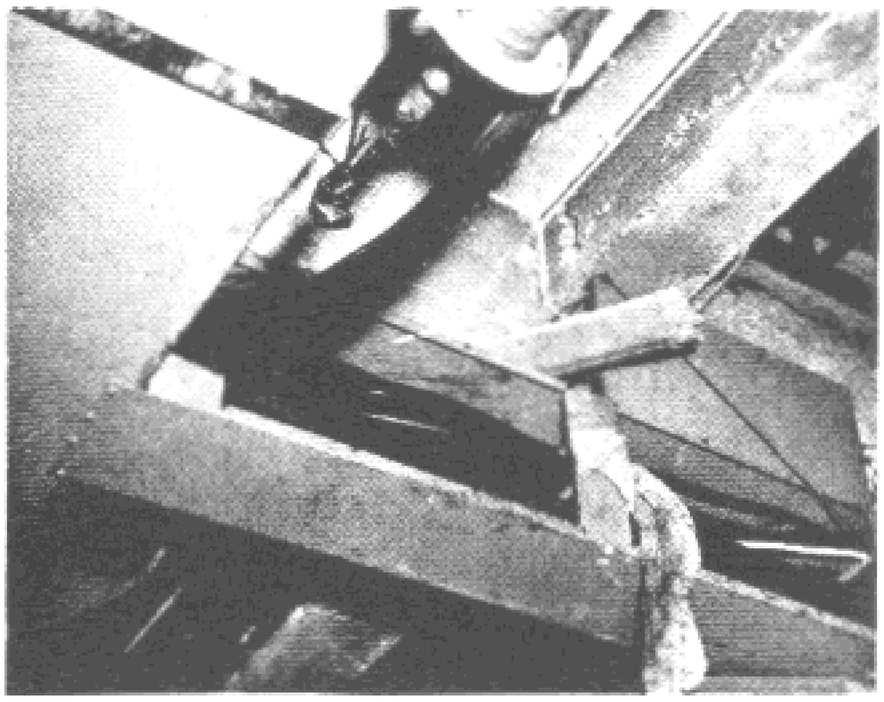
6. Rigid conduit is the old standard. Originally all conduit ends had to be threaded. Couplings, boxes and other fittings were all equipped with threaded connections. This is still common practice where installations are explosion proof or moisture proof. However, most regular conduit installations today are of galvanized steel or some other electroplated, rust resistant finish and make use of "threadless" connectors and fittings. Horizontal runs of conduit in the machine room are placed in or under the concrete forms, preferably before the floor slab is poured (if "under the slab" method is used). Vertical runs in machine room, hoistway or on the car must be well secured and effectively grounded. Runs are made as short and straight as possible within practical limits. Boxes should be well secured. Strain boxes must be placed in long vertical risers to support the weight of the wires. "KO" or knock-out boxes, "unilet" and similar fittings are widely used. Junction boxes in the hoistway and under the car are sheet metal or cast iron and are equipped with blocks of terminal studs. They serve to connect traveling cable wires with fixed wires in the raceways as well as some secondary functions. Quite a few junction box designs include supports for the steel center or hang wires of the traveling cables. The junction boxes, like most other conduit boxes today are frequently arranged for threadless connectors. There are a number of special fittings that serve as adaptors. A typical one is the modified coupling that connects flexible tubing or "Greenfield" to a box or conduit. This is made with a female clamp at one end which grips the flexible tubing and a male thread on the opposite end that is screwed into a pipe coupling or secured to a box with a lock nut and bushing.



Pulling Wires into Conduit Raceway With a Snake—Note the Pulley

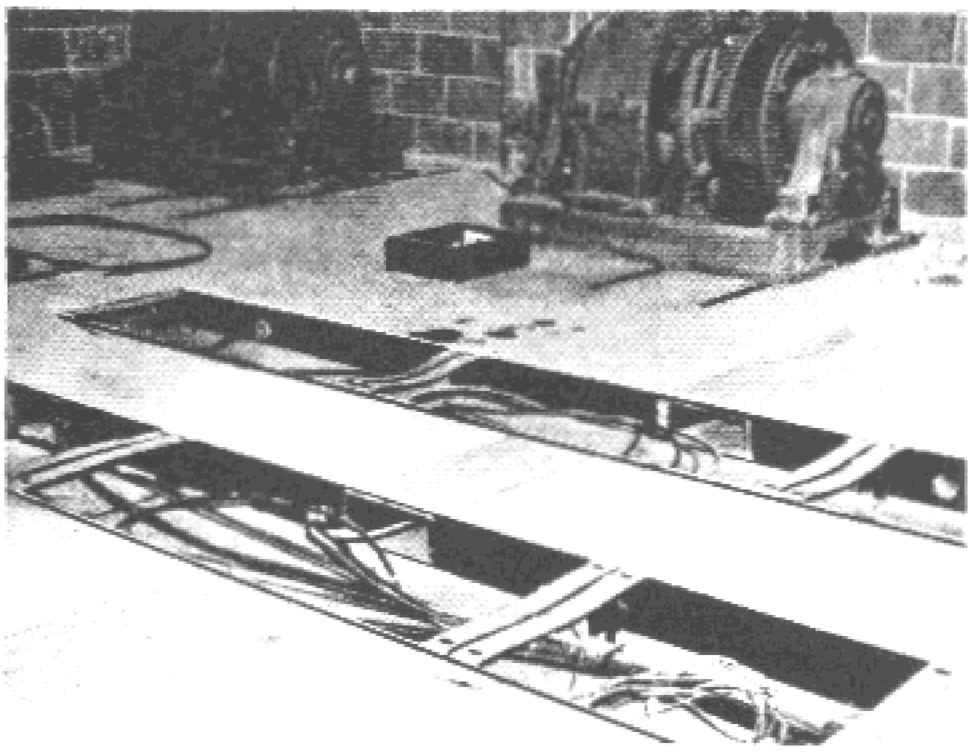
7. Conduit and fittings are measured by the inside diameter of the conduit. We use sizes 1/2" to 2" commonly and may use larger sizes of rigid conduit on installations which require them. We can also use troughing instead. Some regulations prohibit the use of thin-wall conduit where it would be embedded in concrete. Rigid conduit or a special trough arrangement should be used in such cases. The standard conduit length is ten feet. Regular U.S. pipe threads are used on rigid conduit. Threadless connectors are normally used with thin-wall tubing as standard pipe threads cannot be cut onto it. Lengths of troughing and their fittings are secured to each other and to brackets by self-tapping screws or by bolts.

8. The trend in conduit and fittings is definitely toward lighter weight materials. There are many new "brands" of threadless fittings on the market and a great number are designed to be used with thin-wall tubing. This tubing has the same nominal sizes as rigid conduit but obviously since the size refers to the inside diameters the outside diameters of the two types are not the same. Generally speaking, however, either thin-wall or rigid conduit may be used in most locations on normal contracts. Elevator companies use wiring material that has the approval of the "Underwriters" i.e., the National Board of Fire Underwriters.


Trough Raceway Under Machine Room

9. Conduit is secured to building walls and beams by clamps and anchors or on brackets clamped to the guide rail backs. All cut conduit ends must be reamed or filed smooth to minimize the chance of cutting wire insulation. Bushings must be installed at conduit ends where wires leave the conduit "run." All pipe sections must be tightly connected to the next length or fitting and must form a continuous ground through these connections. Ninety degree "sweep" elbows are available but bends of less degrees and curved sections are made in the field. The bends are made with tools called "hickeys" for small sizes of rigid and "pipe benders" for thin-wall conduit. Bends in larger sizes of conduit (generally 1-1/4" and larger) are made by powered bending tools. The most popular type of field tool is a special hydraulic jack which is equipped with bending dies.

10. Troughs or "auxiliary gutters" (per N.E. Code) are a type of wiring raceway that is fabricated from sheet metal. Generally it is steel and is formed into a box for the full length of the steel sheet stock. Covers are completely removable on many styles. Troughs are commercially produced in stock sizes such as 4" x 4" x 10'-0" and 4" x 8" x 10'-0", but limited side clearance in some elevator hoistways requires that the troughs be special in size. A 2"x 8" x 10'-0" has been commonly used and it provides the same cross section area as the commercial 4" x 4". Junction boxes are often formed right in the troughs by using a slightly larger section to provide space for terminals.


Machine Room Troughs are Installed on Rough Floors as Soon as Possible

11. Machine room raceways are usually set in the concrete forms before the floor is poured or on the rough floor where a "fill and finish" machine-room slab is provided. This latter system is one where the contractor builds a rough concrete floor or "arch" and then elevator men and other trades install equipment on it. A fill of coarse concrete or something similar is then troweled over conduit (where used) and a smooth finished concrete floor laid on top of the fill and up to the planned floor level. This method presents a good appearance and assists maintenance. Most buildings with large elevator

SCHEDULE OF WIRES IN CONDUIT

WIRE SIZE (A.W.G.)	18	18	16	14	12	10	8	6	4	3	2	1	1/0	2/0	3/0	4/0
RUBBER WALL IN 64th INS.	1	2	2	3	3	3	4	4	4	4	4	5	5	5	5	5
VOLTAGE	300	←							600							→
RUBBER O.D.	.110	.146	.158	.204	.221	.242	.311	.397	.452	.481	.513	.588	.629	.675	.727	.785
AREA	.010	.0167	.0196	.0327	.0384	.0460	.0760	.1238	.1605	.1817	.2067	.2715	.319	.3578	.4151	.4840
THERMOPLASTIC O.D.		.106	.118	.131	.148	.168	.228	.323	.372	.401	.433	.508	.549	.595	.647	.705
AREA		.0088	.0109	.0135	.0172	.0224	.0408	.0819	.1087	.1263	.1473	.2027	.2367	.2781	.3288	.3904

CONDUIT				NUMBER OF WIRES OF EQUAL DIAMETER IN CONDUIT															
SIZE	I.D.	AREA	40% AREA	18	18	16	14	12	10	8	6	4	3	2	1	1/0	2/0	3/0	4/0
1/2"	.622	.30	.12	12	7	6	4	3	1	1	1	1							
3/4"	.824	.53	.21	20	12	10	6	5	4	3	1	1	1	1	1				
1"	1.05	.86	.34	33	20	17	10	8	7	4	3	1	1	1	1	1	1	1	
1-1/4"	1.38	1.50	.60	57	35	30	18	15	13	7	4	3	3	3	1	1	1	1	1
1-1/2"	1.61	2.04	.81	78	49	41	25	21	17	10	6	5	4	3	3	2	1	1	1
2"	2.067	3.36	1.34	128	80	68	41	34	29	17	10	8	7	6	4	4	3	3	2
2-1/2"	2.469	4.79	1.92	183	115	98	58	50	41	25	15	12	10	9	7	6	5	4	3

FOR OPERATING AND SIGNAL CIRCUITS

WHEN USED FOR FEEDERS DO NOT EXCEED 9 WIRES PER CONDUIT

MOTOR AND GENERATOR LEADS

NOTES:

Based on using 40% of capacity of inside diameter of conduit, per National Electrical Code (Chapter 9) 1959.

When wires of unequal diameter are placed in one conduit, the total area of same must not exceed 40% of inside conduit area.

Where Local Electrical Code rulings apply, they take precedence over those given in the above chart.

contracts have this type of floor. Where troughs are used, the trough top is kept about level with the finished concrete and 1/4'' steel or aluminum alloy ''checker-plate'' is used for covers.

12. The machine room trough provides a convenient means to run interconnections between various pieces of equipment, such as from a bank of controllers to a bank of selectors. The troughing is run to the hoistway trough to form a continuous raceway.

13. Car top and bottom troughs are frequently installed. They are neat and easily accessible for wiring and maintenance. Some car troughs also form the car junction box and have traveling cable hangers as supplementary parts.

14. All trough installations, whether commercial or special design, permit the use of short runs of conduit or flexible tubing, such as from the hoistway riser to the limits and hall buttons. Some troughs have knock-out blanks at fixed intervals. Others require that holes be punched or cut with a hole saw or dies, in order to run tubing to switches and button boxes.

15. Troughing has been used for some jobs for many years. However, it has become more popular in the last few years and is used on elevators in various forms on a world wide basis.

16. Many types of wires are used on elevators. The main power leads are generally stranded wire but may have rubber and braid covering or one of the thermoplastic (PVC) insulations. Some companies provide solid wire for interconnections, these may be of #14 gauge or smaller. Others use stranded wire throughout. Within the past few years some companies have begun wider use of another form of wire. This is the ''cable'' form of polyvinyl insulated wire. A fixed number of individual conductors, such as 7 or 14 or 21 coded conductors of #18 gauge wire with thermoplastic insulation are wound into a cable. These are then covered with a thermoplastic sleeve or sheath. The advantages of this form of wire are most apparent when installed in conjunction with the machine room and hoistway troughing. The grouping and color coding of wires is extremely useful in reducing wiring errors. However, the wire has not yet been officially and unconditionally approved by all authorities.

17. The 1959 edition of the National Electrical Code permits wire of #20 American wire gauge or larger to be used for elevator operating circuits. Voltage is restricted to 300 on the operating circuits and to 600 volts on motor lines. Insulation can be rubber covered with cotton braid or a polyvinyl (thermoplastic) but it must be flame retarding, moisture resistant and be suitable for use where fairly high temperatures are encountered.

18. Specifications of the elevator manufacturers detail the requirements further. The wire is often tinned and is generally to be ''free skinning.'' Although the N.E.C. recommends that the ''ground'' (current carrying or neutral) wire be white or neutral gray, some foreign countries specify other colors. It is common practice for us to use the white. Most companies employ some form of ''color coding'' on elevator wiring installations. It is very useful for identifying wires and, as noted, helps to reduce wiring errors.

19. The N.E. Code permits different systems (circuits) and voltages to be run in the same raceway provided they are not over 600 volts and assuming, of course, that they all relate to the same elevator or bank of elevators. However, all wires must be insulated for the maximum voltage included in that raceway. Elevator telephone wires can be included in the group. Circuits for special equipment such as "inter-com" systems or electronic equipment may require shielded wires to assure satisfactory operation.

20. Elevator power feeders and other power lines (as well as water or gas lines and air conditioning lines not associated with the elevator) are to be installed outside of the hoistway by code ruling.

21. When solid wire is used, the insulation is skinned an appropriate distance from the ends and the conductors scraped, then formed into an eye.

22. Some form of patented "eyelet" type terminal is normally used to make stud connections on stranded wire. There are many kinds of terminals and each elevator company selects one of its own preference. Tools are generally special for each type. Connecting sleeves (solderless connectors) are available also. The photos in this section demonstrate several kinds of tools and fittings.

23. Wiring should be installed in a workmanlike manner, electrically and mechanically sound, to be sure that operating costs of the elevator will be at a minimum for repairs, shutdown and maintenance.

24. Standard wiring is not applicable to special installations, such as bridges, gasoline cracking plants, refrigerator plants, etc. Moisture proof, explosion proof or armored cable type of wiring must be installed. The layout of such electrical work is special and follows the particular specifications for the individual installation involved. The erector is cautioned to assure himself that the wiring complies with the code and the specifications for each particular hazardous location involved.

25. An erector usually receives the following specific wiring information from his company office in a folder, together with the regular construction data:

a. conduit layout

b. list of wiring material

c. set of wiring diagrams

It is necessary for the erector to check the layout against the actual field conditions. He also checks the wiring material lists with the layout requirements and the material received. The layout is to be followed unless field conditions make slight variations desirable. In such cases the erector must call these changes to the attention of the field superintendent, determining whether or not additional wiring material may be needed.

26. Standard erection wiring materials usually include the following:

a. conduit; thin-wall, rigid, flexible and/or troughing

b. cable; control, signal and light

c. wire; control, signal and building

d. lugs; terminals, special connectors

e. boxes; landing lantern, push button, junction, strain, motor outlet, hoistway, pull and trough

f. brackets for conduit support (rail, platform, crosshead, brackets for strain box supports, etc.)

g. hangers for traveling cable supports

h. bolts, washers, screws, masonry anchors

i. clamps and yokes for supporting conduit

j. ground clamps and flexible braid

k. bushings; insulating and metalic

l. couplings; thin-wall, rigid and combination

m. elbows, 90°

n. unilets or similar fittings

o. chase nipples and lock nuts

p. bells and signal gongs

q. solder, solder paste, tape, varnish

r. sundries (drills, paint brushes, armature binding cord, junction box marking cards, etc.)

27. Some standard wiring installation practices will be described on the following pages of this instruction.

28. Early traveling cables were primarily sources of light supply on ''shipper rope'' installations. As car switches, gate contacts and other components were added, the requirement for a greater number of wires forced development of modern traveling cables. Higher car speeds also introduced new, complex problems that had to be solved to make the cables satisfactory. This development still continues and presumably always will as our industry progresses.

29. The A.S.M.E. Safety Code describes elevator traveling cable as, "A cable made up of the electric conductors, which provides electrical connections between an elevator or dumbwaiter car and fixed outlet in the hoistway." The code stipulates that traveling cables shall be provided with a flame retarding, moisture resistant outer covering. The National Electrical Code specifies that while individual conductor wires for operating circuits may be as small as gauge #20, the wires for car lighting must be at least #14 gauge or enough lighter gauge wires must be paralleled to equal the cross section area of #14 gauge.

30. Traveling cables for special installations such as elevators with explosion proofed wiring, shipboard units or towers are special as a rule. They may have neoprene outer jackets and sealed connections to the junction boxes.

31. Conventional traveling cable in the "code" territories is usually made up of several strands of steel support "hang" wire wound around a fibre center, with layers of color coded conductors wound around the steel "center." Each conductor wire is of stranded copper with rubber insulation that is covered by a woven sleeve of color coded cotton. Layers of wires are wound in opposite directions from preceding groups. The exact arrangement of wires in each layer is determined by the designer according to the number of conductors in the cable. The entire assembly is then covered by a cotton sleeve, light cloth taping and the woven, moisture resistant, flame retarding outer covering.

32. The number of conductors range from 2 per cable up to about 70 conductors. The smaller cables do not have a support wire. The larger cables – say from 40 conductors up – have preformed steel support ropes instead of the individual steel strands. The gauge of the conductors varies according to the elevator manufacturers specification but can be as noted above, as small as #20 gauge. Because of restrictions imposed on size of traveling cable loops and their flexibility by high-speed elevators, traveling cable manufacturers have produced "combination" cables that contain groups of different gauge wires. For example, they may include several pairs of shielded P.A. system wires in #20 or #18 gauge, a half dozen #14 gauge for car light and door operator and the balance in regular #18 gauge for operating circuits. When used in combination with other traveling cables that have only one gauge of conductors, the loops would form about the same shape and all cables could be hung from the same point and still be clear of the car platform during elevator travel. Construction of the cable affects the loop also.

33. Where steel "hang" wires are provided, traveling cables are suspended from fixed supports by these wires. On small cables with no steel center, the cable must be looped over the support to conform with the N.E.C., section 620-41. All traveling cables 100 feet or more in length should have steel hang wires.

34. The standards of design and manufacturing quality of traveling cables are consistently high in the United States and Canada as well as some other areas. This is not true on a world-wide basis. Many countries use cables with flammable coverings. A number do not provide steel hang wires and some have only sizes up to ten conductor cables available. This last creates quite a problem when used on higher speed, automatic elevators. Many countries now tend to fall into line with our general code requirements. However, progress in this respect is slow because of the high costs involved in the development and production of manufacturing facilities and techniques.

CHAPTER 10
Section -a2

CONSTRUCTION WIRING

Wiring Tools

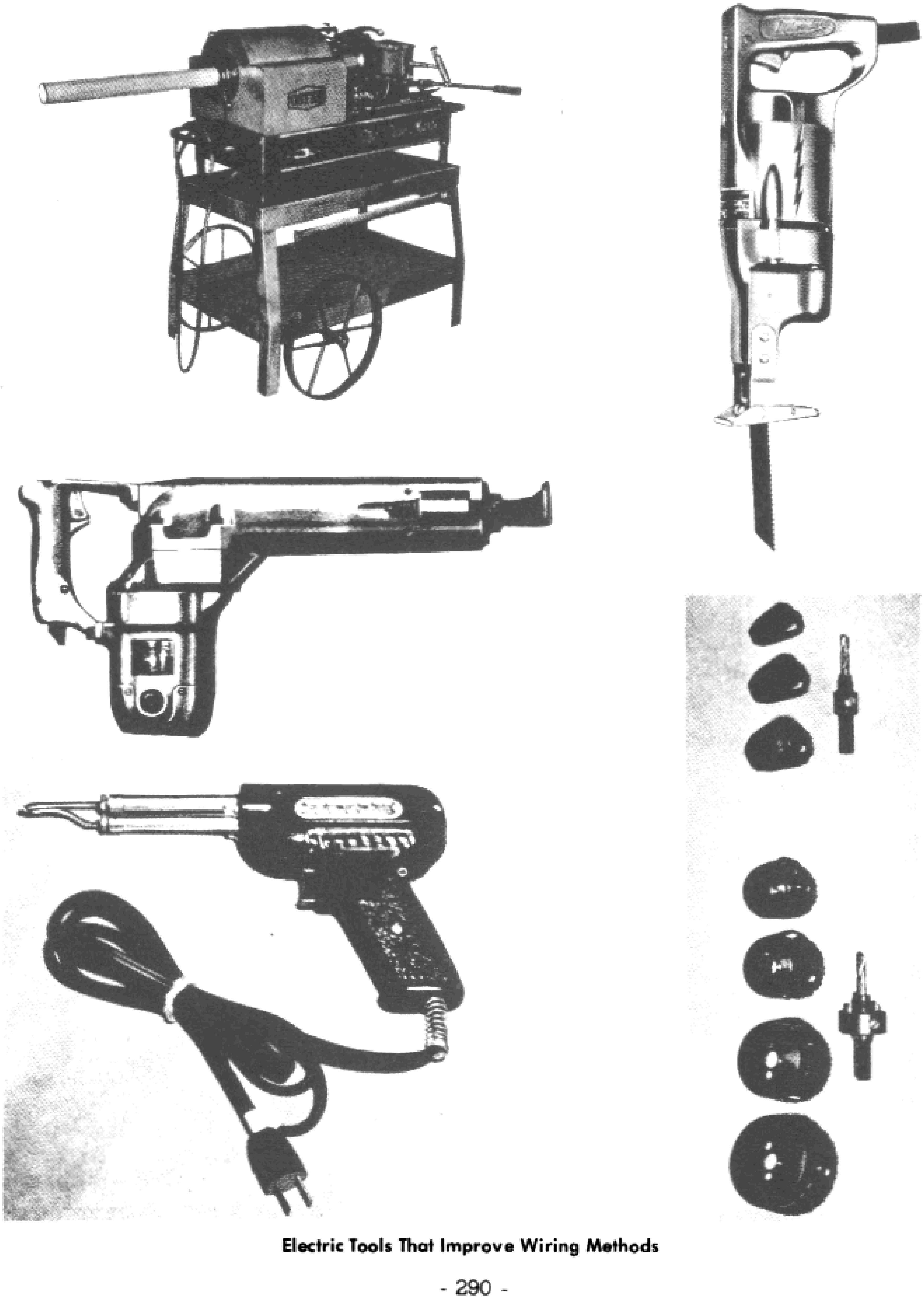
1. The handling and installation of wiring materials requires some tools that are not general in application to other elevator work. The extent to which these tools are needed is based on two considerations. First of all the design of the material determines that certain tools are needed. Wire terminal setting tools are a good example of this type. The second consideration is economics. Companies are organized to manufacture and sell elevators for a profit. Therefore, each operation must carry its own weight. Because of this certain companies may determine that patented eyelet terminals and the tooling needed to install them, represent an unwarranted expense so they will use solid wire instead of stranded and thereby eliminate the use of terminal eyelets and their crimping tools. Another company may find its experience to be just the opposite, of course. A further example of how the economics of elevator work affects this matter of wiring tools relates to use of troughing. A large installation may have hundreds of feet of troughing. Electric hack-saws would probably be used on this type of contract, whereas on a small, semi-standard unit with only a few short lengths of troughing, the mechanic might make the one or two required cuts with a hand hack-saw.

2. In addition to the special considerations given to the supply of wiring tools, we also have the fact of constant change in the design of basic elevator control equipment, material and tools. It is, therefore, evident that a ''standard'' set of wiring tools cannot be established.

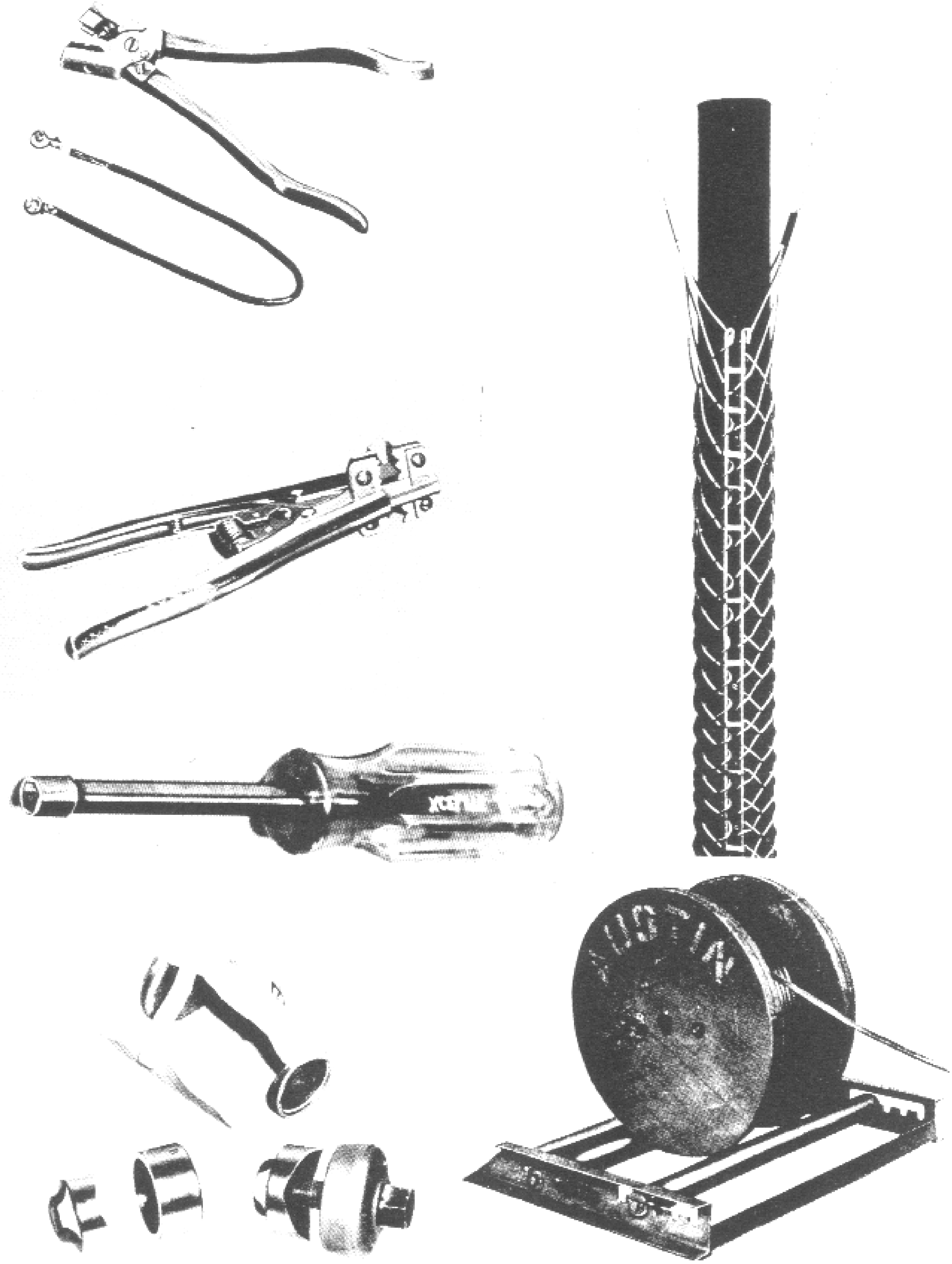
3. The following lists and pictures describe and illustrate some of the wiring tools commonly used today.

4. Power or heavy tools include:

Pipe threading machines
Portable electric hack-saws
Power hack-saws, bench type
Hydraulic terminal crimpers



Electric Tools That Improve Wiring Methods



Manual Tools Used by Elevator Mechanics When Wiring

Electric wire strippers
Electric drills
Electric hammers
Heating torches
Soldering irons or guns
Portable arc welders

5. Light manual tools and sundries include:

Hack-saws and blades
Wire terminal crimping tools
Pipe reamers
Blowtorches
Steel snakes
Telephones, hand or headsets
Ohm-meters and other meters
Masonry drills
Ringout boards
Rubber and electrical tapes
Pipe benders and "hickeys"
Wire strippers
Rattail files
Cable grips
Pipe or chain wrenches
Buzzer or bell test sets
Hammers
Masonry anchors and driving tools
Approved wire lubricants
Insulating varnish and brushes

6. Uses of some of these tools will be mentioned in later parts of this chapter.

CHAPTER 10
Section -b1

CONSTRUCTION WIRING

Machine Room — Conduit

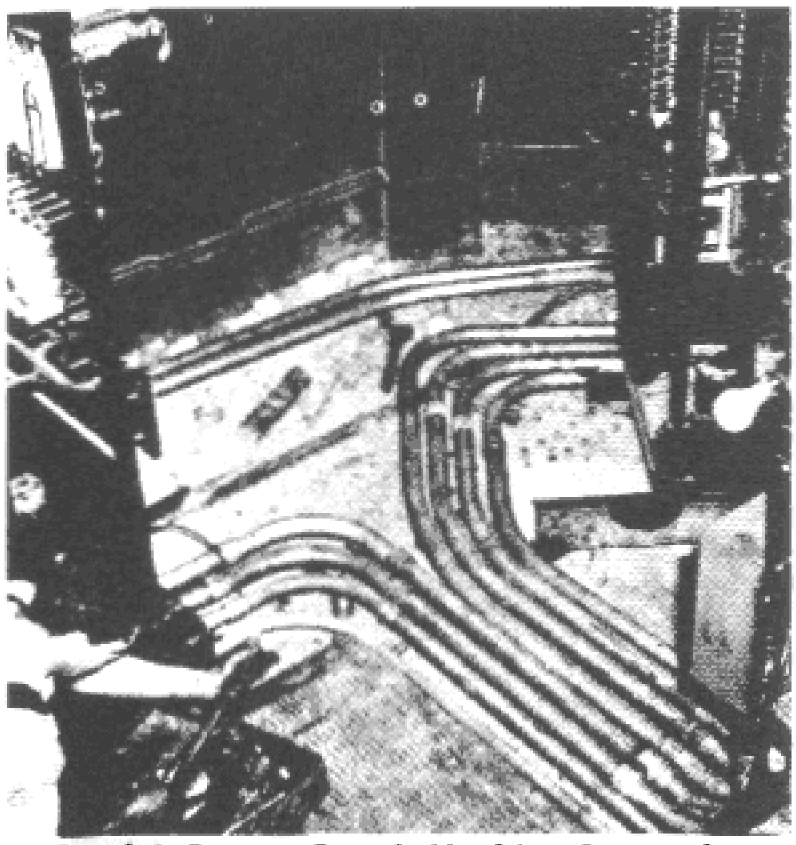
Suggested:

Materials —
a. conduit
b. fittings
c. sundries

Tools —
a. hand tool kit
b. pipe working tools
c. eyelet tools, etc.

1. Either rigid or thin-wall conduit may now be used for conduit runs in most localities. For sizes up to two inch, thin-wall is generally acceptable. All raceways 2-1/2" or over in size must be of rigid conduit. The conduits terminate in boxes attached or grounded to the apparatus, or terminate with insulating bushings adjacent to equipment. The layout indicates the method to be used in each case.

2. Conduit runs are usually placed underneath the machine beams and pointed up through the floor slab, on small installations. (The code requires that raceways extend at least 6" above the floor.) All conduit work should be in place before the machine room floor is poured. If conduit sleeves are required for traveling cables,



Conduit Run on Rough Machine Room Floor to Controller and Selector Boxes Floor Will be Filled to the Top Edges of the Boxes

where junction boxes are omitted or located in the machine room, get them in place before the slab is poured.

3. Conduit ends should be capped and all boxes covered as soon as they are installed, to prevent dirt and moisture from entering the raceway system.

4. In large buildings, a machine room floor may consist of a rough slab, which will later be completed with fill and a finished floor. The conduit runs are to be installed on rough slab as follows:

Place all apparatus, such as troughs, boxes, etc., on rough slab and block up all of these in the proper relation to the finished floor line. Fasten them securely to steel or to the slab, in their permanent position, to prevent them from shifting. Install all conduit and point (extend) down to any risers below.

5. Conduit must be run so as to avoid any unnecessary crossovers. Install the larger sizes of conduit first.

6. Protect it against damage from trucking of heavy materials by other trades. This can be accomplished by pouring cement against the conduit runs at certain vulnerable points, and by laying planking over it, thereby providing paths for wheelbarrows and walkways.

7. Thin-wall conduit can be dented easily and so must be properly shielded against mechanical damage.

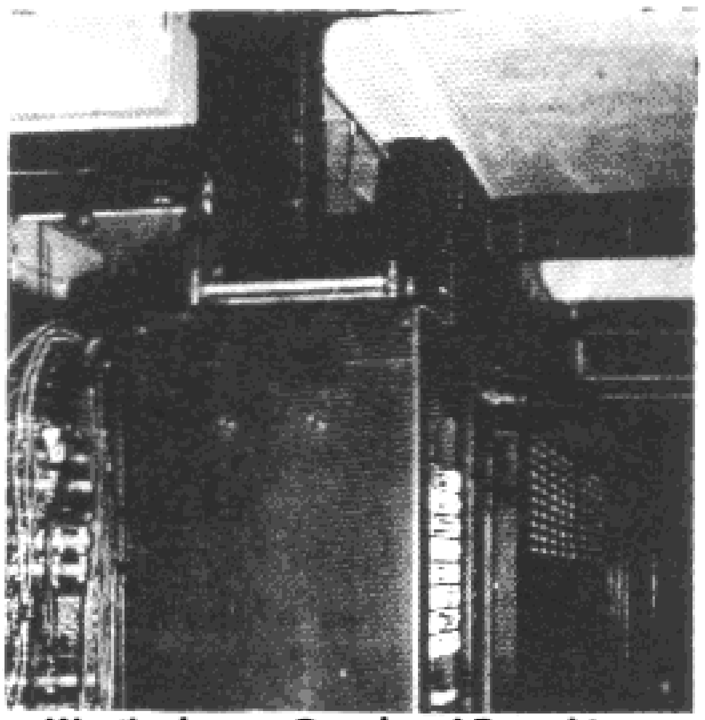
8. Crossovers, i.e., one conduit over another, are to be made only when the total conduit falls within the rough floor. A minimum of 1'' of fill should be above all conduit. With such minimum cases a wire mesh should be placed over conduit to prevent the concrete floor from cracking.

9. If crossovers cannot be made in accordance with this, reroute the conduit or run it overhead instead of following the original plan.

10. Exposed overhead conduit must be run parallel or at right angles to walls, beams, or partitions, and as close to the ceiling as practicable. It must be substantially supported and braced. Air space should be left between the conduit and motor room ceilings to reduce effect of heat accumulation on the wire insulation.

11. Vertical conduit pointing up or down from equipment should be run plumb and parallel. It should be fastened to frames of controllers, selectors, etc., unless the apparatus is sound isolated. In such cases the conduit must be independently supported and the apparatus must be grounded with flexible leads.

12. Exposed conduit work is run only where concealment is not practical. It should be installed inconspicuously, straight, and neatly arranged in groups, with a minimum of offsets and bends. These recommendations are made in order to assure good appearance, avoiding what might otherwise result in unsightly conduit runs.



Westinghouse Overhead Troughing

13. In large installation grouping, where auxiliary equipment is placed on floors other than the machine room, the exposed conduit runs become very evident. In such cases grouping in parallel runs becomes an installation rule. The use of group pull-boxes and common hangers to improve the appearance of such conduit is strongly recommended.

14. Often troughs are used between controller and other panels instead of conduit. Layouts of these should be carefully studied in order to avoid interference with other work, especially in regard to the accessibility of trolley beams and trap doors.

15. All conduit work in machine rooms must be grounded or "earthed." All connections to equipment must be so bonded. Where equipment (pull boxes, etc.) to which conduit is strapped is connected to steel beams, it is not necessary to provide ground clamps. However, where conduit terminates with insulating bushings and is not otherwise bonded to steel or to frames of equipment, it is necessary to provide ground clamps and wire braids for ground jumpers to assure the electric bond between the various parts of the installation. Use wire gauge *8 or larger for grounding.

16. Conduit grounded in the machine room and extended to other equipment need not be grounded elsewhere.

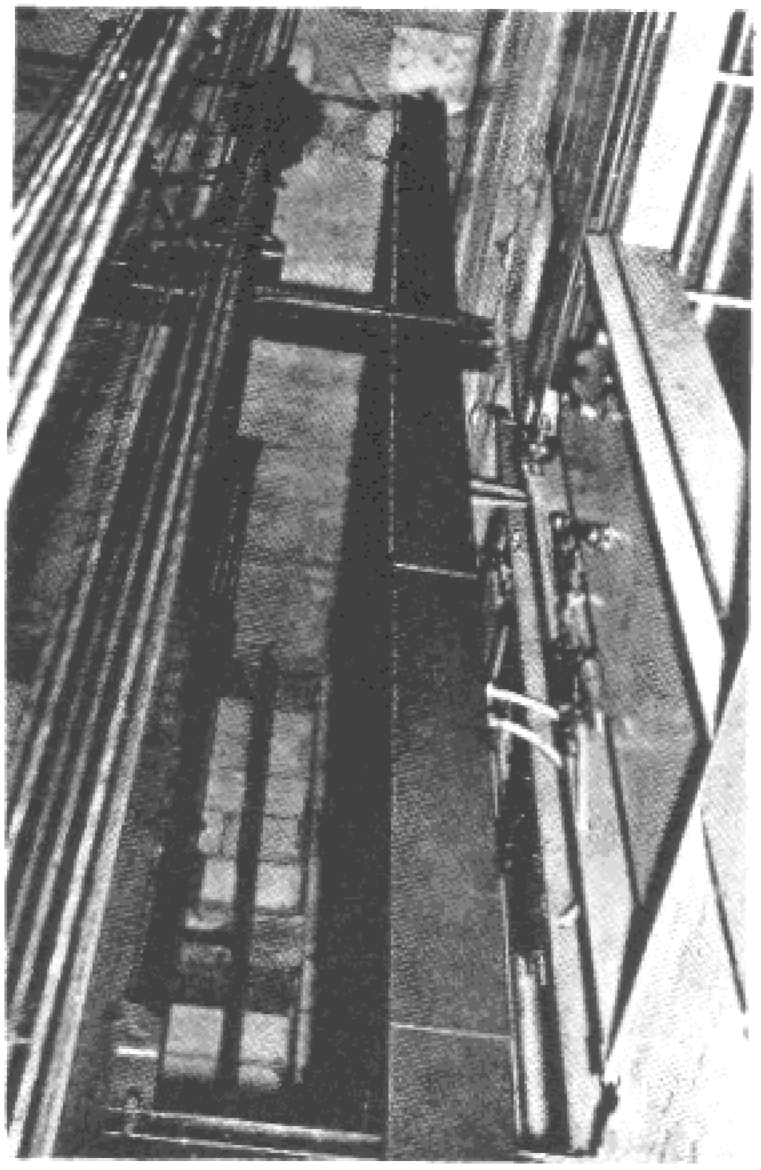
17. Run conduit with due consideration of the possibility of moisture pockets. These can be avoided, if conduit is pitched to be self-draining at pull boxes, troughs, etc. Moisture can be more easily detected and removed at these points during maintenance.

18. Vertical and exposed conduit work presents no difficult problem on this score. Conduit with both ends turned up should be thoroughly dried out if damp, then capped to prevent moisture from re-entering it. Possible future condensation should be carefully considered in such cases.

19. All machine room conduit is installed without wires. It is preferable that no wires be pulled in until the room is enclosed, and all concrete and plaster work is dried out. Whenever possible, delay pulling wires during cold weather until the motor room is heated.

20. Conduit caps can be used to seal conduit ends temporarily. Small outlet boxes can be packed full of paper. Cabinets, boxes, troughs, etc., should be left with their covers fastened until ready for wiring.

21. "Live" wiring gives off heat through induction, and this in turn tends to keep the conduit system dry. There is, however, a period at the beginning of a wiring installation when the wires are "dead" and do not carry current. It is during this period that moisture often enters a conduit system. There is no means of preventing condensation at this time. Dry weather and good ventilation aid in preventing the trouble. It is recommended, therefore, that all wiring be done under the best possible weather conditions.



A Neat Hoistway Trough Raceway

CHAPTER 10
Section -b2

CONSTRUCTION WIRING

Machine Room — Troughing

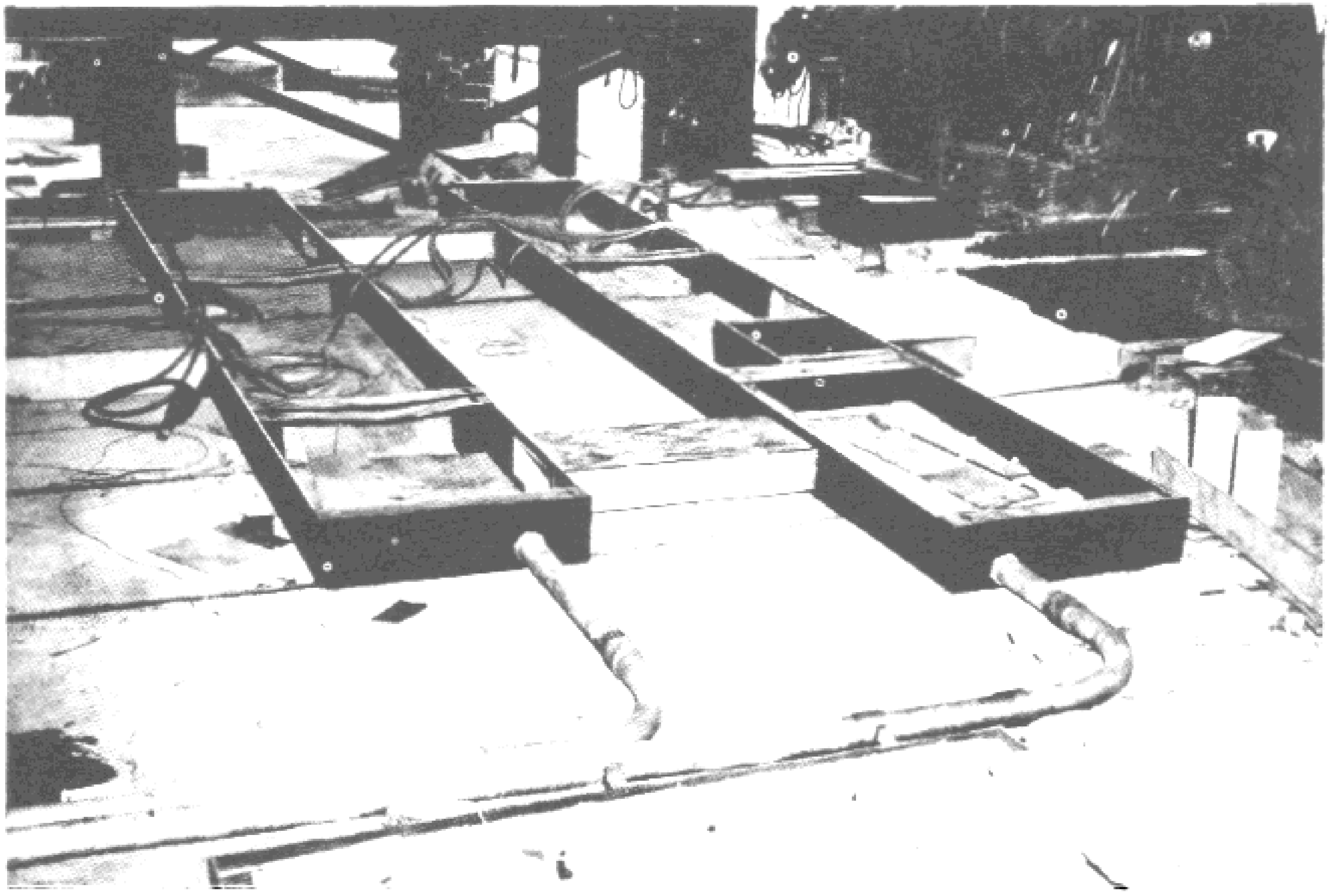
Suggested:

Materials –
a. trough
b. trough fittings and adapters
c. conduit
d. flexible tubing
e. anchors for concrete
f. angle and flat iron
g. sheet-metal screws

Tools –
a. electric hack-saw
b. standard hand tools
c. line level
d. knockout punches
e. arc welder
f. electric hammers and chucks
g. chalk line or heavy twine

1. If we concede that differences of opinion on methods of installing guide rails result in the most controversy of all kinds of elevator work, we can also say that arguments on the merits of troughing as compared to conduit for raceways has that same dubious honor in respect to elevator wiring.

2. Troughing has been used for many years, both in machine rooms and in hoistways. It has advantages over conduit but also has some real disadvantages. These are not always the same in all localities. For example, the relatively high material cost of trough may be justified in a city where a manufacturer of troughing is established but may become prohibitive if the material has to be shipped a thousand miles into mountain country. Codes may also restrict use of troughing.



Example of Machine Room Troughing Set on Rough Slab Floor

3. Considerations of this nature may cause any elevator company to elect to use conduit in one locality and troughing in another.

4. Troughing practices in the machine room parallel those of conduit work. The ducts can be placed in a fill and finish floor, below the floor and pointed up to equipment or run overhead. One advantage to use of troughing is the fact that 50% of the section area can be used for wires. Troughing is quite practical in jobs with fill and finish floors in machine room areas.

5. Generally the troughing is carefully arranged on the conduit layout drawing. The mechanic checks his machine room dimensions and conditions to be sure they

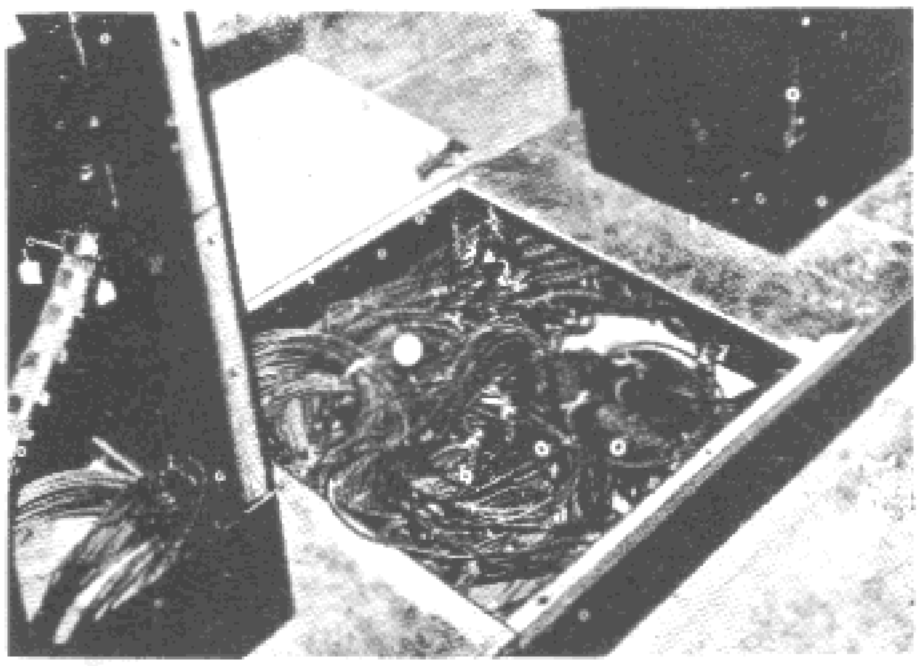
correspond to details on the final layout and conduit layout. If any serious variations exist, the trough arrangement may have to be revised. The superintendent must be informed of this.

6. Some troughs are arranged to form a support for the controllers, relay panels and other equipment. Others require that the equipment may be supported separately on legs or brackets.

7. Regardless of which kind of trough is to be installed it is good practice to run lines between locations of equipment and set these at a fixed distance above the finished floor line. The lines are then leveled.

8. Generally, the controller troughing is set first to conform to the layout. It is leveled at the correct distance below the lines. Then the troughs are blocked with wood, or other material, if required to obtain the proper height.

9. Fastenings will vary. Where conditions permit, anchors can be installed into the rough floor and the trough bolted to the floor with these anchors. To do this, first drill holes in the trough bottom at desired points. Scribe or chalk mark the holes on the concrete, move the trough to one side, install the anchor shells, then replace the trough and bolt it in place.



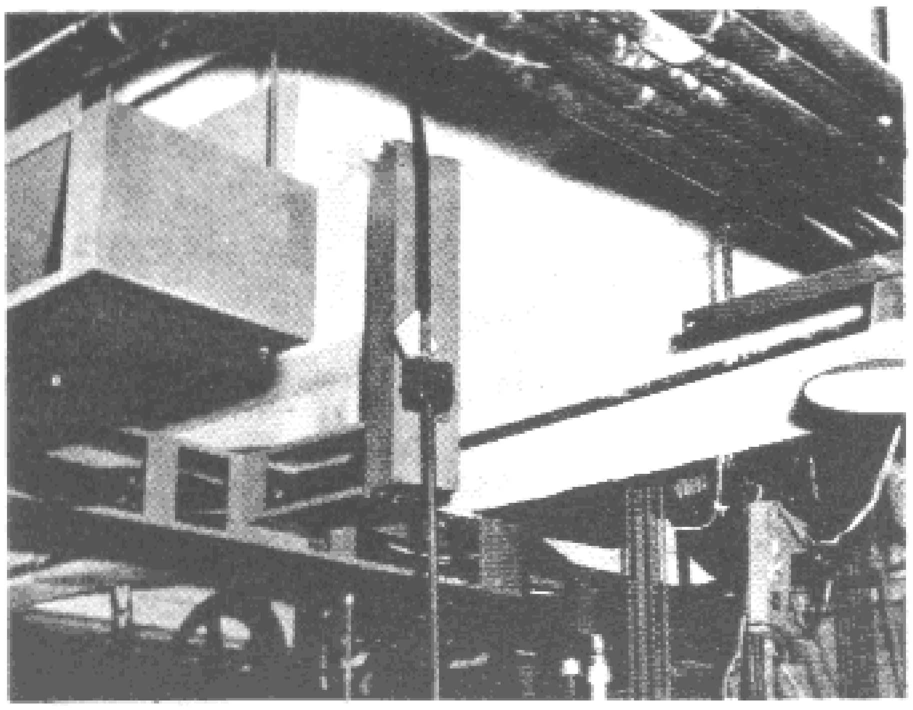
Troughing Accommodates Large Quantities of Wire

10. Field conditions often require that troughs can be secured by means of brackets. Once the trough is blocked (and assuming it is too high off the floor to permit direct anchoring) a flat iron or angle iron bracket can be secured to the trough by bolting, tack welding or with sheet metal screws. The brackets themselves can be of bolted or welded construction to suit job conditions.

11. Corners or elbows are secured to the trough by sheet metal screws or bolts.

12. Where stock lengths of trough must be cut, the portable electric hack-saw can be used. A power hack-saw on a stand or bench is very useful on large installations.

13. Motor wires are sometimes led through the trough to a point adjacent to the motor bedplate then run out in short pieces of conduit. Governor contact and other wires are frequently run in the same manner. The practice followed by the company on whose job you are working will determine these details. Holes for connecting these conduits can be easily made in trough sides or bottoms by means of punches similar to the Greenlee Knockout Punch *735. This tool does a neat job with minimum effort.



Conduit and Troughing Installed Under Machine Room Floor

14. Once a piece of conduit is shaped and placed it is attached to the trough by a locknut and bushing. The conduit should be supported to avoid strain on or tearing of the trough material while waiting for the fill to be installed.

15. When all floor troughing is in place, the machine room equipment can be set on its brackets, if this was not done previously.

16. Covers should be installed on floor troughs to avoid possibility of their being filled when concrete is poured.

17. Troughing must be grounded in a manner similar to that used for conduit. The ground wire must be inside the trough or above it. Do not imbed it in concrete.

18. If troughing is not galvanized or otherwise protected, it should be given an inside and outside coat of a good protective paint before wires are placed in it.

19. Sharp corners or edges should be eliminated also, as in conduit work.

20. Support brackets may be needed on vertical sections that point up in the machine room. However, if they are short and in poured concrete, no support is usually required.

CHAPTER 10
Section -b3

CONSTRUCTION WIRING

Hoistway Wiring — Conduit

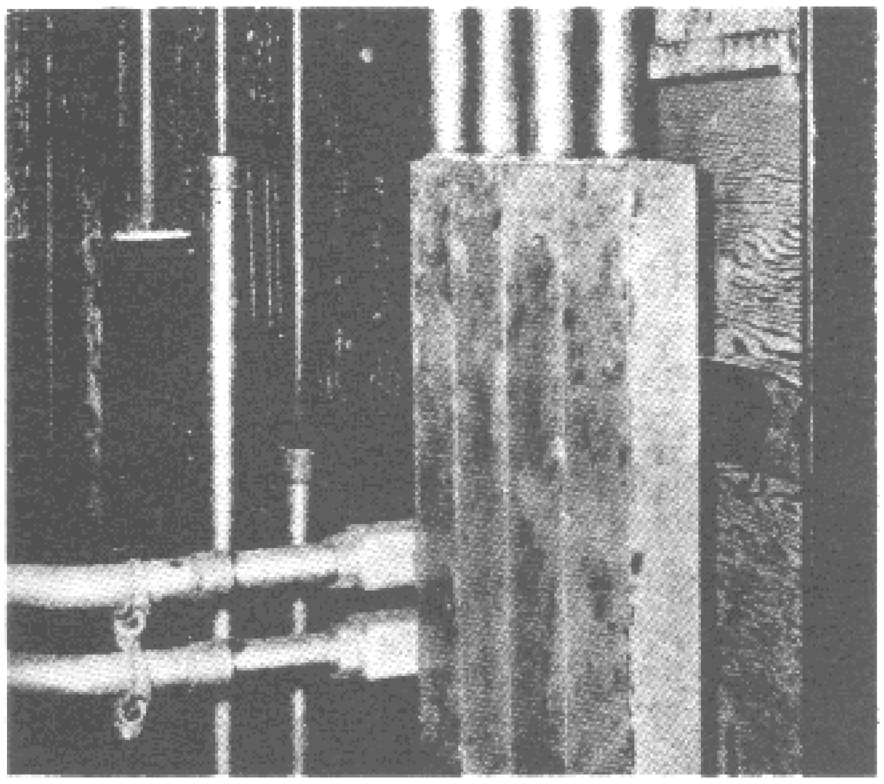
Suggested:

Materials –
- a. wiring materials
- b. cutting oil
- c. cotton waste
- d. sundries

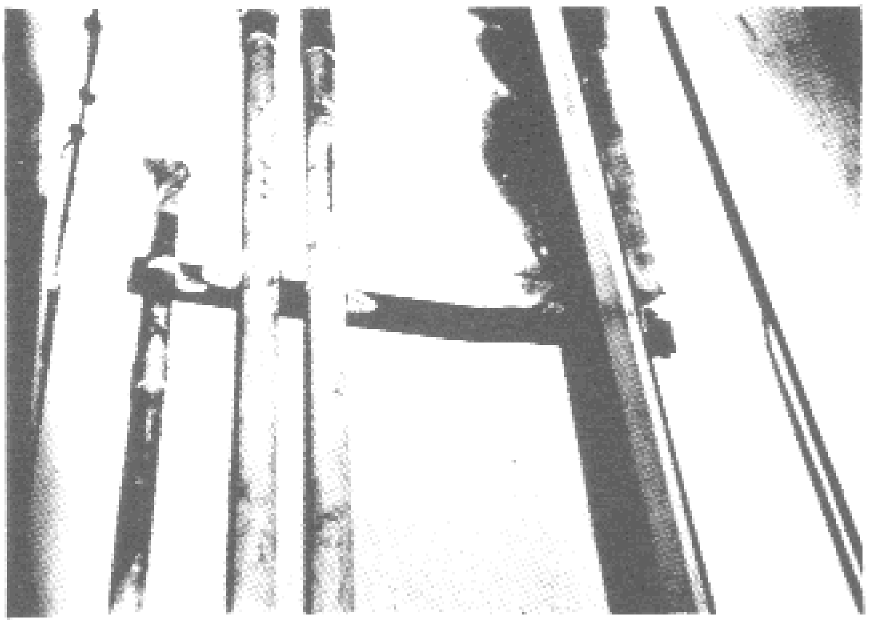
Tools –
- a. hand tool kit
- b. pipe wrenches
- c. stock and dies
- d. pipe cutter
- e. vise

1. The hoistway conduit work follows the same general working rules as the conduit for machine rooms. However, there are secondary factors that have to be considered, such as branches to door locks, hall buttons, limits and similar floor switches. The vertical conduits connecting these parts are called "risers." The branches are the short, horizontal runs that connect the switches to the risers. Junction boxes are set in the hoistway and serve, as the name suggests, to join the wires of risers with those of the traveling cables.

2. Standard company practices are desirable. The conduit layouts issued to the field men are made up to help standardization, to avoid the use of unnecessary material, to eliminate unnecessary work, and to maintain set hoistway clearances. They should be followed as closely as the field conditions permit.



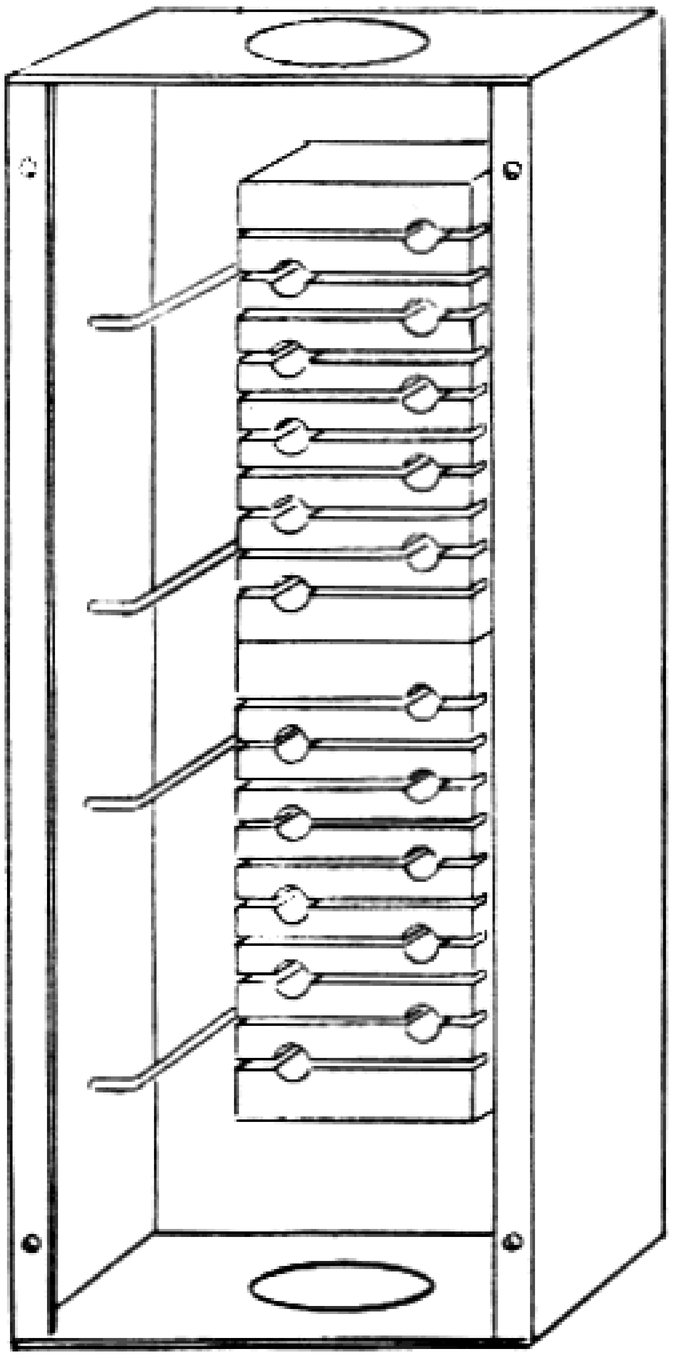
Conduit "Runs" to Hoistway Junction Boxes



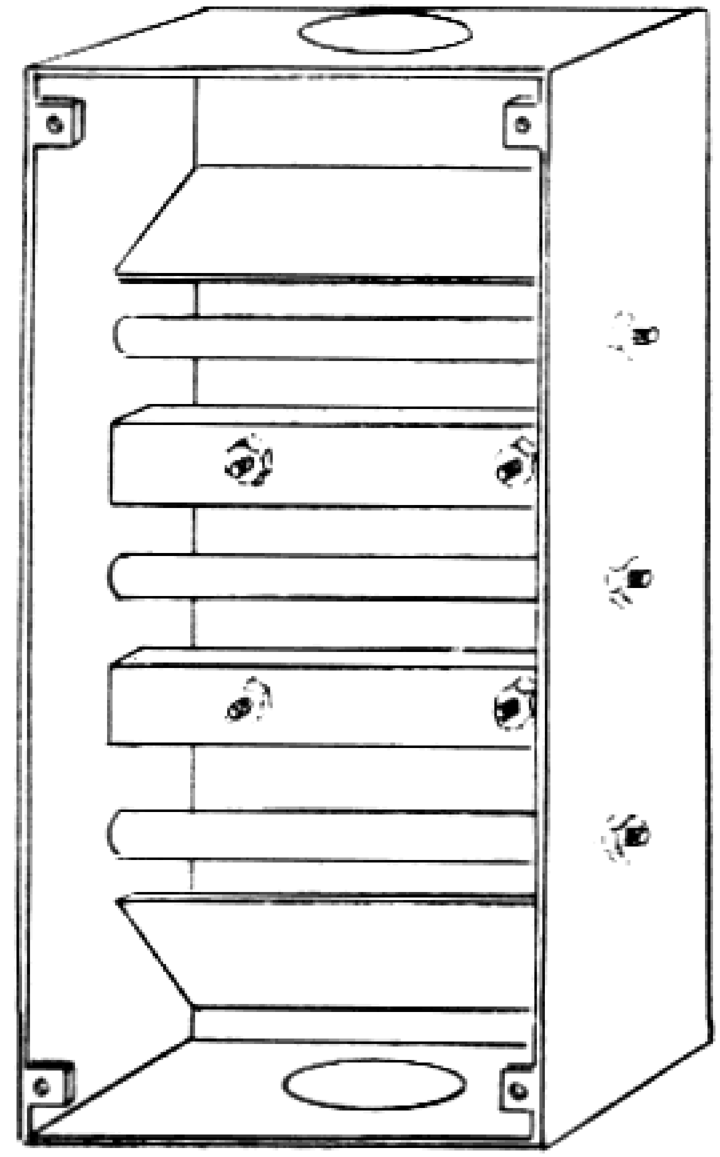
Conduit Can be Supported From Rails on Low-Rise Elevators

3. Conduit risers should be run plumb. They are fastened to main guides, beams or walls as specified. Fastenings and brackets will be supplied by each company in accordance with the conduit layout. Boxes are set with their covers facing the hoistway. Conduit should be supported every twelve feet, or one fastening for every length of pipe as preferred. Make up all joints, connectors, or locknuts tight and square. Horizontal conduit must be supported at least every eight feet. Flexible conduit is clamped to avoid sagging.

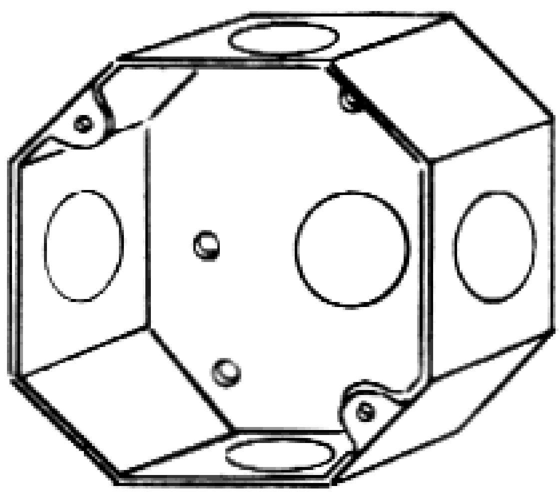
4. It is suggested that no branch exceed 36", if it is of flexible conduit. The correct size of fitting must be used with this tubing and it should be kept clear of the car and other parts with conduit clamps. Never grout flexible conduit in a wall, and do not use it where it may be exposed to excessive dampness. If the run from the outlet box to the appliances is more than 36", use thin-wall or rigid conduit from the outlet and, if necessary, connect to the appliance with a short length of flexible conduit. Such outlet pipe should be pitched slightly toward the riser box so condensation cannot collect in the branch. Moisture in the line will tend to run to the bottom of the hoistway, where the risers can be made self-draining. This feature is obtained by merely leaving an open fittinq end at the bottom of each riser, where conditions warrant it.



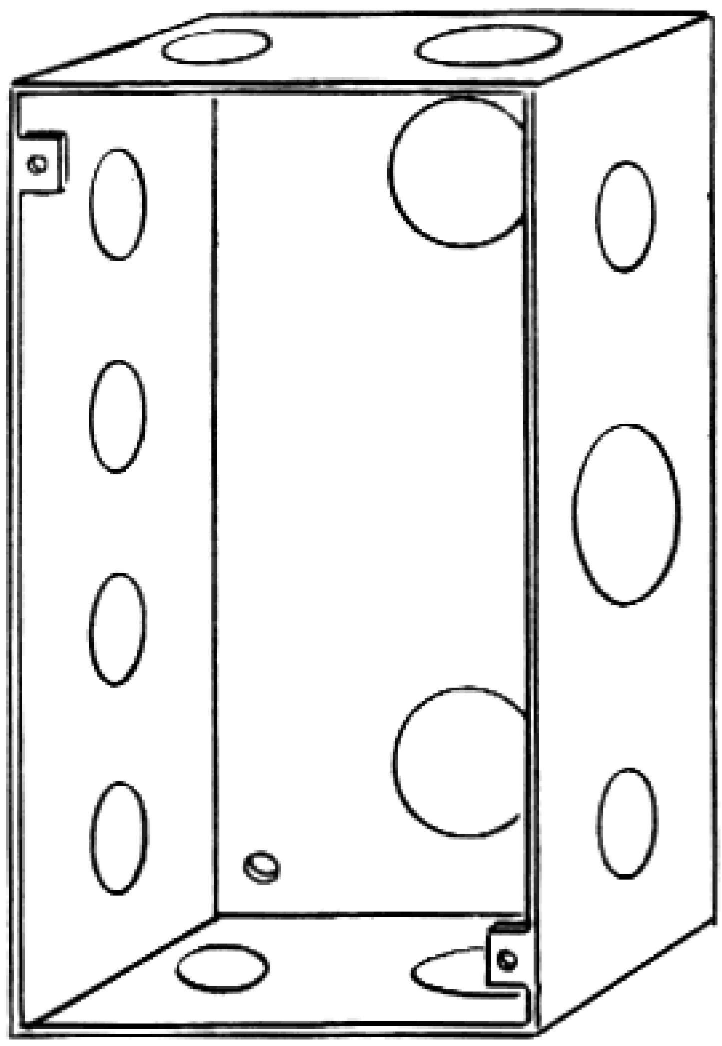
JUNCTION BOX



STRAIN BOX



KO - BOX



PULL BOX

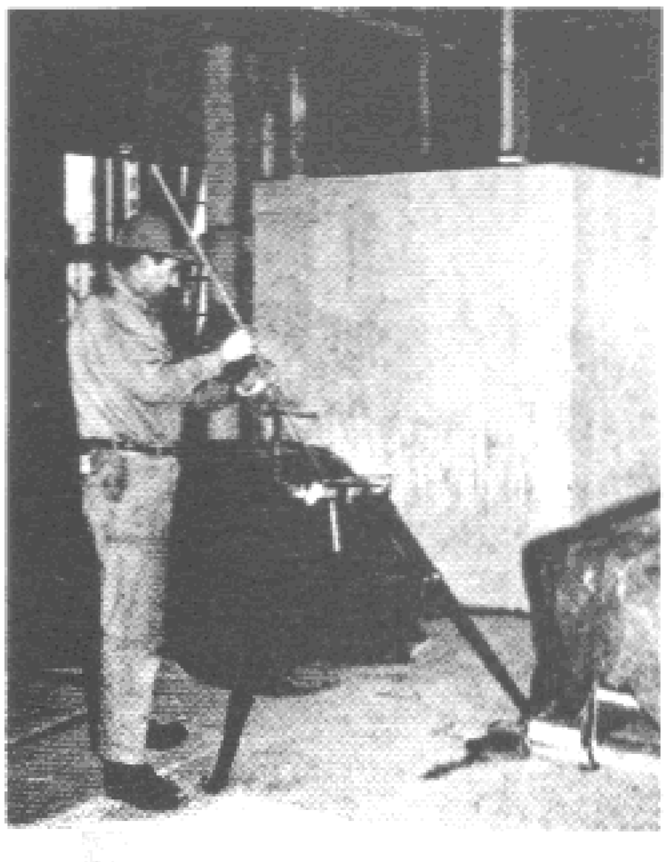
Sketch #1

5. If the length of any hoistway conduit is 100' or more, strain boxes must be supplied to carry the weight of the wires. These boxes are equipped with spools and/or clamps to reduce the pull on the vertical wires. In this way they differ from pull boxes or outlet boxes, which merely serve to route wires. Strain boxes are individually supported to beams or walls.

6. Conduit in a continuous run and fastened to building steel requires no other electric bond to ground. Where isolated conduit is used for any purpose, it must be grounded by means of a ground clamp and a flexible copper braid of *8 wire or larger gauge.

7. File or ream the ends of all conduit smooth to protect the wires. This can be done either with a reamer or with a "rattail" (round) file. It must be done thoroughly. Some thermoplastic wire insulation "skins" or tears very easily so the provision of smooth conduit ends is very important when the "PVC" wire is used.

8. Where junction boxes carry the weight of the traveling cables, they must be securely installed and fastened. On high rise or high-speed installations, we recommend that conduit and boxes be supported on beams or walls rather than rails. (For various types of boxes, see sketch *1.)



Standard Pipe Vise With Hickey for Bending Pipe

9. Where floor heights are such that nonstandard conduit lengths will be required, the lengths from floor to floor can be made up in advance in the locker area. Boxes can be attached to each length and the material assembled in the hoistway with less hazard to the men. Branches to the button boxes, door contact and hall lantern boxes can also be formed before going into the hoistway.

10. This routine has an added advantage. Power hacksaws, pipe threaders (if required) and other power tools can be located in one place rather than "man handled" from floor to floor.

11. Conduit can be bracketed to steel beams by means of clip angles welded or bolted to the steel. The pipe itself is usually held to the brackets by simple clamps that are bolted to the clip angles.

CHAPTER 10
Section -b4

CONSTRUCTION WIRING

Hoistway Wiring — Troughing

Suggested:

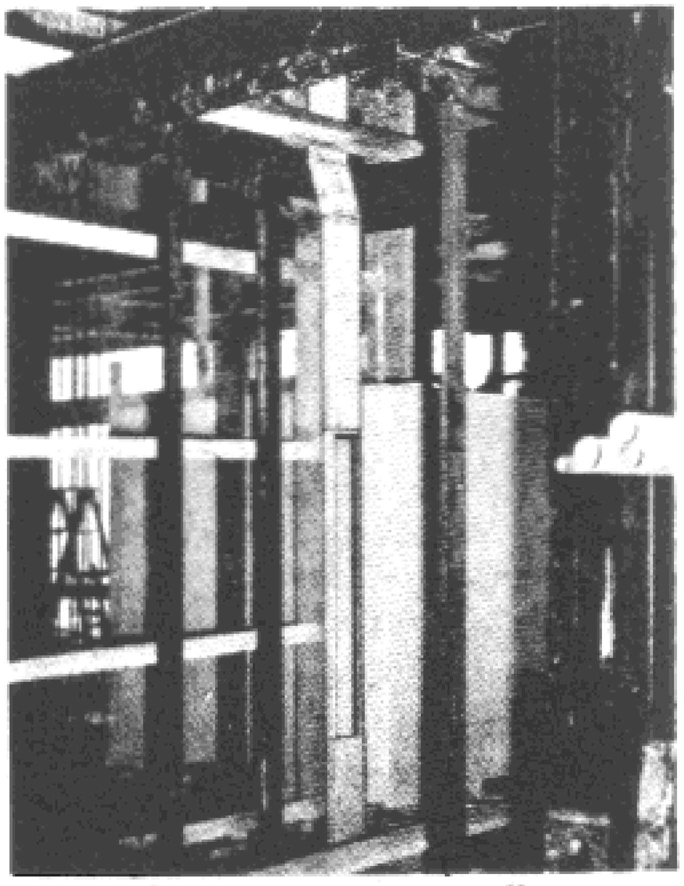
Materials —
- a. trough, fittings
- b. junction boxes
- c. angle iron
- d. flexible and thin-wall tubing
- e. sheet-metal screws
- f. sundries

Tools –
- a. electric hack-saw
- b. electric drill or hammer
- c. arc welder
- d. hand tool kit
- e. conduit box knockout punch

1. Where an installation is large enough or other conditions exist that justify the use of troughing, this can be substituted in place of conduit hoistway risers. Branches of thin-wall or flexible tubing will undoubtedly be used to lead off from the riser trough to wall boxes and switches.

2. The trough can lead up from a separate hoistway junction box or the lowest wide sections of troughs can be fitted with terminal blocks and be used as junction boxes. A supplementary traveling cable hanger will be needed for the latter arrangement.

3. The trough location is planned by the wiring material specifier or draftsman so it will be far enough from the guide rail to permit traveling cables to clear rail brackets. This distance must be maintained to avoid cable problems.

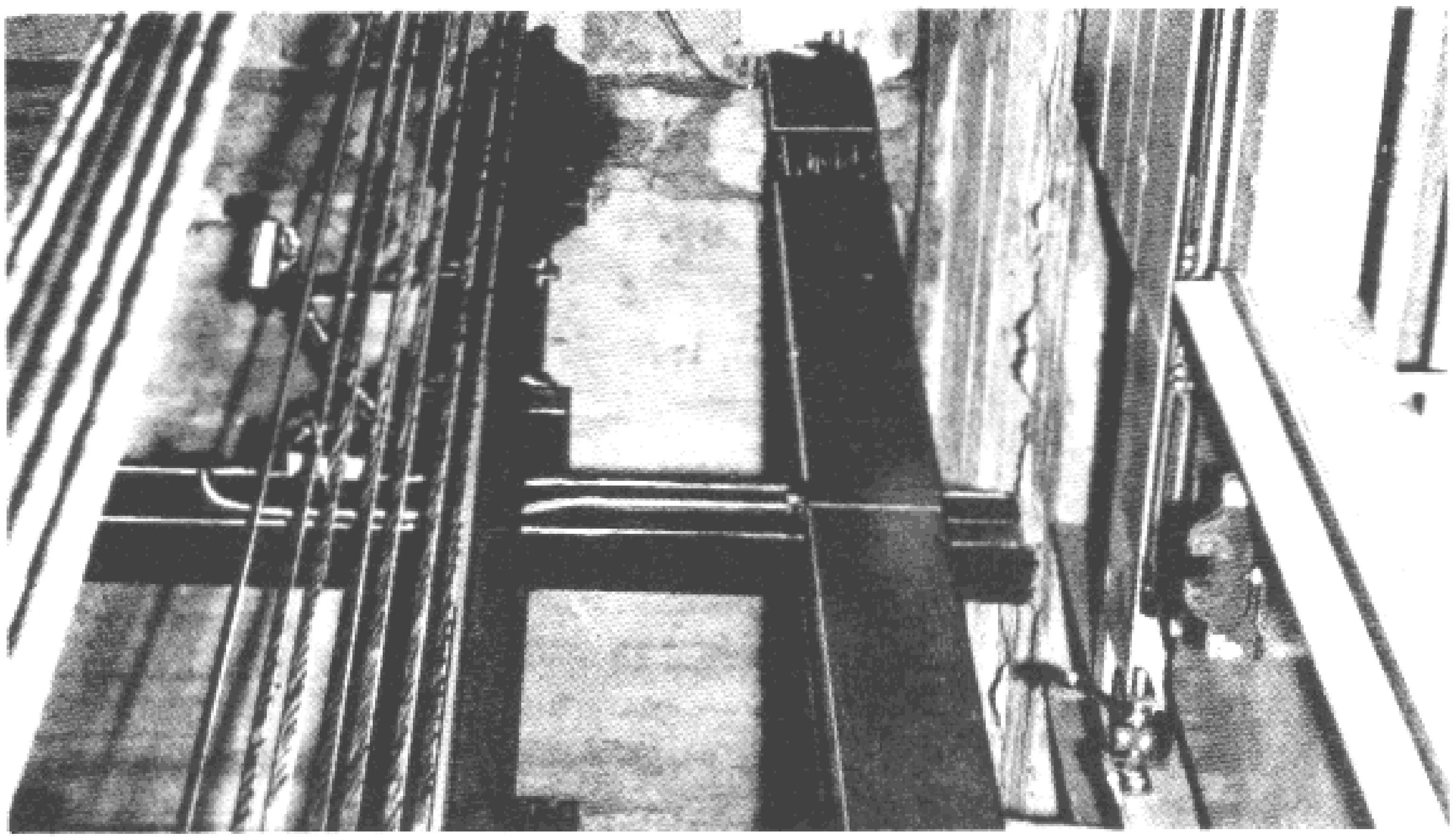


Hoistway Troughing Offset to Clear a Beam

4. Where the trough continues to the bottom of the hoistway to carry wires to a starter's panel or other equipment, the trough must be offset at the junction box. This is also to provide running clearance for traveling cables.

5. On high rise contracts, troughing is sometimes begun before the building is topped out. Under such conditions, the junction box would be set and the troughing installed working from the bottom up. The last few sections would not be fastened permanently until the machine room sections were placed and joined to the riser.

6. Branches of conduit to wall boxes and switches would be bent and cut in advance the same as for an elevator with conduit risers. If the trough had no "knockouts" at convenient locations, the necessary holes could be provided by use of the knock-out punch or hole saw. Conduit is secured to the trough by means of a locknut and bushing.



Conduit Leading to Top Limit From Trough

7. Such conduit branches should lead down to the trough slightly to drain condensation and should be clamped to the building structure for mechanical strength.

8. These trough risers should also be painted, if they are not provided with anti-corrosive finish in manufacturing.

9. The troughs should be reasonably plumb to the eye and securely fastened throughout.

10. The clearance to the elevator car must be checked when the car can be moved through the hoistway. The play in the car shoes should be zero on the trough side during the check. A minimum clearance of one inch is recommended.

11. Another routine is sometimes used where the machine room equipment is set in place early. This is to install machine room troughing, then join the first sections of hoistway trough to it and work down. This permits gradual "leading" of the trough a slight distance to front or back to obtain a planned location of the junction box, if the field conditions prevented layout of machine room troughs exactly to plan.

12. Secure each length of trough to the preceding one with sheet metal screws, preferably with the points out. Fasten the assembly to the building beams or wall with angle clips welded to beams or with patented anchors in concrete. Sheet metal screws fasten the troughs to the angles.

13. Measure from the nearest guide rail to establish a straight, nearly plumb installation of duct work.

14. Troughs are reinforced at one hundred foot maximum intervals so "strain" blocks can be arranged to support the wires.

CHAPTER 10
Section -b5

CONSTRUCTION WIRING

Car Wiring – Conduit

Suggested:

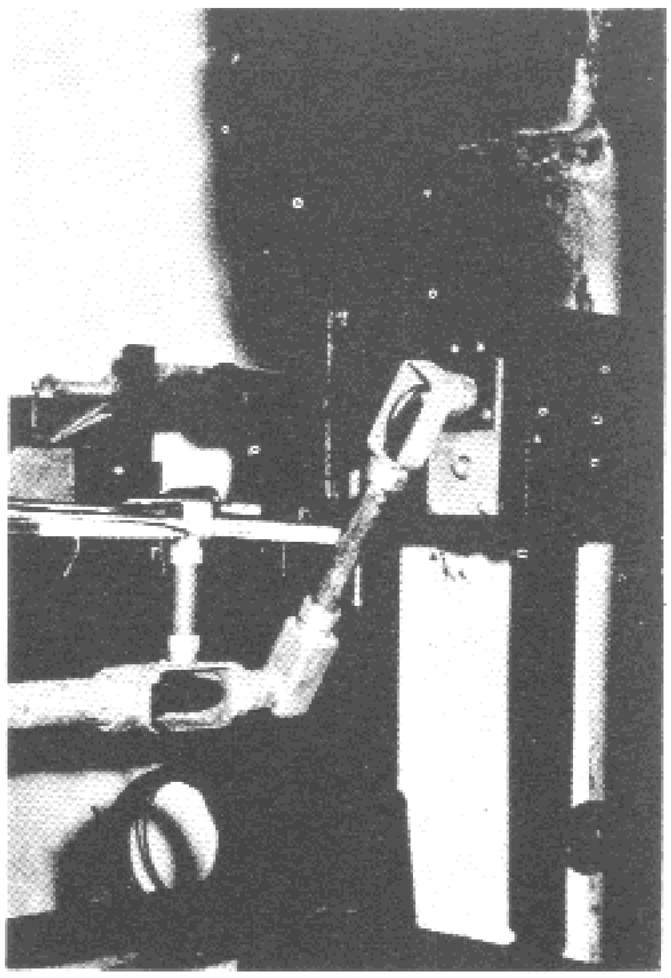
Materials –	Tools –
a. conduit	a. hand tool kit
b. fittings	b. portable electric hack-saw and blades
c. sundries	c. pipe reamers

1. Car conduit should be installed in a neat manner and supported rigidly. All conduit brackets and fittings should be made up tight. Conduit ends must be reamed or filed smooth.

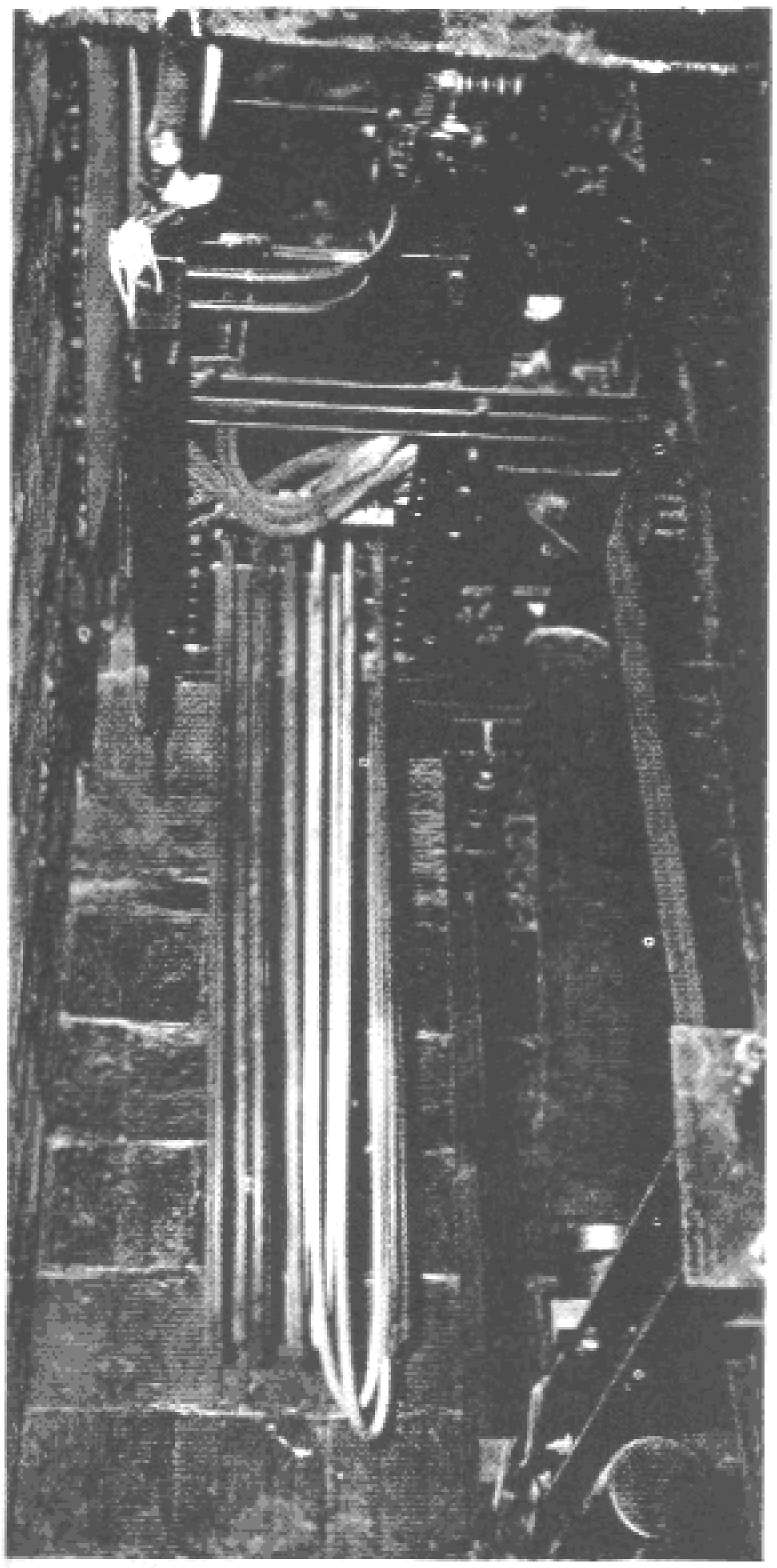
2. Most companies show a trend toward standardization of conduit plans for modern elevator cars. The layout supplied to the field man should, therefore, be followed to the greatest possible extent. Standardization is of assistance to both the constructor and the maintenance mechanic.

3. Junction boxes are supported from the car-frame steel members, or the underside of the car platform, either directly or by means of brackets.

4. The car ends of traveling cables are suspended as near to the car center axis, front-to-back, as practical to maintain a good cable loop. "Hangers" vary with cable types and company standards. Photographs in chapter 10 illustrate several of the more common types.



Conduit to Stopping Switch on Car Top



This Photo Illustrates Conduit Runs to Car Junction Box, as Well as the Traveling Cable Hanger. Also, Note Canvas Sleeve on Oil Buffer Piston.

5. Car conduit is supported in various manners, such as clamps on flat iron brackets which are clipped to the framing, or clipped directly to the car platform. Be careful not to fasten conduit to sound-proofed platforms or car enclosures. Only flexible conduit should be used to connect car fixtures to conduit fittings on such installations. On these sound isolated jobs, connect the conduit system and car fixtures to a ground. Use a *8 stranded wire or its equivalent for this purpose. Where the junction box is mounted on a soundproofed platform the conduit is sometimes ended about two inches from the box. The exposed wires in this space are protected by friction tape coated with varnish. The box must be grounded also. However, common practice is to mount the junction box and cable hanger on the car steel frame.

6. It is not necessary to have junction boxes for low voltage annunciator wires. The annunciator fixture can be piped to the car bottom and its traveling cable run through the conduit from the hanger spool to the fixture.

7. Car operating boxes are piped with flexible conduit on small installations, whereas troughs replace piping on other cars.

8. Most conduit work on small elevator passenger cars is now done with thin-wall tubing and threadless connectors. The material is easy to handle and produces a workmanlike job. Most freight cars are equipped with thin-wall also.

9. Some type of troughing is commonly used for wire raceways on passenger elevators with larger platforms. This is particularly true of banks of elevators where, as noted earlier, a standard arrangement helps both construction and service men. A description of these troughs will follow in the next section of this chapter.

CHAPTER 10
Section -b6

CONSTRUCTION WIRING

Car Wiring — Troughing

Suggested:

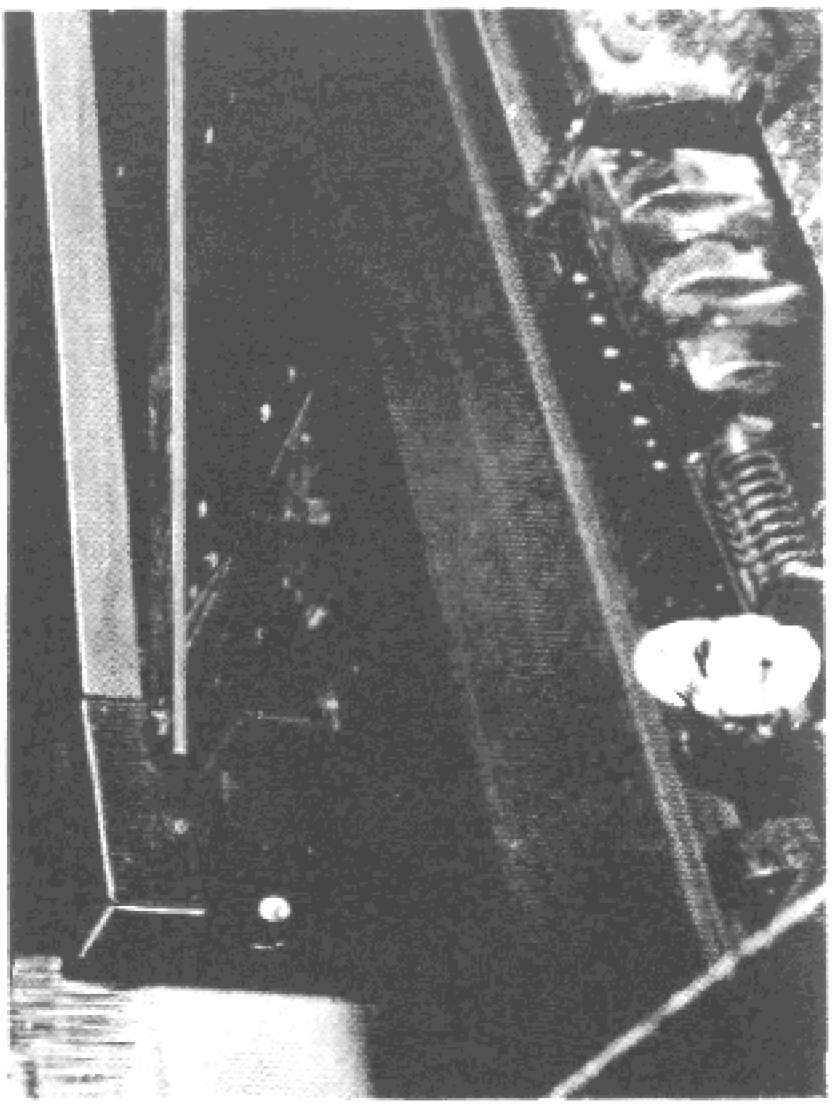
Material –
- a. troughing and fittings
- b. flexible tubing
- c. thin-wall conduit
- d. fittings
- e. sheet-metal screws
- f. ground wire, sundries

Tools –
- a. electric hack-saw and blades
- b. electric drill
- c. knockout punch

1. A number of companies have used car top troughing for some years. These were often connected to the junction box under the car by conduit and threadless fittings.

2. Development of troughs for car platform frames has also been proceeding. Introduction of elevator cars with double sets of operating panels has increased interest in the standardization of the bottom troughs for cars.

3. The bottom trough and junction box can form a unit across the car platform frame and short troughs may be extended up to the car operating panel or panels. The troughs are bolted or screwed to the frame. The ends extend to the edge of the platform postwise and vertical troughs or conduits run up to join the car top trough which is bracketed to the car crosshead. They are not fastened to the sound isolated platform or enclosure.



A View of the Car Bottom Showing Joint of Junction Box and Side Trough

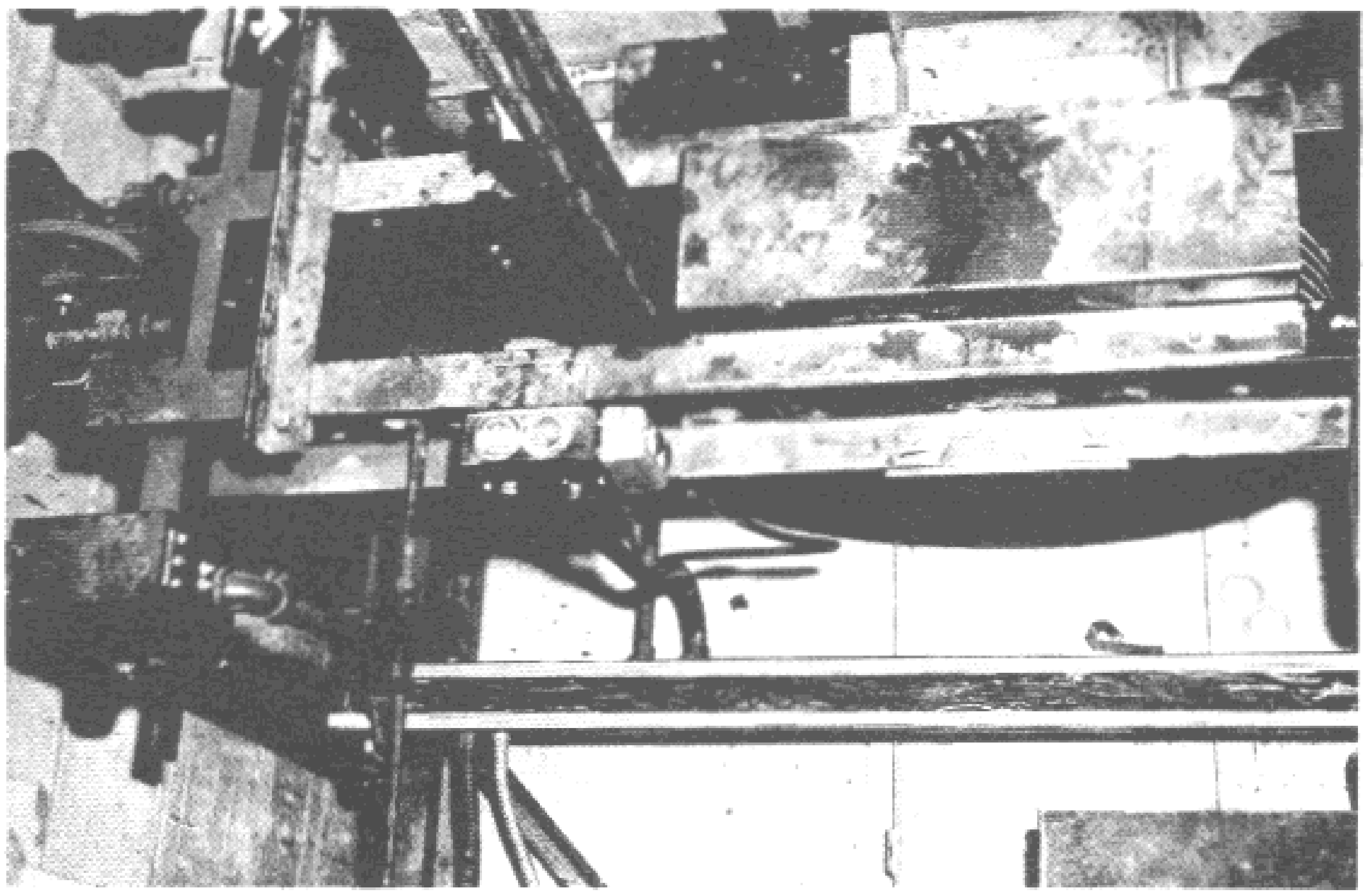
4. Traveling cables are suspended from a separate hanger plate and led into the junction box in loops.

5. Inductor switches, stopping switches, door operators and appliances are connected to the top trough with short lengths of flexible tubing or thin-wall and flexible tubing.

6. Care must be exercised so that no solid part of the raceway ties in the sound isolated enclosure with the carframe.

7. The car troughing should form a continuous raceway for wires and be grounded to the carframe. Carframes are normally considered as grounded since frames with slide guides have direct contact with rails, which are automatically grounded on steel structures and cars with roller or non-metallic slide guides are grounded to the machine by means of the hoist ropes.

8. To this point, use of troughing has been reviewed merely as a mechanical feature and as a substitute for conduit. The advantages of it over conduit, under certain circumstances, will be outlined more completely under sections of this chapter which describe the actual installation of the conductor wires.



One Example of a Car Top Trough

CHAPTER 10
Section -c1

CONSTRUCTION WIRING

Machine Room – Pulling Wires

Suggested:

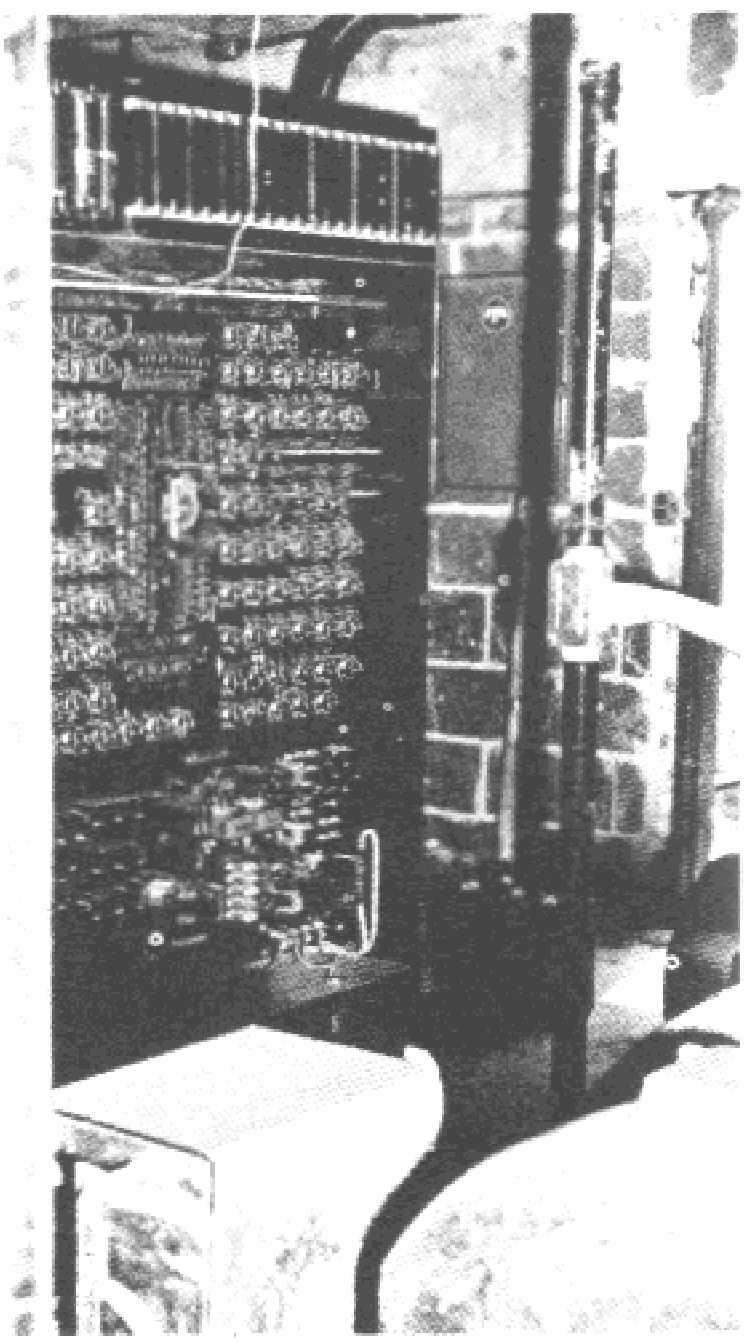
Materials –
- a. powdered soapstone
- b. heating-torch gas
- c. friction, rubber & scotch electric tape
- d. cotton waste

Tools –
- a. hand tool kit
- b. steel snakes
- c. "kum-a-long" (wire grip)
- d. markers
- e. ringout boards

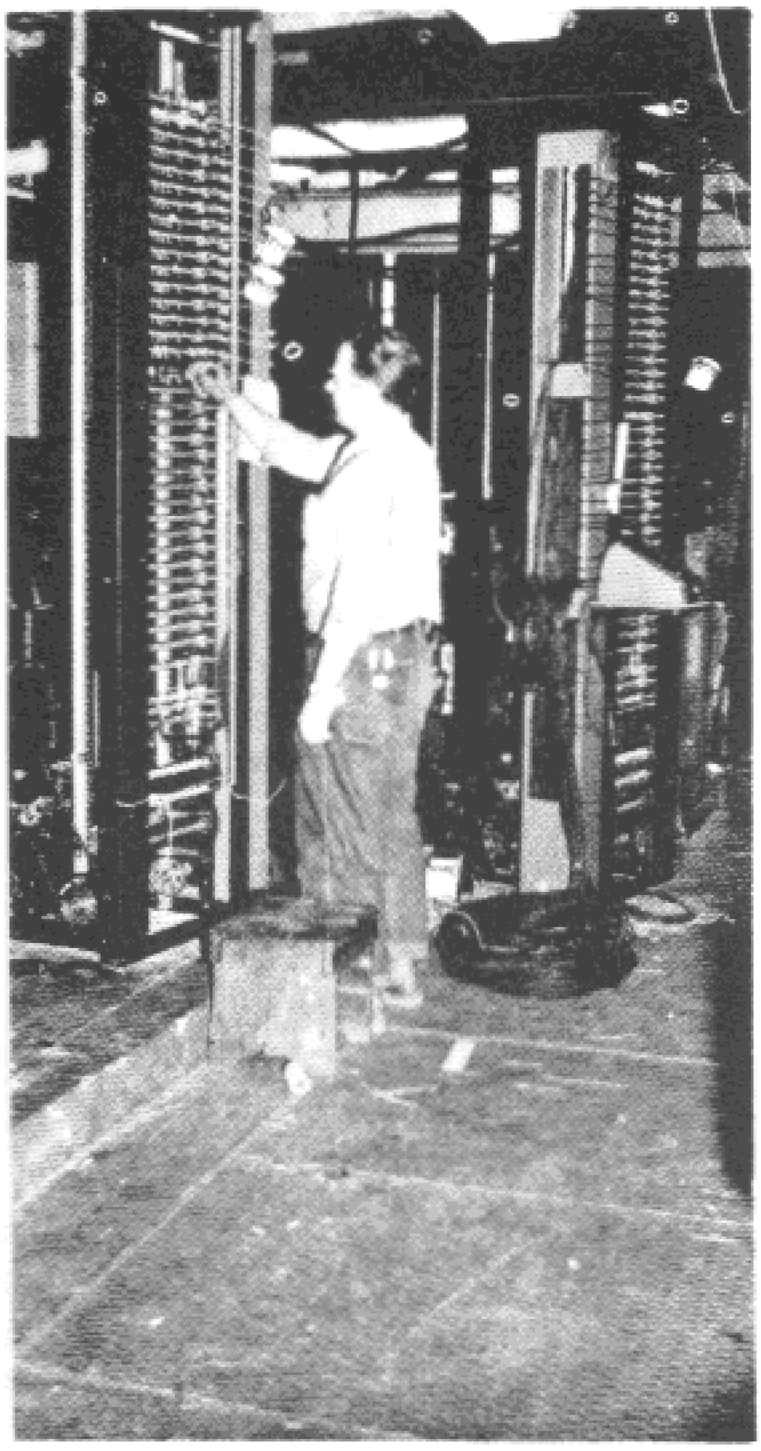
1. The engineers and construction managers who establish material quality levels for their elevator companies now have a much wider choice of conductor wires than a few years ago. The old standard wire was copper with rubber and cotton braid covering. Some companies used stranded copper while others preferred solid. The copper was often tinned and generally the specifications called for "free skinning insulation." Gauge #14 was the minimum permitted for operating circuits. Later this ruling was relaxed and #16 gauge became the accepted standard.

2. Today the N.E.C. permits the use of wire as small as gauge #20 for connecting operating circuits where current capacity of the wire is suitable. However, #18 is generally used because it provides a somewhat greater measure of mechanical strength. This is particularly important in vertical risers.

3. Rubber and cotton braid insulation is still used by some firms but the great majority of elevator companies provide "thermoplastic" (or polyvinyl) insulated conductor wires. When the proper quality of insulation is used, the "PVC" wire has a number of advantages. Identification of wires by color coding is easier since colors are sharper in tone, for example. One disadvantage is that the plastic



Controller for Geared UMV Elevator



Wiring a Haughton Selector

insulation can tear if pulled over a sharp edge and, therefore, a bit more care must be used than is necessary when rubber – cotton covered wire is pulled into conduit.

4. Another comparatively new form of wire is the PVC wire cable. This consists of a fixed number of PVC covered conductor wires wound together and covered with a sleeve of polyvinyl. The wire is color coded and can be ordered to include pairs of wires. Common sizes of this type of cable include 7 wires, 14 wires, 21 wires and 32 wires.

5. The cable form of PVC is probably most useful when used in conjunction with troughing.

6. These new types of conductors have changed the pattern of procedure as identification of conductors. The color coding aids considerably and in some cases eliminates the need for any other identification. However, there will always be a certain number of wires that will require separate marking. The old routine of "notching" wires is used to some extent yet but modern practice is to use other means of marking or identifying them. The "ring-out board" and telephone system is still one of the best for certain types of work. Another popular method, especially for locations like car wiring, or from selector to controller runs, is the use of adhesive backed numbers which are printed on cloth or plastic.

7. The use of notching, ring-out boards and printed marking tags will be reviewed in this chapter.

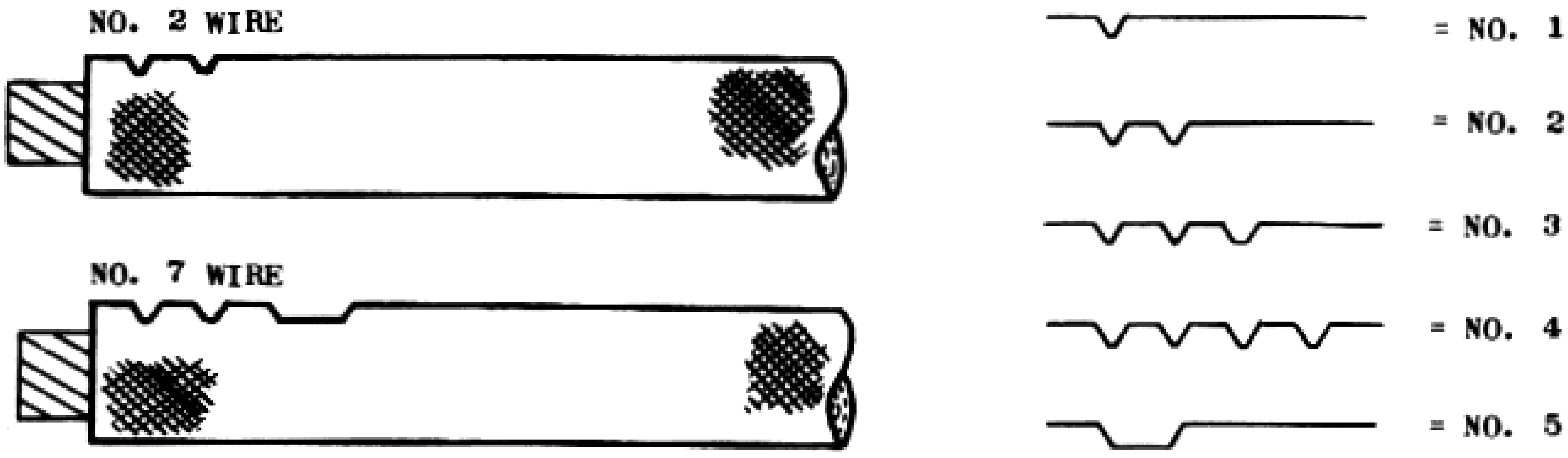
8. When conventional individual wires are pulled into conduit, wires may be laid out in a group and pulled in when the conduit runs are complete and the machine room conditions are satisfactory.

9. First study the field wiring diagram and prepare the reels or coils of the proper sizes and colors of wires. Decide how many wires of each size will be required for each conduit run and whether any colors other than black or white insulation are required.

10. Push the steel snake through the first conduit – say, for example, the motor to controller run. Mark the snake at the coil end and pull it out of the conduit.

11. Measure the length that was in the pipe, being sure to allow enough extra at each end for the shaping in and connecting to their terminals. Remember that heavy leads do not bend in as short a curve as a #18 wire, so allow a few inches extra length on these leads.

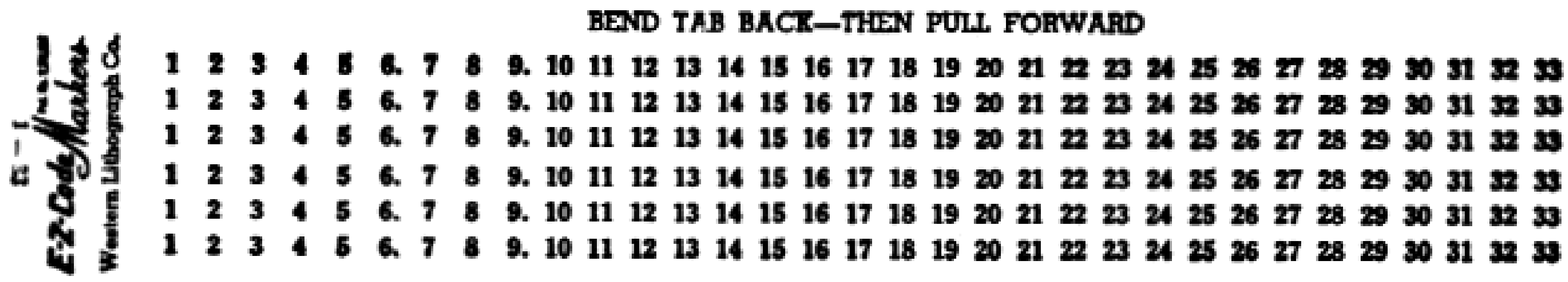
12. After the leads are cut, mark the two ends of each wire. This can be done with identifying notches as in sketch #1 or with the adhesive backed printed numbers shown in sketch #2. Feed one end of the group of wires into the "kum-a-long" and fasten it to the steel snake. Then, as one man feeds the wires smoothly into the conduit, being careful to avoid crossed wires, the other can pull the wires through by means of the snake. Pull the wires until the ends are at the desired terminals and about equal. Powdered soapstone may be used to provide a slipping surface, if required. Do not use any other form of lubricant unless it is approved by your "super."



Sketch #1

13. Coil the wire ends or wrap them with burlap to protect them from damage.

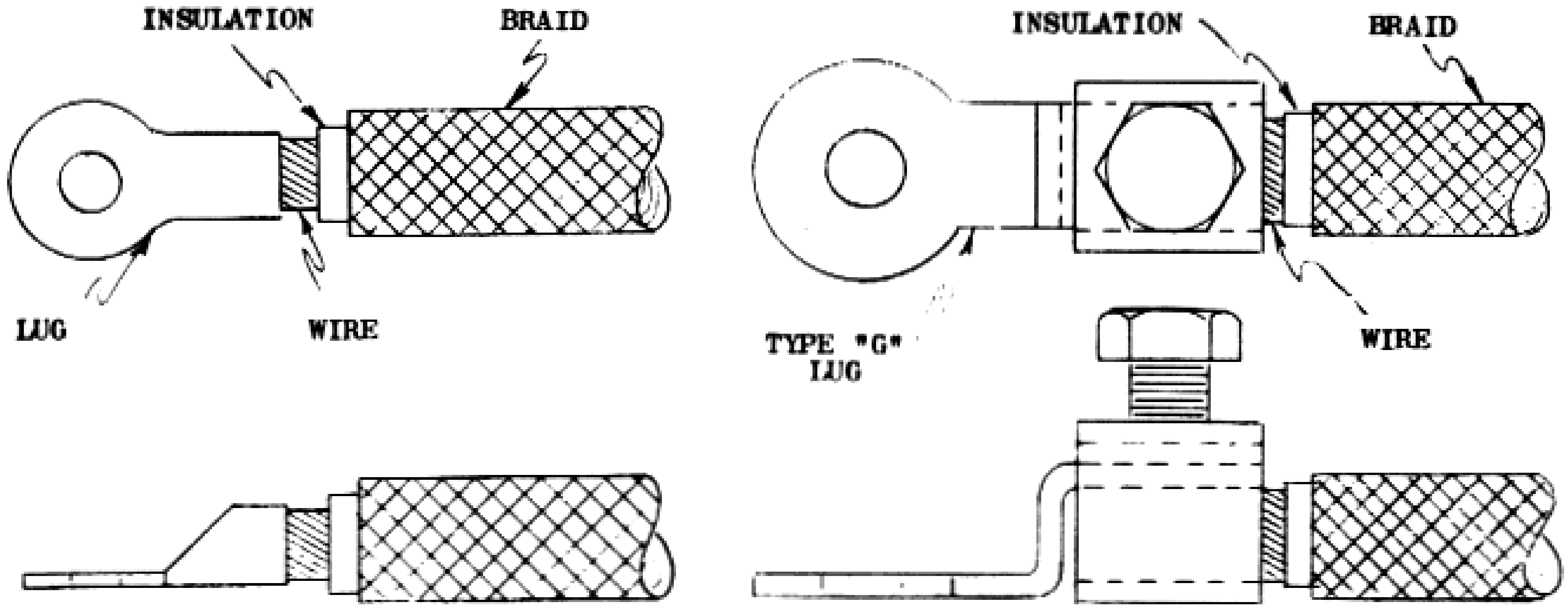
14. Generator wires are pulled in a similar manner.



Sketch #2 (Marker Tags)

15. Repeat the same general procedure for the lighter gauge wires from the controller to selector, relay to selector, and any other components. When pulling in these wires, mark them. As a rule the number of wires used on the controller and selector make it more economical to ring out the wires or use marker tags. Therefore, if you are to ring out the wires, merely hang the "loop" (excess) over some temporary support, and have a helper insert the wire ends in the holes or ring-out boards. Terminal eyelets are used for connecting these wires if they are stranded. Formed eyes can be used on solid wire. (Washers are normally used to hold the formed eyes in place.)

16. Motor wires are usually field equipped with "lugs" that are clamped or soldered onto the wires. Solderless lugs are now most popular. For either type, first strip back the wire ends as illustrated in sketch *3. When the wire is prepared, clamp the lug on it. (If it is the solder type, heat the lug in a torch flame. Melt solder in it until it is about 2/3 full. Tin the inside by revolving the lug slowly. When the lug "tins," the solder is at the proper temperature. Coat the wire end with soldering flux and, bracing the lug, insert the wire into it. Chill the lug immediate with water soaked waste. When it is cold, test it with a pair of heavy pliers to be sure that it is tight.) (Test all lugs for tightness, whether solderless or solder types.)



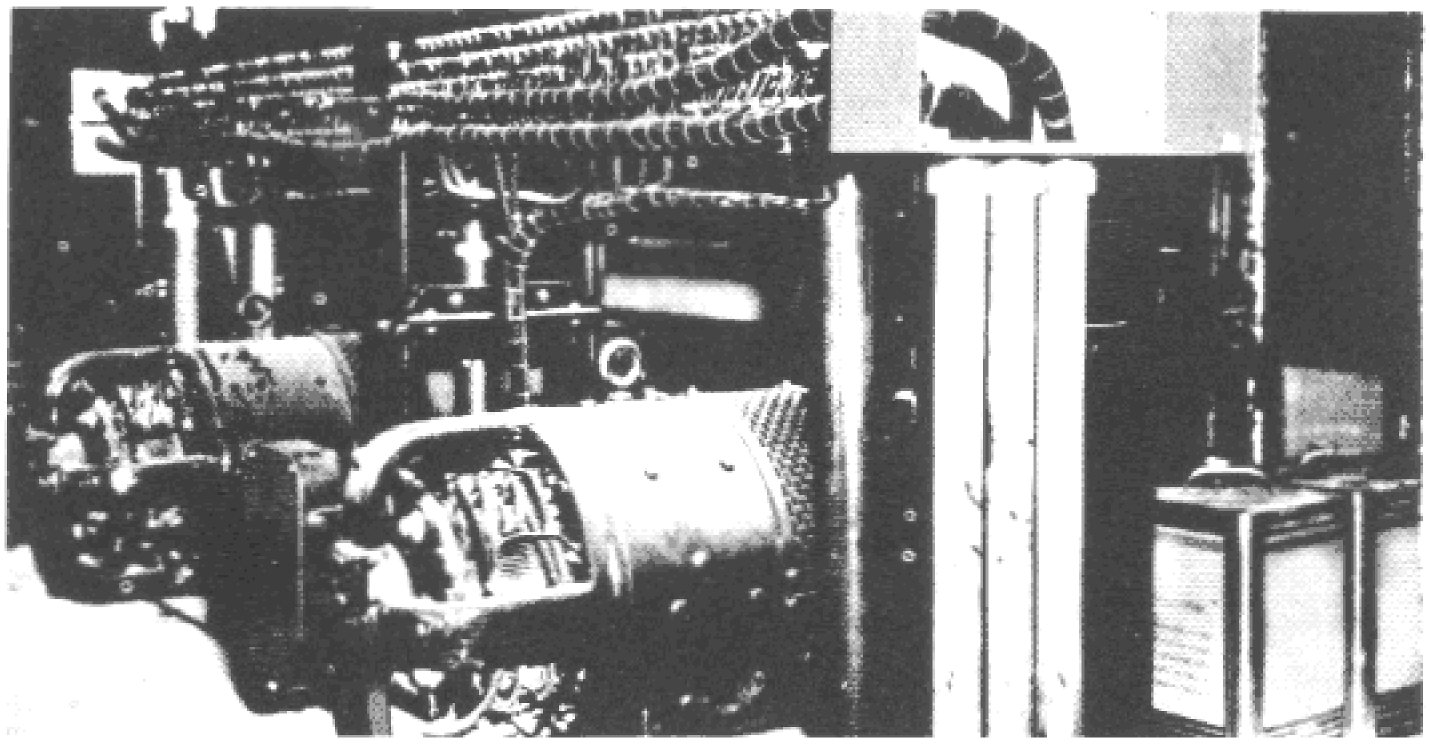
Sketch *3

17. As a rule heavy motor leads are connected as soon as the lugs are on. Shape them neatly, bind them with heavy, white cotton cord or a similar binder and paint the wire bindings with black insulating varnish (the latter is done to all the machine room wiring at one time). Use spring washers under all armature, field and stator lead bolts and studs. Use split pins in field lead studs in addition to the spring washers, if the terminal bolts are drilled for them.

18. If the length of the wires does not exceed 72'', open wiring (i.e., without conduit) can be used between the motor and the controller, and the generator and the controller. The wires must be grouped, corded and painted with black insulating varnish. The stack of wires must be so arranged that it is protected against mechanical injury and be supported at intervals of three feet or less.

19. As a rule, controllers, relays and floor controllers are not hooked up until all wires for the hoistway are pulled in. The center junction box is then hooked up and the studs rung back to the controller, floor controller, relay panels or other parts. This system eliminates the possibility of ringing false circuits through other equipment. Then the other circuits are rung out and connected. Read Chapter 10 -c6, for details of ringing circuits. Use of colored wire for the specific circuits is also helpful and good practice.

20. When pulling the wires do not overcrowd the conduit. The code permits 40 per cent of the square area (cross section) of conduit to be filled with wires on elevator



Generator Wires Connected Directly to the Controller and Corded Together Neatly

work. Run the wires evenly and parallel so that, in case of trouble, individual wires can be pulled out and replaced more easily. In conduit or troughing pull in 10% more wires than are actually needed. Having these "spare" wires delays the need for replacing wires in the event of trouble.

21. Generally, elevator wiring is subject to inspection by building officials, city and state inspectors. Because of this and also to assist maintenance, it is necessary to perform the work in a neat, workmanlike manner.

CHAPTER 10
Section -c2

CONSTRUCTION WIRING

Hoistway Wiring – High Rise with Conduit Risers

Suggested:

Materials –
- a. wiring material
- b. cotton cord
- c. eyelets
- d. electrical and rubber tape
- e. varnish

Tools –
- a. hand tool kit
- b. terminal crimping tools
- c. wire skinners
- d. 4" clothes line pulley
- e. soldering iron or gun
- f. tags (adhesive backed numbers)

1. Where rigid or thin-wall conduit is used the risers generally terminate in pull or strain boxes at the top of the hoistway. This assists considerably in the pulling in of wires. The following paragraphs describe a method of pulling wires for a high-rise installation.

Mechanic "Feeding" Wires into a Conduit Run at the Top Strain Box– Note, that Ends of Wires Already Pulled in are Temporarily Tied Overhead so They Cannot Slide Down the Pipe.

2. After the conduit work is completed, hang the 4'' pulley near the top of the hoistway a few feet above the pull box. Set the reels of wire up on horses in front of the top terminal landing. About five reels of wire are generally used, one or more of which could be red, white or other color. Run the end of the white wire through the pulley. Tie a small weight on the end of this wire and feed it into the first conduit run. Lower it to the center junction box, and pull out about five extra feet of wire. Cut and fasten the wire at the top, near the pulley. Lower the new end to the center box outside the conduit. Cut this wire and splice both ends of the two wires. An endless loop, which is called the ''drag,'' is formed in this manner. It is used to pull or ''drag'' wires into the conduit. In long runs it is advisable to make the drag of #14 gauge stranded wire.

3. See sketch #1 for a suggestion of how to make the splices in the loop. Refer to the sketch for details of the job setup.

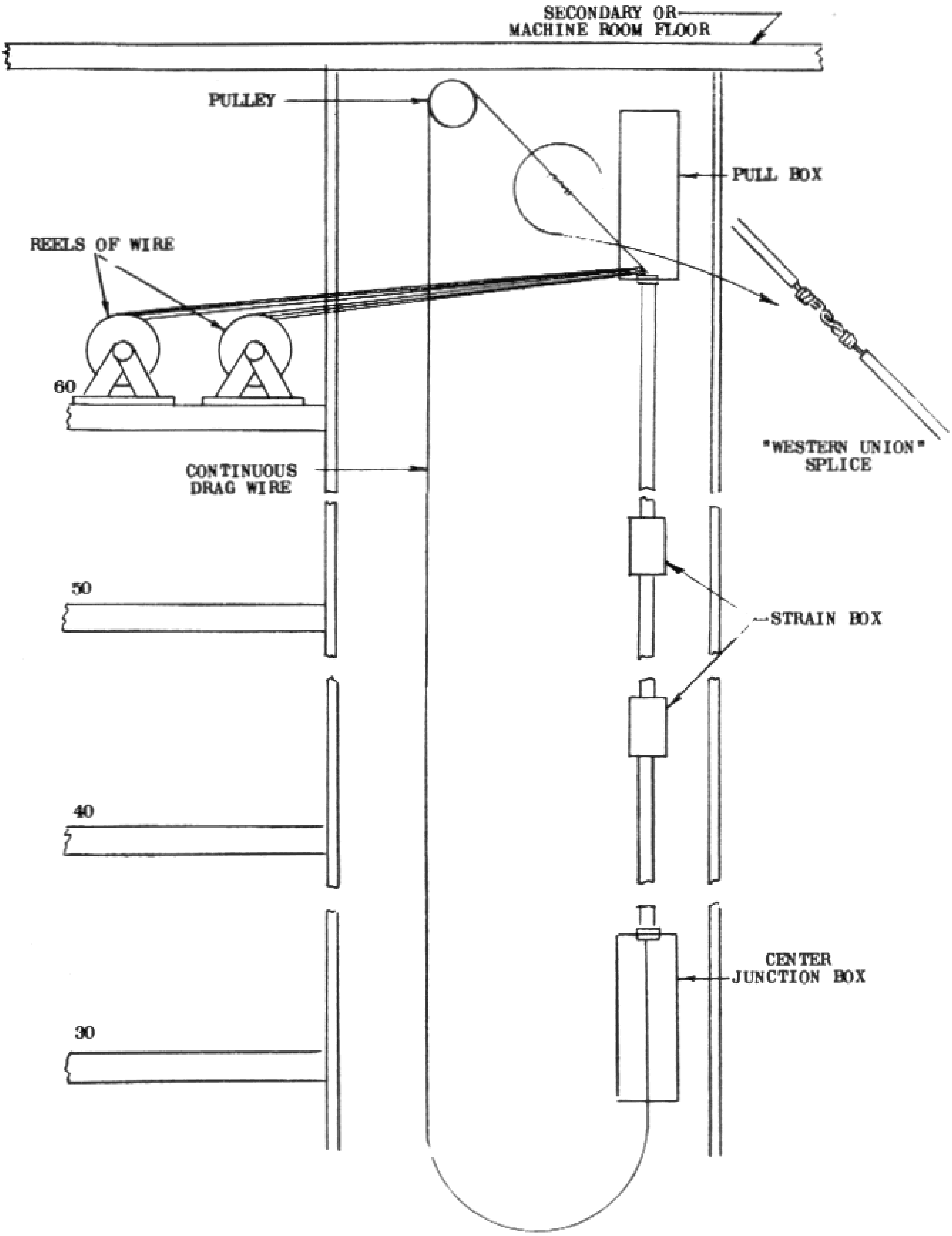
4. Splice the ends of the five wires onto the drag at one of the two drag splices. Station the helper at the center box. Have the helper pull the wires down while you feed them from the reels to the conduit. Be careful not to ''hook up'' the ends when passing the strain boxes. (When wires ''hook up'' or catch as on the conduit ends of the strain boxes, they can generally be cleared by pulling back evenly for a few inches, then again pulling down.) Pull out enough length of wire to permit hooking up to the junction box studs. About one half of the circumference of the junction box should be ample for shaping in and connecting the wires.

5. Hook one red wire to a junction box stud and mark it ''telephone.''

6. Measure the length of wire required to extend from the top pull-box to the controller (or other apparatus) including sufficient wire to make connections. Mark this distance on the floor back of where the wire reels are set. Pull the ''loops'' of all five wires from the reels to this mark and cut them. Lay all wires to one side and in a position where they will not be damaged.

7. As a rule the weight of the wire will support the length in the conduit, but it is advisable to wrap a little friction tape around the wires and bind them to a conduit. If no conduit is readily available, place a 2'' x 4'' across the doorway. Lay the wires over it, and then down the hoistway.

8. Skin the top end of the odd colored wire that was connected to the TEL stud at the center. Connect this to a telephone, battery and ground. Connect a telephone to the stud at the center and to a ground.


SECONDARY OR
MACHINE ROOM FLOOR
PULLEY
PULL BOX
REELS OF WIRE
60
"WESTERN UNION"
SPLICE
CONTINUOUS
DRAG WIRE
50
STRAIN BOX
40
CENTER
JUNCTION BOX
30

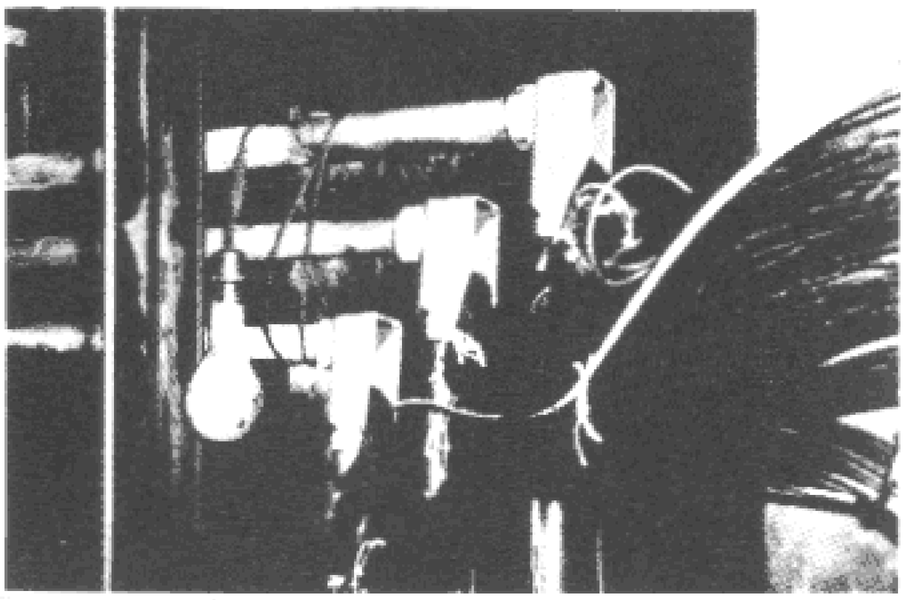
Sketch #1

9. Once this telephone circuit is established the work of installing the wires may proceed by splicing wires to the "drag" loop and having the helper pull them down to the mark at the center box. The mechanic then pulls the ends out to the mark at the top floor, cuts and secures the wires, then attaches five more wires to the drag and repeats the procedure. The telephone aids by reducing chance of error due to misunderstanding of signals.

10. When the specified number of wires, including spares, have been pulled in, move the drag to the next conduit and pull in the desired number of wires. Bear in mind that the second conduit probably does not go to the same equipment, in the machine room, and therefore, the length of pull-out at the top floor will not be the same as for the first raceway.

11. Wires are pulled out at each floor for the common wire or "loops" of the door lock, landing position indicators, and landing button wires. These are generally made of a distinctive color or white. (This simplifies the hooking up and pulling in the wires.)

12. These loops must be pulled out at each floor as the wire is run in. They extend from the top to the bottom of the hoistway. Customary procedure on high rise equipment is to install a "drag" on a pulley from the top to the bottom, allow the loop end to hang in the pit. The common colored wire is run in first, and enough extra is pulled out at each floor outlet box to permit the loop to be pulled over to the fixture. The balance of the wires are then dragged into the riser.



Wires are Tied to One Side Until the Mechanic is Ready to Pull Them in Horizontal Conduit

13. For landing buttons, a certain number of wires are run from the relay panel to each landing. This means the wires become progressively shorter. They must be pulled out at each outlet, again with a sufficient allowance to permit them to be snaked around to their fixtures, shaped and connected.

14. Landing position indicators are treated in a similar manner, but the fixtures are commonly wired in parallel. Therefore, it is necessary to either pull loops out on each wire at each landing, or to splice short wires to the riser wires at each landing outlet. Local practice dictates the method to be used. In either method the feed wire could be colored, or if the ground side, it should be white. This complies with the N.E.C. and makes identification easy at each floor.

15. Car position indicator lights in starter's or dispatcher's panels are frequently used in conjunction with landing position indicators. They are electrically paralleled to the hall or landing position indicators. As a rule these fixtures are located adjacent to the elevator entrances at the main landing. They are often piped with

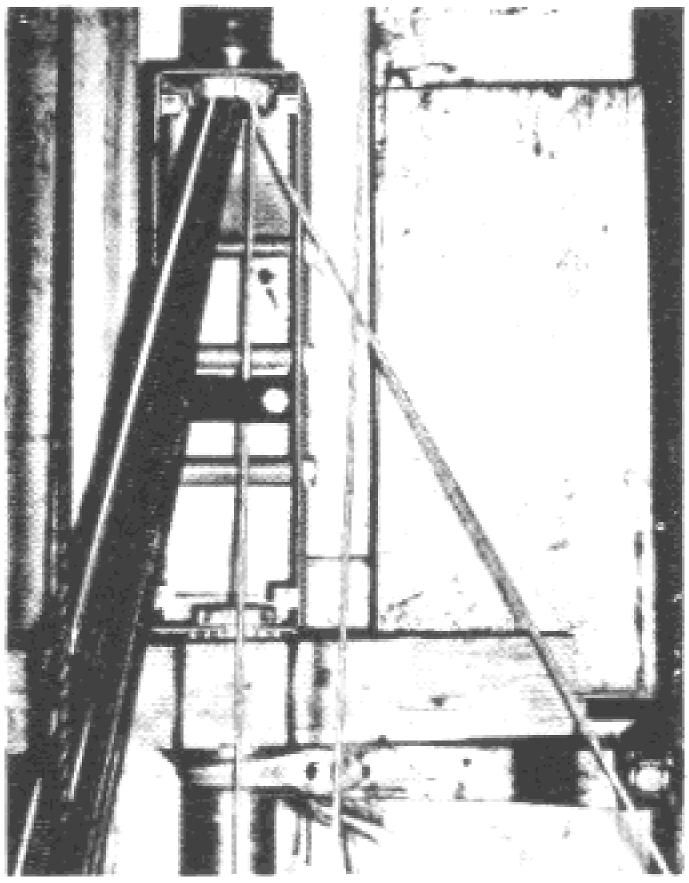
conduit or trough from the bottom of the position indicator riser. It is easiest, therefore, to handle these wires in the same manner as the wires at the top of the hoistway; that is, by measuring to determine the length needed to reach the starter's panel, dragging the wires 5 at a time, pulling out the extra length at top and bottom, cutting and securing the wires. When all the wires are dragged in, they are pulled to the fixture with a steel snake and a cable grip, if necessary because of the number of wires.

16. Door lock wires usually consist of two, one black and one white. If in a conduit common to many wires, they are most easily pulled in separately on a single drag. Drag them directly to the lowest floor. Pull out enough of each wire to reach the door contact. Fasten them and then work up the hoistway, hauling out a loop on one wire and securing it. The loop must be long enough at each floor to reach the contact.

17. Once all hoistway wires are dragged in, push a steel snake through each of the machine room pull-box conduits in turn, and snake the individual groups of wires to their respective apparatus. The mechanic should shape the wires smoothly by "rolling" them in his hands before placing them in the cable grip. This must also be done while the helper pulls on the snake from the machine room. Use powdered soapstone as a lubricant, if any is needed.

18. Wires are then rung out and connected, as described in chapter 10 -c6. This applies to dispatch panel and position-indicator wires as well as those for operating circuits.

19. Splices, if required (as for position indicators), are made at the outlet boxes. They should never be concealed in conduit. All splices must be made mechanically secure, then soldered and covered with a layer of rubber tape, equal to or greater in thickness than the original insulation. This is then protected by a layer of friction or electric tape. Friction tape should be coated with insulating varnish. Splices should never be handled in any other manner. (Patented sleeve splices must be taped and painted also.)


Typical Strain Box on Vertical Conduit Riser

20. When strain boxes are used, the spools and clamps are removed until all the hoistway riser wires are pulled. The spools and clamps are then reinstalled to take the strain on the wires before they are untied at the hoistway top and pulled through to the floor controller, controller, relay, and other equipment.

21. If two or more sizes of wires are to be included in a riser, be sure to include the proper reels when setting up to drag the wires and to be sure all different sizes are held secure in the strain boxes.

22. If cars are installed in a bank of two or more, some common conduit risers are often used. Be sure to pull in the correct number of wires for each car. In such cases landing button wiring for each riser is usually common, though the wires from duplicate risers of buttons are normally paralleled at the relay panel rather than at each floor.

CHAPTER 10
Section -c3

CONSTRUCTION WIRING

Hoistway Wiring – High Rise with Trough Risers

Suggested:

Materials –	Tools –
a. wiring materials	a. hand tool kit
b. PVC wire in cable form on reels	b. terminal crimpers
c. terminal eyes	c. adhesive numbers (wire markers)
d. friction, rubber & plastic electric tapes	d. wire strippers

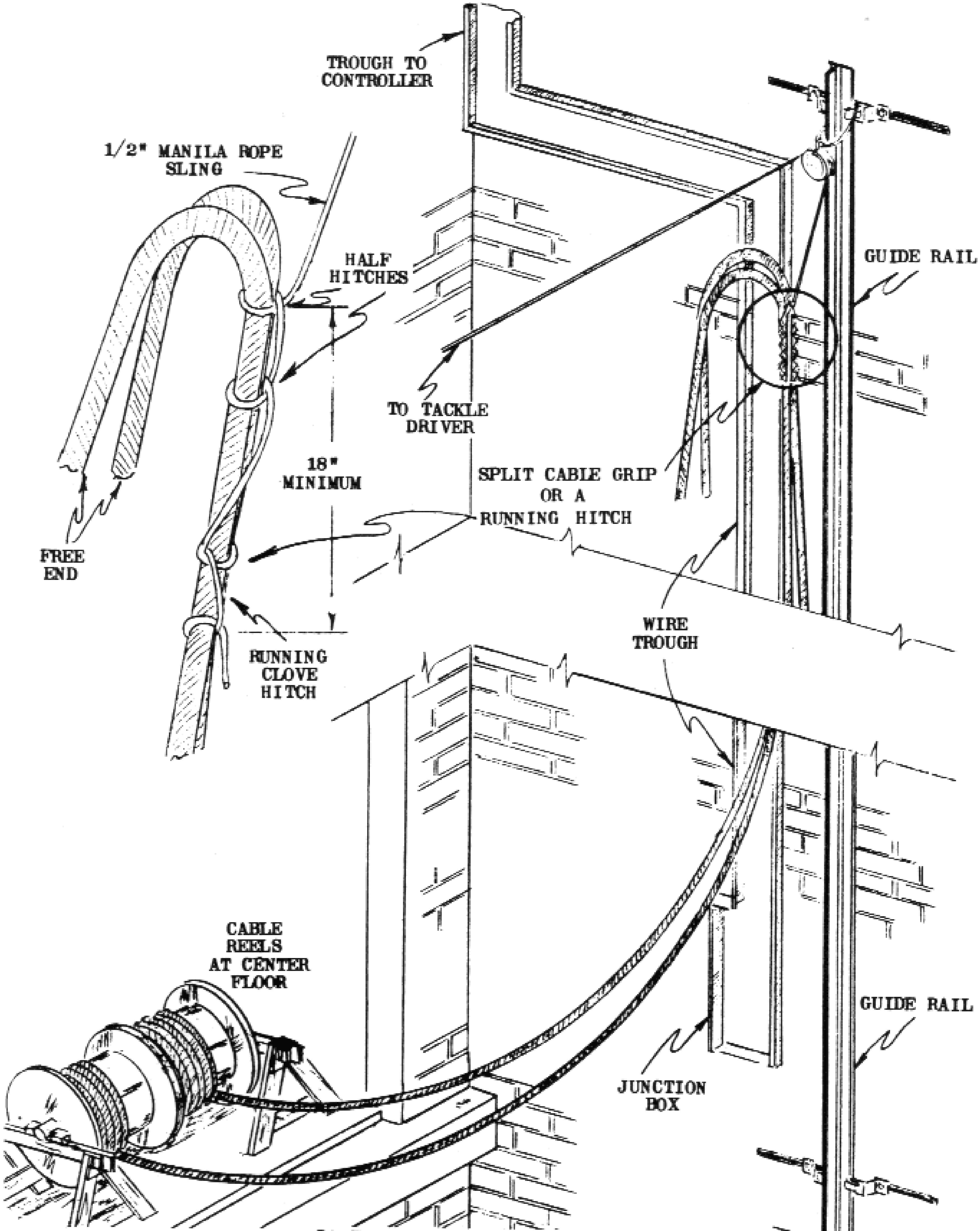
1. The PVC wire in cable form as referred to in the earlier part of this chapter is installed in vertical risers in several ways, depending mainly on the design of the ducts and on job conditions.

2. On high-rise installations where the hoistway junction box is at the center and the troughing covers are off for the entire length of the duct, installation of the cables is simple.

3. The reels of cable are set up at the bottom floor or the floor nearest to the junction box. An electric hoist or a single whip rope fall and an electric tackle driver are rigged at the top of the straight run. This may be in the machine room, secondary or at the top of the hoistway.

4. The distance from the top of the straight run to the terminal ends of the wire run is measured (that is, to the controller, selector or other equipment involved). This amount must be allowed on each cable for pulling through to the machine room.

5. An adhesive numbered marker is placed near the end of each cable. The cable is unreeled enough to allow for the ''pull through'' and the hoisting rig made fast. This can be done with a clove hitch and several half hitches, using a 3/8'' or 1/2'' manila rope. Sketch *1 illustrates this basic procedure. Split wire grips can also be used.



ROUTINE METHOD OF HOISTING
MULTI-WIRE PVC CABLES

Sketch #1

6. The cable is hoisted to the top at slow speed with the excess end hanging free. When the cable reaches the top, it is swung into the trough and secured to the top strain block. The cable is then allowed to lay into the trough down to the junction box, where it is marked with the same number as on the top end. An allowance is made for the length needed to connect wires to the center box terminals and the cable is cut.

7. Where several reels of cable and a power hoist of the right capacity are available, it is possible to use several cable grips or light rope slings and hoist all cables at the same time. This permits installation of the required strain blocks simultaneously for all cables, working down from the top.

8. After all cables are secured, numbered, and cut, the work of pulling the top ends through to the machine room equipment is performed. This can normally be accomplished by merely passing the cable ends along in the open trough. If concealed areas exist, it may be necessary to use a steel snake to pull the cables through.

9. Care must be taken not the tear the outer covering or insulation of conductors when laying the wire in the trough. This is especially true if ''snaking'' the cables is necessary. It is also important to use long hitches of the manila rope or to use patented or wooden clamps when rigging the cable for hoisting. Excessive pressure in small areas or sharp bends could damage the cables.

10. Where dispatcher's panels in the main lobby require the use of many wires (as they usually do), PVC cables are often used. The cables can be installed in the same manner described except that the reels would be set up at the landing nearest the dispatch or starter's panel and an allowance made at the bottom for pulling through to the panel and hooking up. Arrangement of the trough at the center box would determine what method to use when installing the cable.

11. Some mechanics prefer to take the reels to the top landing or even to the machine room and lower the cables to the center and bottom. This is a practical method also but on high rise jobs it will be necessary to rig a brake on each cable reel since the weight of the cable tends to make it run away when lowering it. There is the danger of losing a cable because of the ''runaway'' possibility but careful work can reduce this to a minimum.

CHAPTER 10
Section -c4

CONSTRUCTION WIRING

Hoistway Wiring – Low Rise

Suggested:

Materials –	Tools –
a. wire & sundries	a. hand tool kit
b. terminal eyes	b. terminal crimper
c. friction tape	c. wire skinners
	d. bell test set
	e. wire markers

1. The hoistway junction boxes of low rise installations are frequently mounted at the top of the hoistway or even in the machine (engine) room. Naturally, in such cases the length of wire required to extend from the machine room equipment to the junction box is short.

2. When conventional (or individual) wires are run between the machine room equipment and the junction box, limits, door locks and other hoistway equipment on low rise units, a steel snake or lengths of wire are dropped along the conduit runs to determine the lengths of wires needed. A tabulated list of these is made. (The sample tabulation attached and identified as Table 1 is a convenient chart form.)

3. Reels or spools of wire are set up on pipes which are set on horses or blocks where wires can be pulled out. Some white and colored wires are generally included. The lengths of the wires are marked on the floor in front of the reels.

4. An adhesive marker is placed on each wire end. The ends are then pulled out to their respective distance (or length marks) by the helper. The mechanic places corresponding marker numbers on the wires near the reels. (These numbers must be identical with the numbers previously placed on the far ends of each wire.) The wires are then cut at the reels and laid to one side.

5. A new set of wires is marked, tabulated, pulled out, marked at reel and cut. This process is repeated until all necessary wires are cut. About ten percent extra wires should be allowed for "spares."

6. Note that the limit, door lock, and hall button wires are considerably longer than those which go only to the junction box. Their numbers must be correctly marked on the chart and they are often handled separately from the others. Those wires which go from controller or selector to the junction box will all be the same length as the others in their group so the numbers need not be assigned to a circuit in advance.

MARKER NUMBER	WIRE NAME OR NUMBER	WIRE LENGTH (FEET)	FROM	TO	SPECIAL NOTES
1	PC	118	CONT.	BFL	-
2	PC1	90	BFL	TFL	-
3	PC2	40	TFL	CONT.	-
4	DC	105	CONT.	DC (1 FLOOR)	-
5	DC2	185	DC (1)	LOOP TO CONT.	-
6	1FS	100	1FS	CONT.	-
7	1FS1	100	1FS	CONT.	-
8	KS	38	CONT.	JB	-
9	6FS	38	CONT.	JB	-
10	1SOS	38	CONT.	JB	-
11	2SOS	38	CONT.	JB	-
12	DM	38	CONT.	JB	#14 WIRE
13	DM1	38	CONT.	JB	-
14	DM2	38	CONT.	JB	-
15	CC3	38	CONT.	JB	-
16	CC4	38	CONT.	JB	-
17	CC5	38	SEL.	JB	-
18	CC6	38	SEL.	JB	-
19	SPARE	38	SEL.	JB	-
20	SPARE	38	CONT.	JB	-

SYMBOLS

JB - HOISTWAY JUNCTION BOX
SEL. - SELECTOR
CONT. - CONTROLLER
DC - DOOR CONTACT
TFL - TOP FINAL LIMIT
BFL - BOTTOM FINAL LIMIT
LT - CAR LIGHT
BF - BUFFER SWITCH
CPI - COMMON, POSITION IND.
EAS - EMERGENCY ACCESS SWITCH
1PI - (2PI) - POSITION IND. FIRST FLOOR, ETC.
1FS - (2FS) - FIRST FLOOR SWITCH, ETC.

TABLE OF HOISTWAY WIRES

CONTRACT NO.
X111001

MECHANIC:
JACKSON JONES

DATE:
6-6-61

Table #1

7. Once all wires are marked and cut, they can be bundled. Starting at the controller (or reel) end, where all wires are more or less even, the wires are placed together and a piece of friction tape bound around them. This is done every few feet. It is important to keep the wires combed straight. Twisted groups of wires will not pull into a conduit easily and will fill the inside areas more completely than wires which are parallel. This can cause them to bind and necessitate their removal.

8. The longest wires in the group are fed into the conduit from the top. This is generally done at the controller. (If horizontal runs are in the system, it may be necessary to run a steel snake through first and pull the wires to the junction box.) One man is stationed at the junction box to pull the wire down while another man at the top carefully feeds the wires into the conduit.

9. As each piece of tape binding nears the conduit, it is removed. All wires are pulled out at the junction box, then the limit and other hoistway wires are pulled into their respective conduits and to their switches or contacts.

10. As noted in a previous paragraph, if the rise is such that it would be awkward to handle limit and hall-button wires with the junction box group, they can be handled separately by a "drag" wire, in a manner similar to that described for "high-rise" wiring. The longest group of wires is pulled to the bottom first, then the correct ones are snaked across to the limit, hall button, door contact, and other pit and lower landing equipment. The wires should be numbered before being pulled down by the drag wire.

11. Wires from the selector or relay panel to the junction box are handled in a manner similar to that described previously. Position-indicator wires might originate at the selector and would be handled much in the same way as the hall-button wires, that is, a different length would be cut for each floor and the longest would be pulled down first.

12. Hall buttons, door contacts and other parts have "commons" or wires that are common to all landings. These commons are the longest and may be white or colored. They are pulled out at the bottom, tied off, then pulled out and tied at each succeeding floor on the way up.

13. It is advisable to provide an extra copy of your chart of wires for the super. It will be useful for those men who adjust and service the elevator.

CHAPTER 10
Section -c5

CONSTRUCTION WIRING

Car Wiring – Handling Wires

Suggested:

Materials –
- a. wire
- b. eyelets
- c. sundries
- d. insulating varnish
- e. tape

Tools –
- a. hand tool kit
- b. terminal crimping tools
- c. wire strippers
- d. steel snake
- e. marker numbers

1. Car wiring can be done in a manner similar to that described as "Hoistway Wiring – Low Rise." Measurements can be taken from the car junction box to the various car fittings such as car operating panel, safety operated switch, door operator and other parts requiring wiring. The wires can be marked with adhesive markers, cut, tabulated and bundled, then pulled into the conduit.

2. Certain wires must be heavier gauge than others. The car-light wires must be *14 gauge (or heavier) or else enough smaller wires must be paralleled for each leg of the circuit so their cross section equals the cross section of a *14 wire. The ground side must be white and the switch should be in the other (generally black) side of the circuit. Door-operator motor and fan wires may have to be *14 gauge also. The conduit layout supplied by your company will detail this P.A. system wires may require shielded pairs. "Electronic" circuits sometimes must have wires with special insulation.

3. All these points must be determined before cutting the wires.

4. As a rule, car wires are pulled in one group at a time by means of a snake. Determine the number of wires, including spares, required. Snake one wire through the conduit from top to bottom. With this, determine the length required for all branches. Pull it out of the conduit, and cut all the wires on the floor.

Identifying Wires of Inductor Switch on Car Top

Arrange them smoothly in a bundle, taping them every two feet to keep them in place.

5. Some wires will be shorter than others. Make all ends even for the bottom junction box, leaving the uneven ends to go to the car top branches.

6. Attach the even ends to the "snake" and begin pulling from the car-top box to the side of the car, then to the bottom fitting. The snake is then pulled over to the junction box. The branch wires at top are snaked over to their individual fittings.

7. Shape and neatly cord all junction box stacks of wire. Keep the spare wires together and leave the ends long enough to use on any stud. They should not be concealed but should be kept visible at the front of any corded stacks in the boxes.

8. Wires in boxes and fixtures should be neatly arranged. Where, for any reason, terminal eyelets cannot be used, the wire should be formed into a twisted eye and then soldered if it is stranded. Solid wire normally is cut to length, formed into an eye and placed on the studs with washers on each side of the eye. Groups of wires are taped or bound and the taping varnished if it is friction tape.

CHAPTER 10
Section -c6

CONSTRUCTION WIRING

Ringing Out

Suggested:

Materials –
a. eyelet terminals

Tools –
a. hand tool kit
b. telephones
c. eyelet tools
d. skinners
e. ringout boards

1. Wire testing on elevators is done in several different manners in the various companies. These methods have the one common object, that is, to identify the wires so they can be connected properly. Any voltages from 220 down can be used for testing but low voltage is generally preferable. For six or even three volts, a dry battery and bell is employed. This article will describe methods using tools called "ringout boards."

2. When the wires have been pulled between the center junction box and the machine room, the wires should be connected to the center-box studs. Connect the top studs

Hall Button Wires are Identified by Testing to the "Ringout" Board

first and work down to bring the longer wires on top of the stack, making the box neater in appearance. The wires are automatically identified at the junction box by the terminal markings.

3. Some wires extend from the junction boxes to the controller. Others go the floor controller, relay panel, governor switch and other parts. Group these sets of wires as much as possible because such an arrangement facilitates both installation and servicing. Always include one wire to each major area for telephone circuits and mark the terminals or junction-block cards to identify these. Telephone wires can be one of the "spare" wires that should always be pulled into a conduit run, but it is preferable to pull in extra wire for the purpose.

4. To connect the telephone at the center, after the center junction-box is hooked up and all wires are identified (on the terminal stud cards in the junction box); connect one wire of the field telephone to a "TEL" stud. Connect the other line to one side of a battery. Ground the opposite side of the battery.

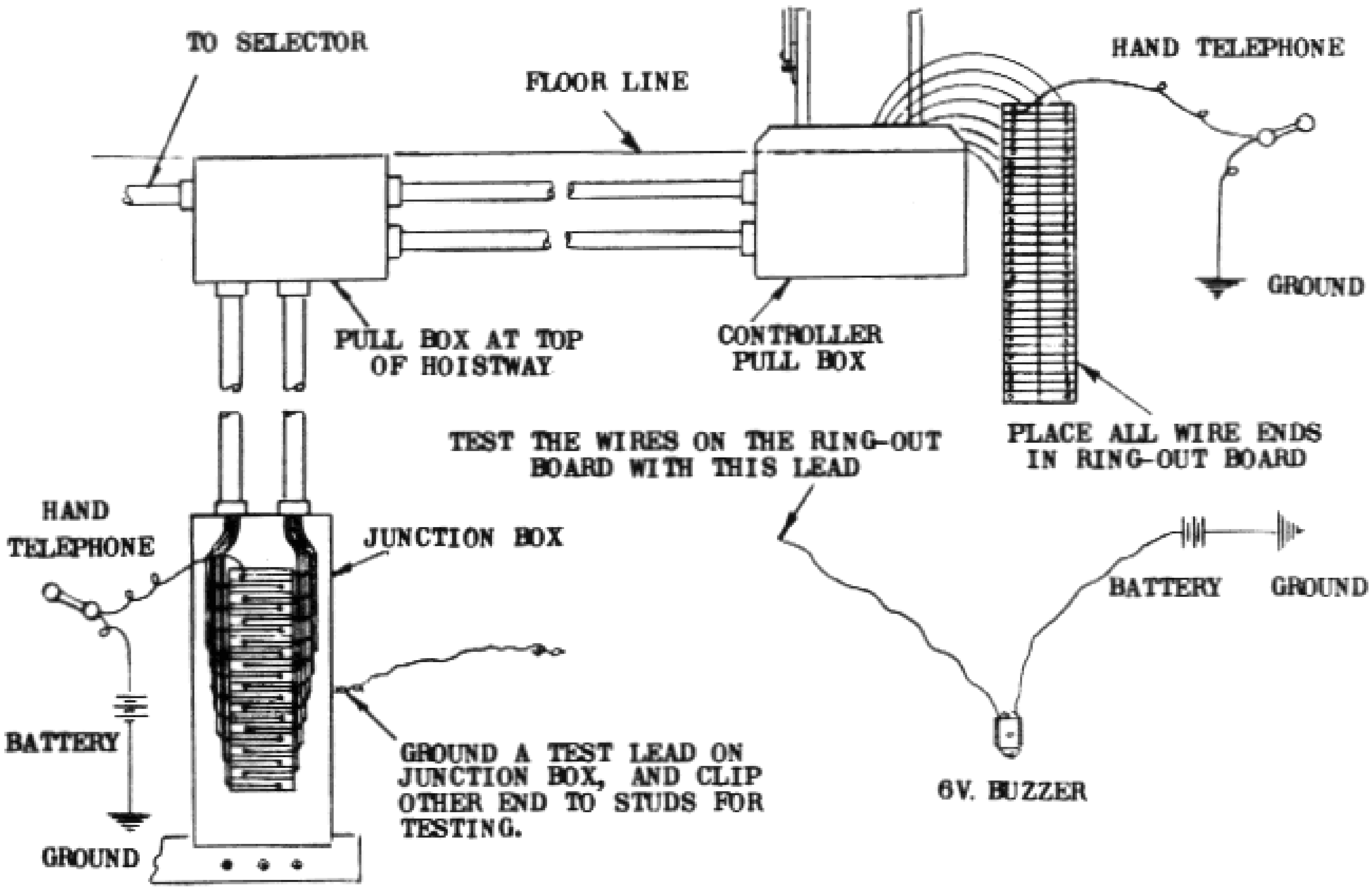
5. For the controller end, have the helper ground one side of another 'phone to the controller frame and identify the "TEL" wire at the controller by ringing it out. Then insert the ends of all of the other wires at the controller into the holes in the ringout boards. Skin about 2-1/2" of insulation from each end of the wires and bend the bare wire around the edge of the board, securing it by winding the bare end around the insulated part of wire itself.

6. When communication between the junction box and machine room is established and all wire ends placed in the ringout boards, the testing can be done.

7. It can be seen that the manner in which the exposed wire ends are arranged in the holes of the ringout board makes it simple to test each wire quickly.

8. There are two general methods of using the boards. The elementary one involves use of both telephones and a bell or light test rig. This is the method that will be described first. The common bell test consists of a 6 volt dry battery and a 3" house door-bell. Two flexible leads are attached and are about 6 feet long as a matter of convenience. The bell tester can be used at the controller end of the wires to be tested. This simplifies handling it since the mechanic may be working from a plank at the junction box.

9. The mechanic places one end of a clip lead on the top terminal of the junction box and clips the other end of the lead to a good ground. By telephone he instructs the



Sketch #1

helper at the controller to connect his bell tester and test the wires on the ringout board in order to locate the grounded wire.

10. The helper should connect one leg (wire) of the bell tester to a ground. The other wire is the working lead. The helper would touch it to each wire of the group at the controller ringout board until the bell rings. When this happens, the mechanic names the wire from the center box terminal marking, using the telephone to inform the helper what the wire is. The helper marks the wire name on the ringout board. The mechanic removes and replaces the grounded clip several times to test-check the wire.

11. The clip is then moved to the next adjacent wire at the hoistway junction box. The helper tests the wires at the controller until he finds the second one. It is then marked and the ground wire shifted again. This is repeated until all wires are rung out and marked.

12. After this is done, the helper moves to the selector and those wires are rung out and marked in the same manner as for the controller.

13. The advantage of this system is that constant telephone communication is maintained, whereas, if the phone itself were used for a testing set, there may be an unavoidable loss of time involved if a wire were ''lost.'' However, most experienced teams of wiremen completely eliminate the use of the bell tester. They use the telephone as a test device. After identifying each wire, the mechanic moves the field telephone clip to the next terminal in the junction box. The helper moves his telephone clip along the unidentified wire ends on the ringout board until he locates the grounded wire by the ''clicking'' noise. If identification is not made within a reasonable time, both men place their clips on the previously identified wire and recheck. The system works well and is generally favored above the ''bell-tester'' method.

14. When the wires from the center junction box to the machine room have been rung out, the controller to floor controller, relay panel, and other wires are tested. Cross connections between elevators can then be rung out and marked.

15. After all wires are identified, they can be connected to their terminals. Hooking up or connecting wires is begun near the conduit outlet, or on the floor controller, at lowest floor bar. This will bring the longer wires to the front and insure a neatly finished appearance.

16. All stacks of wire are bound with white cotton cord or lacing twine, and any friction tape bindings are painted with air drying varnish.

17. As noted in 10 - b4, spare wires are grouped and their ends taped together. They are then tagged ''spares'' and neatly corded into the wire stacks, but left easily visible and accessible.

CHAPTER 10
Section -d1

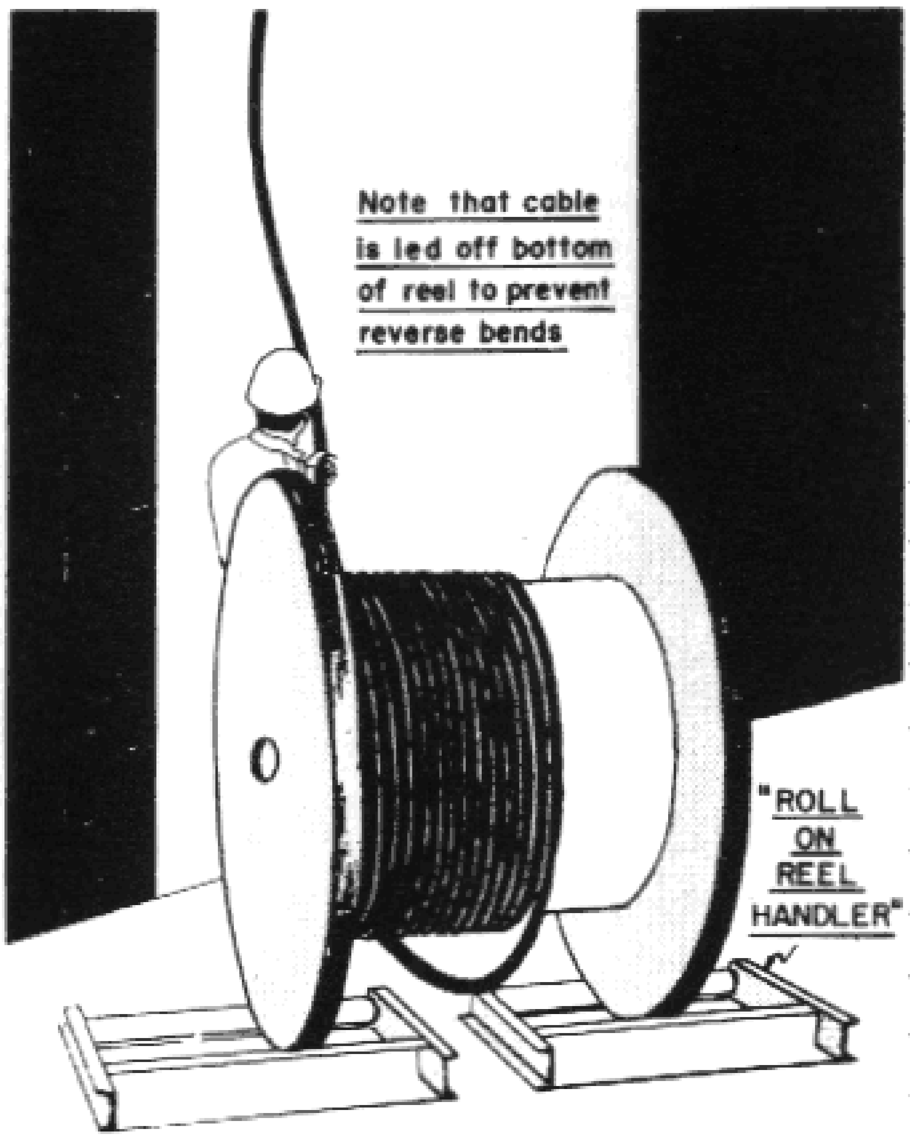
CONSTRUCTION WIRING

Hoistway Wiring – Traveling Cables

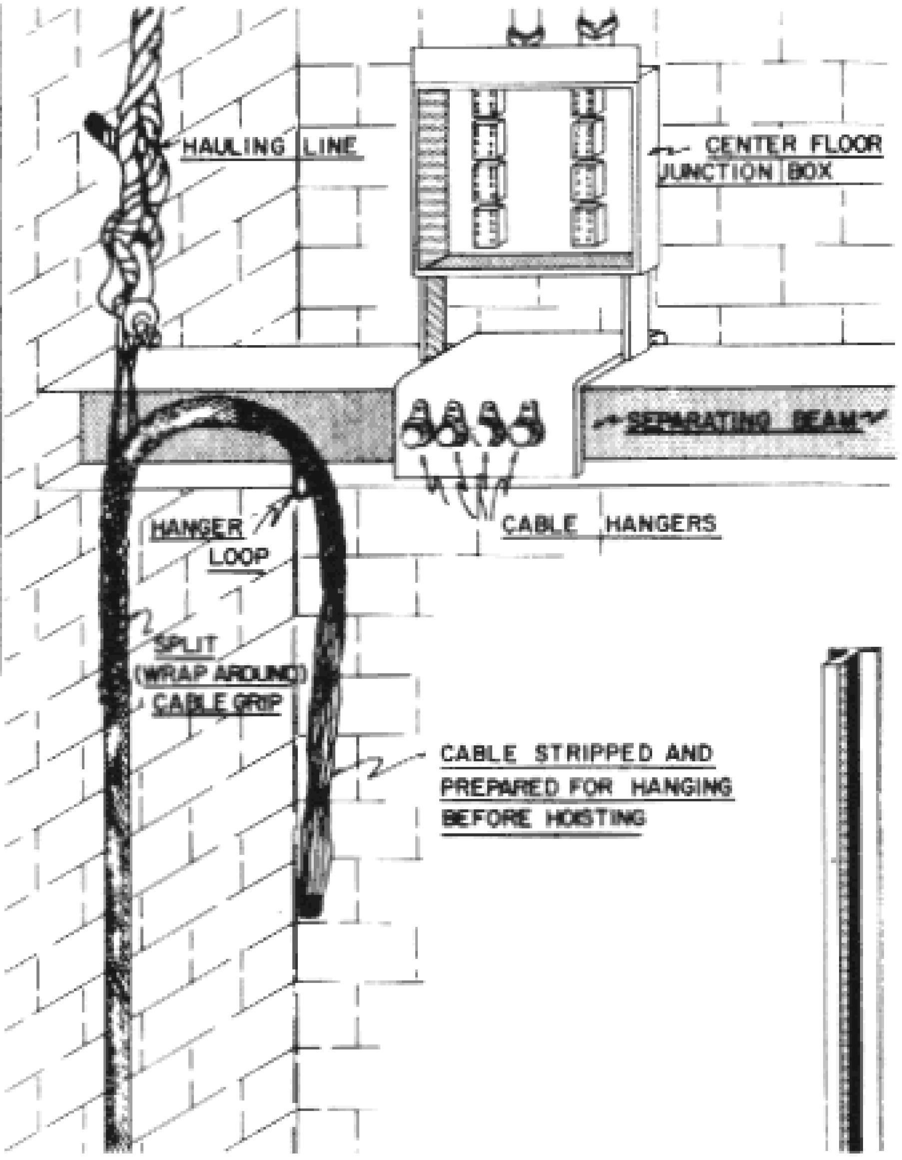
Suggested:

Materials –	Tools –
a. cables	a. hand tool kit
b. eyelets	b. pliers, terminal crimping
c. sundries	c. block & fall or power hoist

1. There are two common ways in which traveling cables are shipped to the field. Like hoist ropes, they are sent either in coils or on reels



Sketch #1



Sketch #2

2. The coils are generally cut to length, i.e., if the specifier calculates that the elevator will need 2 - 20 wire cables and 1 - 16 wire cable, each 118 feet long, the man in the field will receive three coils exactly as specified.

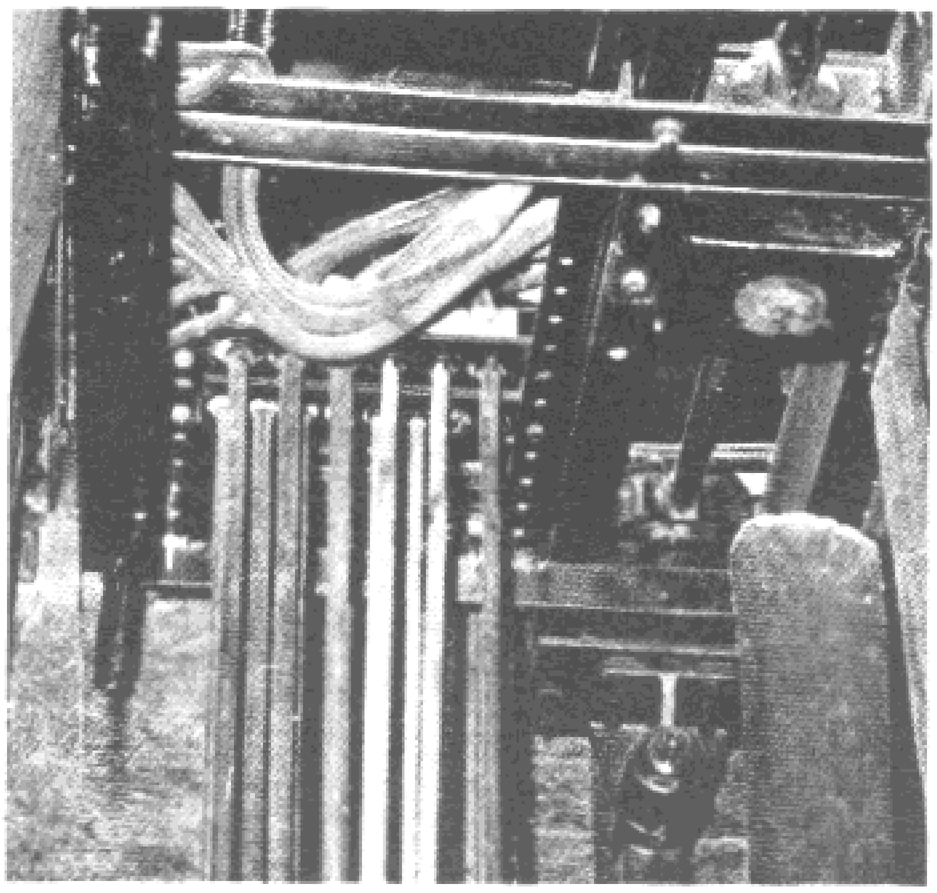
3. Where a high-rise installation requires long, heavy cables or where the material may be subject to damage because of transportation or job conditions, the elevator superintendent may direct that the cables be shipped on reels. This would protect the cables and facilitate handling. Long distance shipments might impose high transportation costs or induce chance of loss, if coils or several small reels were sent. Therefore, the "super" might have all cables shipped on one large reel. The size of the reel must be held to a practical limit as determined by handling facilities and space conditions.

4. It can be clearly understood that there are various methods of installing cables. However, there are several basic rules to follow in any method and to some extent they parallel those for installing wire ropes. See sketches #1 and #2.

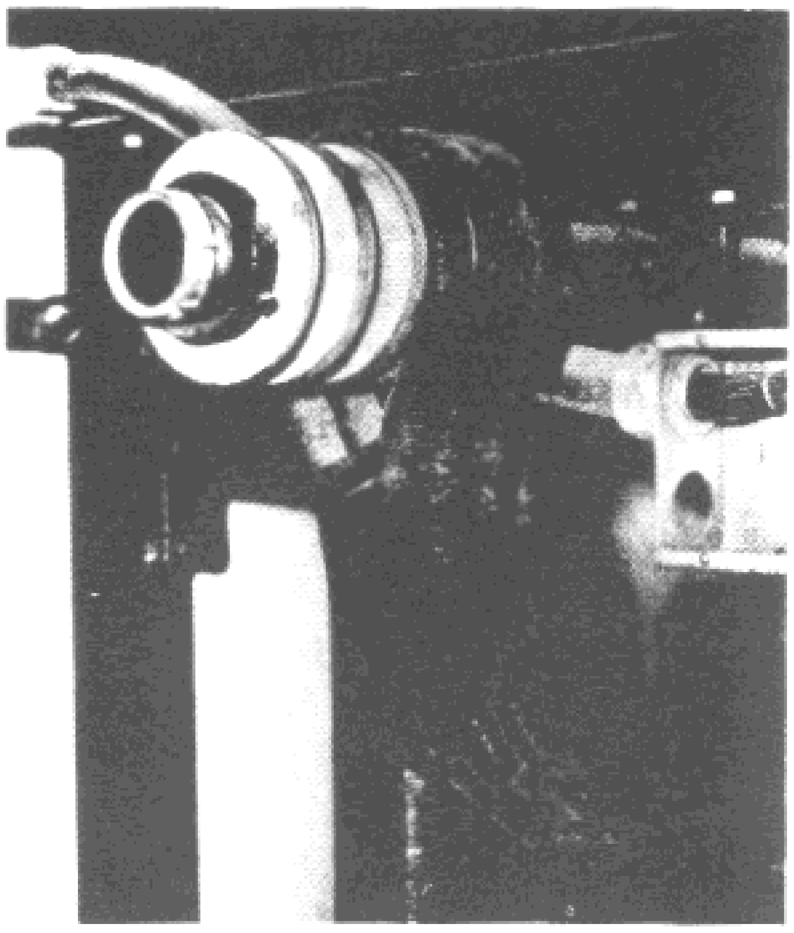
5. Traveling cables must be unrolled, whether on a reel or in a coil. They should never be pulled off the side of a reel or coil. They must not be twisted during installation. All cables with steel centers (or hang wires) should be suspended by these

COLOR SCHEME FOR TRAVELING CABLES						
30 CONDUCTOR			*Contract No.*			
BASE	TRACER					
RED	-					
BLUE	-					
ORANGE	-					
GREEN	-					
BROWN	-					
BLACK	-					
PURPLE	-					
WHITE	-					
RED	BLUE					
RED	ORANGE					
RED	GREEN					
RED	BROWN					
RED	BLACK					
RED	PURPLE					
RED	WHITE					
BLUE	ORANGE					
BLUE	GREEN					
BLUE	WHITE					
ORANGE	GREEN					
ORANGE	BROWN					
ORANGE	BLACK					
ORANGE	PURPLE					
ORANGE	WHITE					
GREEN	BROWN					
GREEN	BLACK					
GREEN	PURPLE					
GREEN	WHITE					
BROWN	WHITE					
BLACK	WHITE					
PURPLE	WHITE					

This Sheet Illustrates a Tabulated Identification of Traveling Cable Wires



Traveling Cable Suspended From its Steel Hang Wire

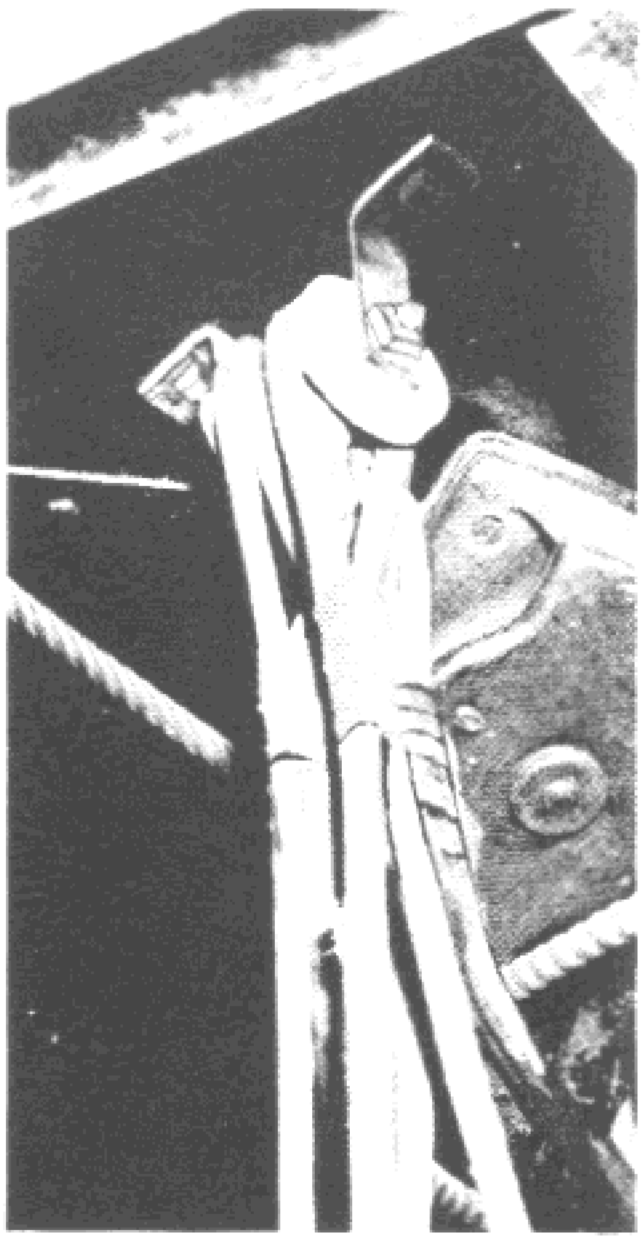


Pipe and Wood Spool Hanger

support wires. Small cables without steel centers are to be looped over their supports and not hung in clamps. (N.E. Code, Article 620-41) Terminals used on traveling cable conductor wires should have a clamping arrangement to prevent the cotton braid from fraying. It is good practice on normal jobs to hang the traveling cable from the hoistway junction box as soon as possible and tie the bottom ends at a floor above the pit. This will allow the cables to stretch and assume their normal position. This is most important where the rise is high or the cables are heavy.

6. On small jobs the coils of cable can be unrolled on a floor near the hoistway junction box and the hanger arrangement made up. The top cable end can be hung from its bracket and the other end lowered to the pit. This bottom end can then be coiled or brought up several floors and tied to a beam or rail bracket.

7. Traveling cables are specified with the construction wiring material. The mechanic is responsible only for installing the right cable in the right place and in an approved manner. Color coding is standard on traveling cable conductors and, therefore, the wires are self-identifying. They do not require



Porcelain Spool Hanger on Bolt

ringing out. However, mechanics must list the wires by color and tabulate the name of the wire on which each color is placed. The table shown on the preceding page is a useful one for identifying wires.

8. Car light circuits can be routed in either one pair of #14 or two pairs of paralleled #16 traveling cable wires or enough #18 wires to equal the cross section areas of the #14 gauge. Door motor wires may also have to be paralleled.

9. Terminal eyelets or their equivalent must be used on all traveling-cable wires. The cables must not be hooked up until all hoistway riser wiring is completed and rung out. Begin wiring at the bottom or at the stud nearest the cable entrance to the junction box. This will bring the long wires on the top of the stack and result in a neat appearance. Stacks of wire should be corded with white cotton cord. Spare wires can be corded into the stack and marked to indicate that they are spares. The spares should be placed at the front in an accessible and visible position in the stack.

10. Where reels are used on high rise jobs the mechanic has a choice of hoisting the reels to the junction box level or hauling the cable ends up the hoistway.

11. If the reels are taken up, they are set at the floor nearest the junction box on horses, jacks or some similar device. The end of the cable is lowered to the pit and brought up and tied off at the position chosen for this. Care must be used to avoid "twisting" the loop. The top end is marked and cut to allow enough length of wire in the conductors so that connections can be made to any stud in the junction box. (Heavy cables must be secured before being cut. Light weight cables can be held.) The cable jacket is stripped back and the hanger prepared in accordance with standard practice of the elevator contractor. The cable is then carefully placed in its permanent position. Here again the car must be used to avoid inducing kinks or twists in the cable.

12. When the cable ends are hoisted, the reels are set up near the entrance where they were unloaded or stored. The cable ends are made up and the cables hoisted one at a time or in a group, in accordance with the hoisting equipment available. The ends are unreeled and tied up in the normal manner.

13. When the car is ready for the traveling cables to be installed, hang cables under the car with the car at the lowest terminal landing. Set the hanger so that the cables are clear of the platform edge. Arrange it to swing the cables away from the platform, so that the cables will not rub against the platform as the car approaches the lower floors at high speed. The loop should be about 30 times the cable diameter on conventional cables.

14. Hang the cables so they clear the pit by at least one foot. Even more clearance is desirable, if there is any possibility of water laying on the pit floor. It is important, however, that the cables be left long enough so they will not break, if the car goes to the pit and compresses its buffer(s). It is important to check this last point carefully. Where convenient, as on a low rise AC job, the helper can run the car to the pit and compress the buffer while the mechanic stands clear in the pit. The mechanic can establish the length visually when the buffer is compressed. This can also

be done on other jobs if a phone is connected so the mechanic and helper can communicate. Experienced mechanics do this work by calculating the amount of loop required rather than running the car down, but the first method serves better to illustrate the problem to a new man.

15. On spring buffer installations #14 or #16 wire should be interlaced in the spring coils, if the traveling cables are near the buffers. This will prevent the cables from hooking up in the spring.

16. It is interesting to note that traveling cable design and manufacturing in the code areas is far ahead of overseas. Elevator companies in many countries are still restricted to the use of 6 and 10 wire cables. Few have steel hang wires. Insulation, color coding and outer covers are poor, some being highly inflammable. England, Japan and several other countries have been manufacturing higher standard cables for some time, however, and are making 30 conductor cables at present.

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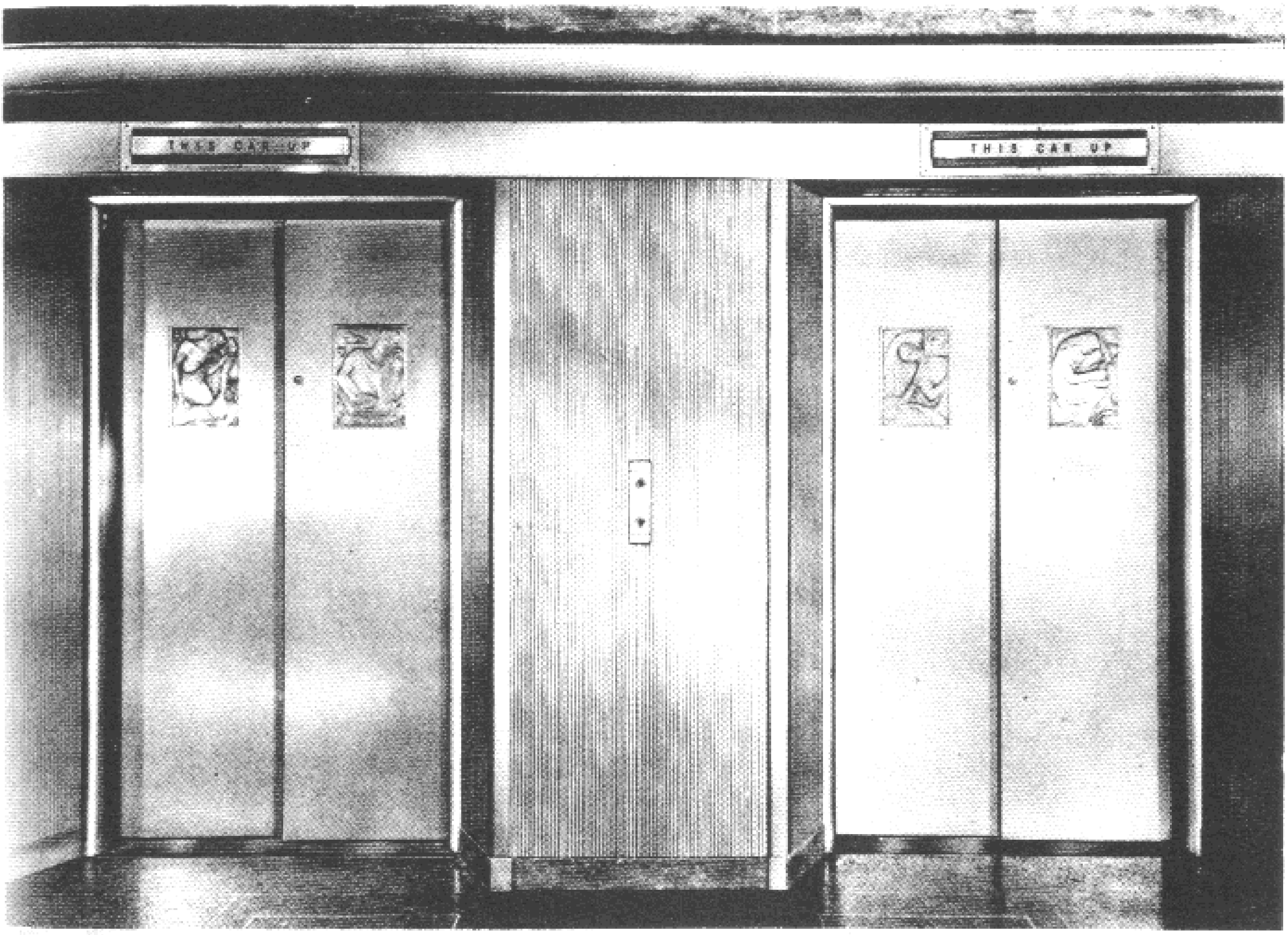
DOORS AND OPERATORS

CHAPTER 11
Section -a1

DOORS AND OPERATORS

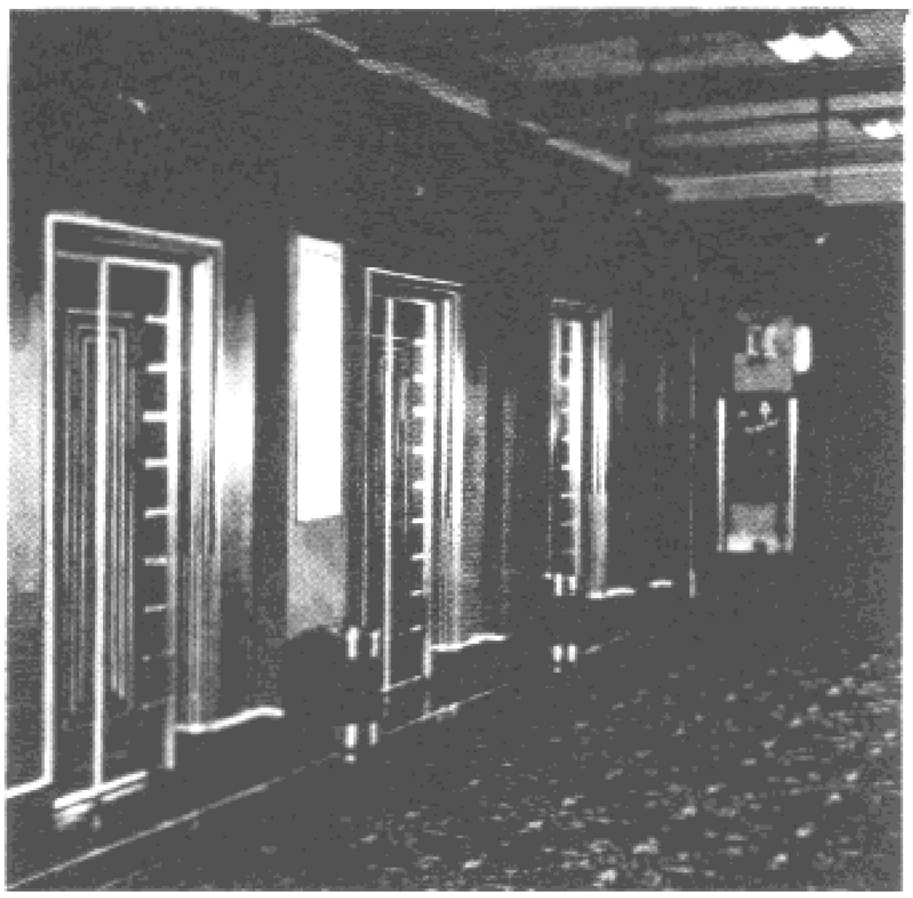
General



An Attractive Main Elevator Entrance

1. Modern elevator doors have developed to their present state from very crude beginnings. Early hoistways were without protection, but of course elevator speeds were low. Despite this accidents occurred so protection was provided in the form of railings. The evolution from these rails to the current steel entrances and totally enclosed hoistways is the history of steady progress in the improvements of design and material.

2. The text of Section 110 of the 1960 edition of the A.S.M.E. Safety Code for Elevators begins with the broad statement that "All elevator and dumbwaiter hoistway landing openings shall be provided with hoistway doors which shall guard the full height and width of the openings." Some twenty-five pages of specific door equipment requirements follow this opening sentence. Further details that apply to particular elevator types appear in other sections.



Entrances for a Three Car Installation

3. This broad coverage indicates the considerable importance to safe elevator operation that is attributed to door equipment by the Code Committee.

4. The present code recognizes various types of doors and their equipment as satisfactory for passenger and freight elevators but in general restricts hoistway doors for power elevators to those that fully close landing openings and which are manufactured entirely of fire resistant metal or of wood framing with metal covering. Vision panels can be included, where required, but these must meet code specifications.

5. Steel entrance frames and sliding, steel panel doors equipped with electro-mechanical interlocks and power door operators are considered standard on today's high-speed elevator equipment. The "center-opening" arrangement is favored by many designers as being the most efficient type for this work.

6. Sliding steel entrance panels with manual operation are not uncommon on medium and slow-speed elevators but generally are outmoded by power operated doors. Most state codes require electro-mechanical interlocks on the manual doors also. In fact, in such codes, interlocks are required for all types of elevator doors on power elevators.

7. "Self-service" and personal service elevators are often equipped with swing hoistway doors. These may be of metal or wood. They are closed by either floor type "checks" (similar to the Rixon), by surface types that mount on the header and the door, or by closers concealed in the door or header. The safety code requires that some type of closer by used. In most areas these doors require interlocks also.

8. Freight elevator entrances are variously equipped. The type of door installed is largely dependent on local or state codes. For heavy duty equipment, fireproof doors of the vertical "bi-parting" type are commonly used. This door permits wider entrances for a given hoistway size than is possible with sliding doors. However, where entrance width is not too important, sliding panel doors are often used on freight installation. Combination sliding and swing doors are used occasionally but are not highly favored.

9. Gates of wire mesh on steel frames or of wood are installed in some instances (if the code permits). As a rule, they are one, two or three panels, which are raised vertically in steel tracks. They are counter-weighted. They are far more common overseas than in A.S.M.E. code areas. Collapsing gates are also used to protect landing entrances in some countries.

10. All of the above types of freight entrance doors may be power or manually operated. As a rule the smaller sizes of all are manual and the larger doors, especially the bi-parting types, are power operated. Vertical gates can be power operated also. "Sliding" (or collapsing) gates could be powered to open part way, but this is not usual for hoistway gates.

11. The code prohibits the use of a rigid or overlapping astragal on the meeting edges of counter balanced vertical bi-parting entrance doors. It requires that the lower edge of the upper panel be equipped with a non-crushing, fire-resistive member to provide a spacing of not less than 3/4'' between upper and lower panels when the door is closed. Leading edges of horizontally sliding doors can have a shallow overlap of resilient, fire resistant material.

12. Design of car gates and doors has kept pace with the entrances. It passed through the stages of development from no protection to wood gates, then to wire mesh, and on to the present equipment. This ranges from solid panels on higher quality installations to metallic pantographic gates on medium and low-speed elevators. Wood or metal gates, either pantographic or vertical lifting, are used on most freight elevators, although there are some areas that do not, as yet, require such devices on elevators. Most, however, not only require the gates but also insist on electric gate contacts. Power operation is used where the hoistway entrances are so powered. Sometimes car doors or gates are powered where the entrance landings are not. This is often true, when the landings are equipped with swing doors.

13. The work of installing doors and operators may be said to be divided into two parts, hoistway landings and car doors. When power operation is supplied, the unit is usually on the car and opens the landing door by means of a cam and levers. The arrangement may include a cam on the car door which picks up rollers and crank arms on the landing door. It may also consist of a cam on the car that motivates a sill trip on the landing which in turn drives the hoistway door through levers and crank arms. There are exceptions to this, of course, such as a Westinghouse passenger elevator landing door operator and the freight elevator landing door operators made by Otis and others. These two types have power units mounted at each landing.

14. The equipment of slide type passenger hoistway landing entrances consists of metal sills on which struts are mounted. These struts support "headers." In turn, the headers support the door hanger rails on which the hoistway entrance door panels are hung. The entrance frames are mounted directly on the sills also and are generally secured to the headers. Often door closer and interlock mechanism is mounted on the sills and struts too. However, on many the interlock is set on the header and the latch is on a door panel.

15. Swing doors for landings are also based on metal sills in this country. The flush type closing check hinges can be installed in the sills. Inter-locks are mounted in the frames or on the strike jambs.

16. Equipment for car doors is also set on a sill, generally made of aluminum, bronze or steel. Car door rails are mounted on the car cab or on a frame that is set on struts that base on the car entrance sill. These rails provide tracks for the hangers that support the door panels. Power operators, when used, are mounted on the car framing or car enclosure parts and, through various types of mechanical devices, operate the hoistway and/or the car doors, through circuits on a door controller panel. This door controller panel is generally a part of the main controller on passenger elevators but may be a separate unit for freight installations.

17. Most companies in the United States and Canada provide manual and power operated door equipment. Since it all conforms to the code requirements, it is generally well designed and manufactured. Since many mechanics in the International Union of Elevator Constructors transfer from one company to another as their work peaks change, we tend to accept code standards as the only existing kind of elevator equipment.

18. This is not true of course, since overseas companies originate and design many items suited to other conditions than those we encounter. In door work our code is one of the most stringent. This has permitted foreign competition to relax designs to the point where doors are made of wood. Collapsing hoistway gates are common in prominent buildings and interlocks are replaced with old type latches, or barlocks and simple contacts. One rather interesting compromise is the English Potter Rax "door." This product combines the features of a folding gate with some advantages of the panel door. Sheet steel is bent into vertical angles that are fastened to bars like those of folding gates. The Potter Rax is installed like a folding gate. The closed appearance is similar to a full panel door. As the "door" opens, the sheet steel angles telescope over each other and the resultant clear opening approximates that of a folding gate for any given opening.

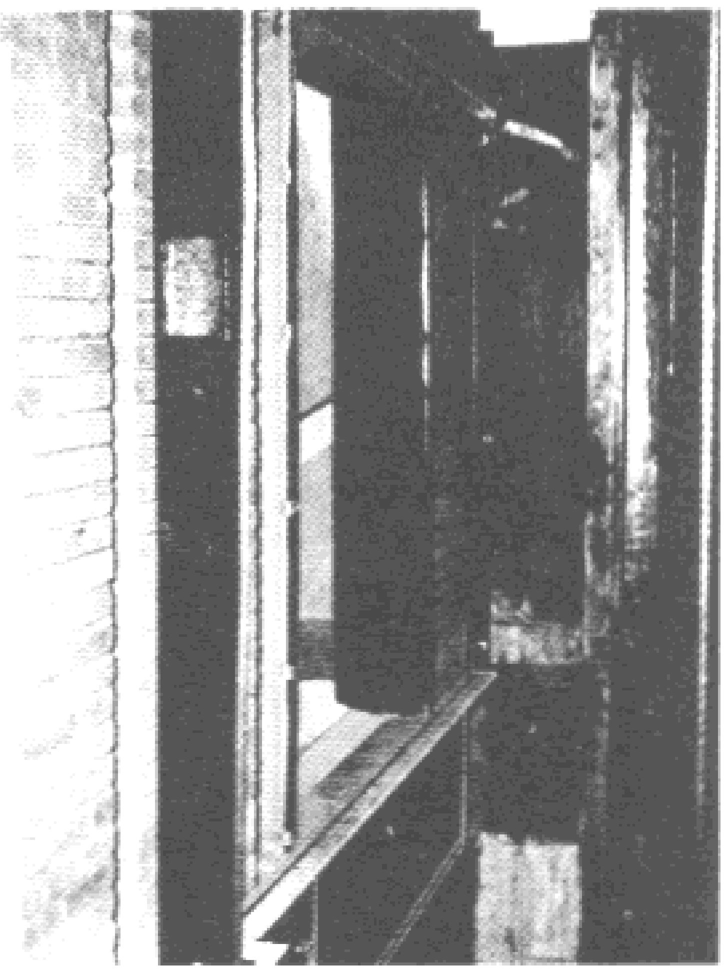
19. Naturally this foreign equipment cannot be installed in the United States but it does affect the sales of U.S. and Canadian equipment abroad.

CHAPTER 11
Section -b1

DOORS AND OPERATORS

Hoistway Entrance Sills — General

1. There are some localities where groups of elevator mechanics are trained as "door men" to install the elevator doors. This is not a normal procedure in most areas but is resorted to where volume of door work is high as related to time available for installation. Subcontractors handle the work in other cases. A new mechanic may not appreciate the fact that the location of the door sills in relation to the main guide rails is very important. This is true of all elevator entrances but is particularly true where doors are opened and closed by power operators. Obviously since hoistway door work is invariably included in the elevator contract, the elevator contractor and mechanic are obligated to be certain that door work is properly done. If it is not, a good elevator cannot be "turned over" to the purchaser.

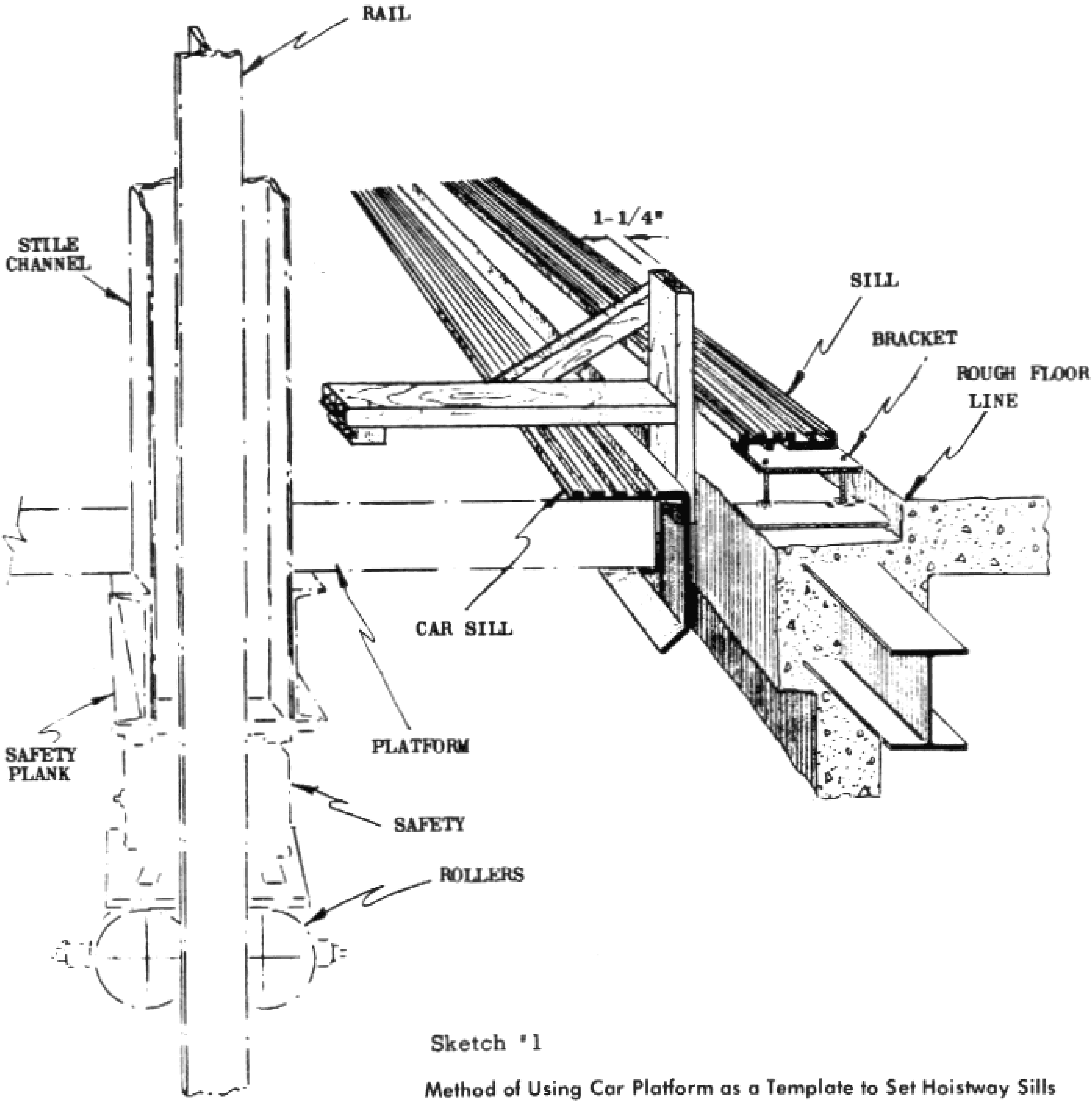


General Arrangement of Center Opening, Sliding Doors Seen From the Hoistway

2. Some form of template should be used to set all door sills to the guide rails. This template may take the conventional form described in the next section of this chapter or may be special to the elevator contractor's methods. If the elevator car is operative, the car platform itself can be used as a template by adding two wood blocks at the extremes of the car sill. For example, if the layout shows that a 1-1/4" space is required between the car and hoistway sills, the mechanic can make two "L" shaped brackets of wood. These would then be tacked onto the rough car platform floor in a position so that the vertical legs would extend 1-1/4" in front of the car sill line (see sketch *1). The center of door opening would be marked on the car sill and on each hoistway sill. The car would be moved from floor to floor and act as a working platform as well as a template. At each floor the car platform would be set level with the floor height indicated by the bench mark. The hoistway sill would be set on its brackets, placed lightly against the wood blocks, leveled, aligned with the center marks and then secured.

3. When this method is followed and the elevator is equipped with roller guides, it is customary to eliminate the play during sill installation. This can be done on some cars by setting up the rollers but on others wedges must be placed in the guide slots to remove the play. Naturally, the guide rails must be aligned before the car platform can be used as a sill template.

4. Occasionally it is necessary to depart from the standard routine of setting hoistway sills, after guide rails are installed and aligned. This may come about because an elevator was contracted for after building construction was advanced. The general contractor, architect or owner may insist that entrances be installed early in order to permit completion of building interior. In such instances, when it is necessary to set floor sills first, the top and bottom sills should be set. Lines would then be extended between these two and the balance of the sills set to the lines. The rails are located from the sills at a later time.



Sketch #1

Method of Using Car Platform as a Template to Set Hoistway Sills

5. When setting hoistway entrance sills the elevator mechanic should assure himself of four points. He should:

a. Align sills with main guide rails.

b. Level them lengthwise and front-to-back.

c. Set them at the correct heights above the rough floor, confirming these points with the building superintendent.

d. Fasten sills, so that pouring concrete grout will not disturb their alignment.

CHAPTER 11
Section -b2

DOORS AND OPERATORS

Hoistway Entrance Sills — Templates

Suggested:

Materials –	Tools –
a. 3/4'' x 4'' clear straight boards	a. hand tool kit
b. nails	b. crosscut saw
c. #9 x 1-1/4'' wood screws	c. square
	d. chalk line

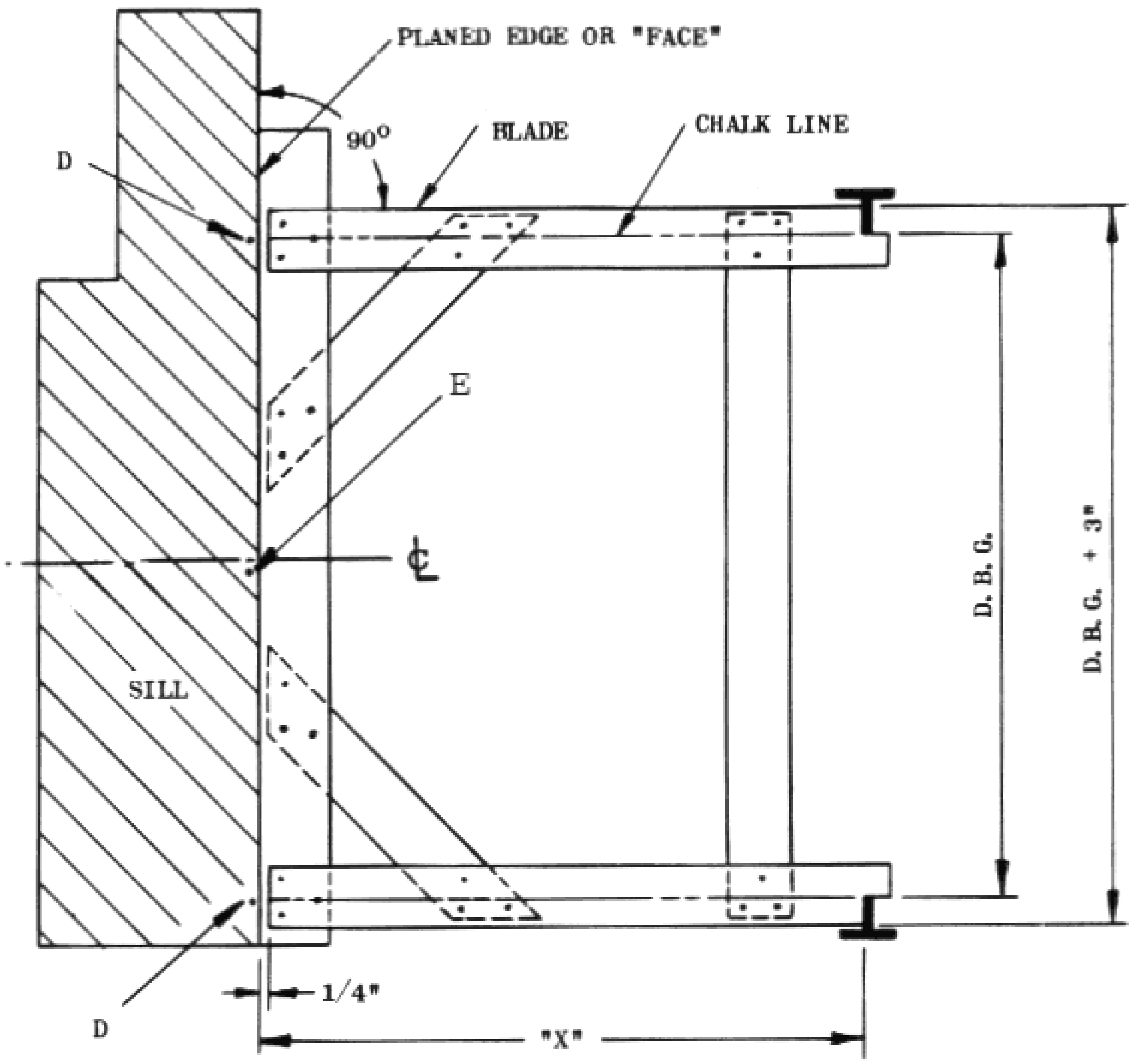
1. Door sill templates can be built in the following manner. First obtain wood that is straight, clear and not heavy. Clear white pine of 3/4'' x 4'' is suitable lumber and can be obtained in most localities. It is easy to work with and is not too heavy. This wood is suggested merely because it is easily handled and is generally obtainable. Any other wood can be used provided it is stiff enough to make the template rigid.

2. Begin the work by cutting a piece of wood approximately the length of the sills. Chalk mark one long edge, and plane that edge absolutely true. This smoothed edge will be the ''face'' of the template (i.e., the part that the sills are set against).

3. Saw two more pieces of lumber, making them about two inches longer than the distance from the main guide rail centers to the hoistway entrance sill. As an example, if the final layout indicated 2' 6-1/2'' between the main rail center and the edge of the car sill, plus 1-1/4'' between the car and the hoistway sill, you would cut the boards 2' 6-1/2'; plus 1-1/4'' plus 2'', or 2' 9-3/4'' long. The ''legs'' or ''blades'' of the template will be formed by these boards.

4. Chalk line these boards lengthwise along their centers. Lay the boards on the ''face'' board as illustrated in the sketch. Space the two chalk lines at the exact ''DBG'' indicated on the final layouts. Make them square with the planned edge of the ''face,'' and keep their ends about 1/4'' inside the edge of the face.

5. Fasten the boards in place, temporarily with nails. Brace the corners. Adjust the template to make the chalk lines square to the face, and screw fasten all the lap joints. Square check it, after all joints are tight. If necessary, re-align it.



a - FOR 8# & 15# GUIDE RAILS "X" EQUALS DISTANCE FROM CENTER OF GUIDE RAIL TO SILL LESS 5/16".

b - SQUARE AND SCREW FASTEN ALL LAP JOINTS TO TEMPLATE.

c - CENTER PUNCH THE SILLS LIGHTLY AT "D". THESE POINTS WILL SERVE FOR FUTURE ASSEMBLY REFERENCE.

Template Used to Set Entrance Sills

6. Mark "X" distance on the two blades, measuring from the face. Cut notches in the blades to fit over the rails. Make these notches 90° from the chalk line as the sketch indicates.

7. Establish the location of the center of the door opening from the dimensions given on the layout or door detail drawing. Mark this on the template, as at "E" in the sketch. This point will serve to locate the sills in a postwise position when the template is used.

8. Paint the contract number of the elevator on the template. This is very important on large installations where the elevators are not identical.

CHAPTER 11
Section -b3

DOORS AND OPERATORS

Hoistway Entrance Sills – Installation

Suggested:

Materials –
- a. sills
- b. sill support brackets
- c. packing
- d. bolts and concrete mix
- e. masonry anchors (if concrete beams)

Tools –
- a. template
- b. hand tool kit
- c. level
- d. electric drill and drills
- e. skip (temporary elevator) or scaffold
- f. electric hammer (for concrete structures)

1. The installation of door sills requires careful work. It is necessary to obtain the finished "floor line" location at each landing from the building superintendent, before beginning work. Once a sill is set and grouted in, it is a very difficult and expensive matter to change its location.

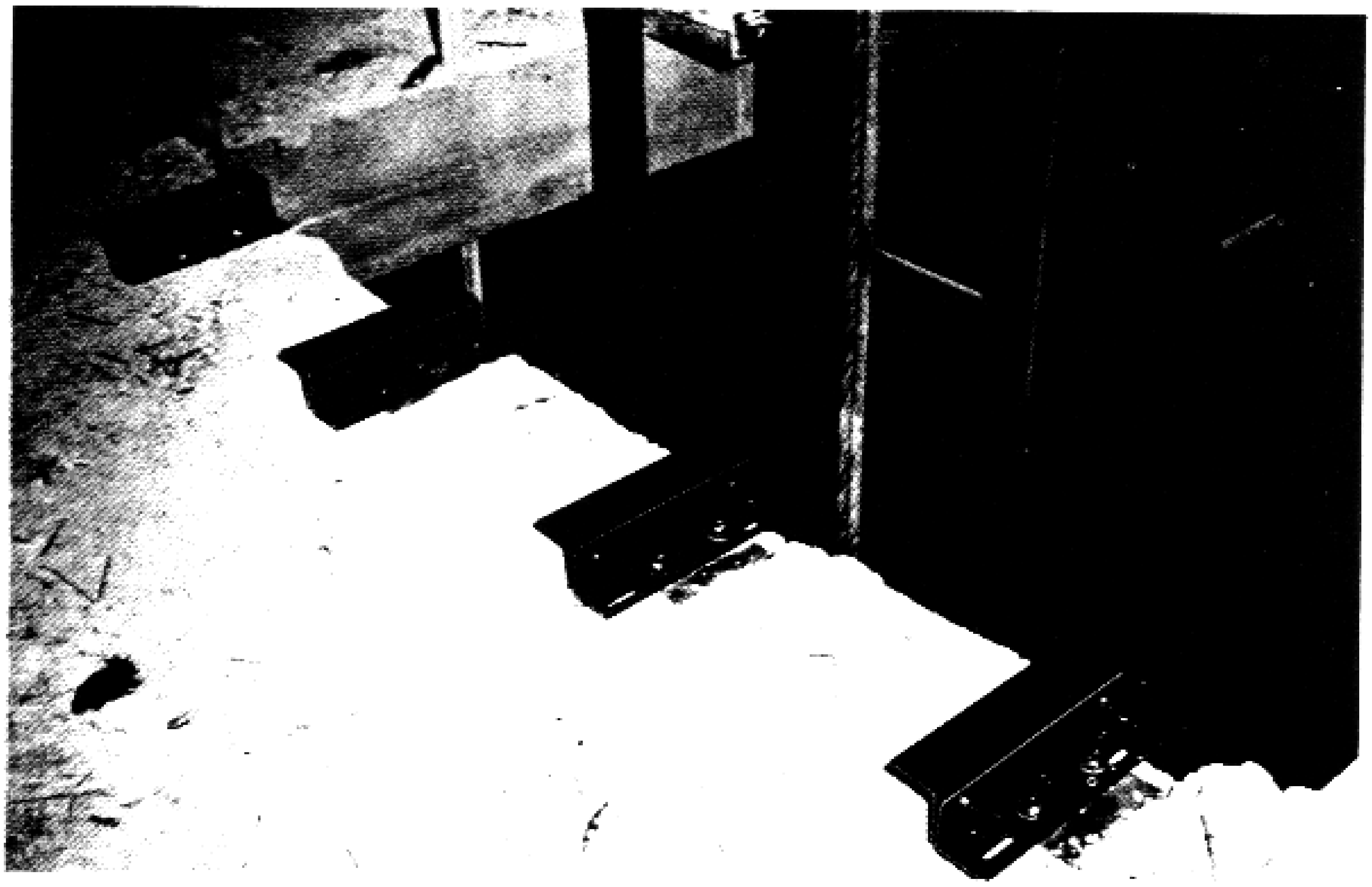
2. Many builders mark all rough corridor walls one yard above the finished floor lines. These lines are called "bench marks." It is not wise to start installation of entrance sills until you have confirmed the location of these marks with the construction engineer or "super."

3. Many times in steel structures it is necessary to run lines between building columns, and then extend a level line across the front of the hoistway at each landing. In this way the finished floor location is established. On masonry structures you will generally find that the builder has marked the guide line on the wall at each landing.

4. It is suggested that the floor level lines be established at as many landings as possible before beginning work on the sills.

5. For door work (as for most other mechanical jobs), it simplifies the job to lay all necessary tools out on the "false" car, platform or scaffold and keep them in order.

6. It is general practice at present to set hoistway entrance sills on some form of sill support bracket. These may be termed, "Z" brackets, "clip" brackets or may have a name peculiar to its individual design. The brackets are secured to steel beams by welding or bolting. They are fastened to concrete beams by masonry anchors or grouting. In all cases they are set to align with the holes in the sill which fasten the two parts together. They are set with their tops about level. Some arrangements allow for a small amount of packing between the bracket top and sill



Angle or "Z" Brackets are Secured to Steel or Concrete Beams

bottom. The practice of the elevator contractor doing the work should be followed. (Obviously it is often necessary to shim under brackets to get their tops level when installing them on rough concrete beams or floors.)

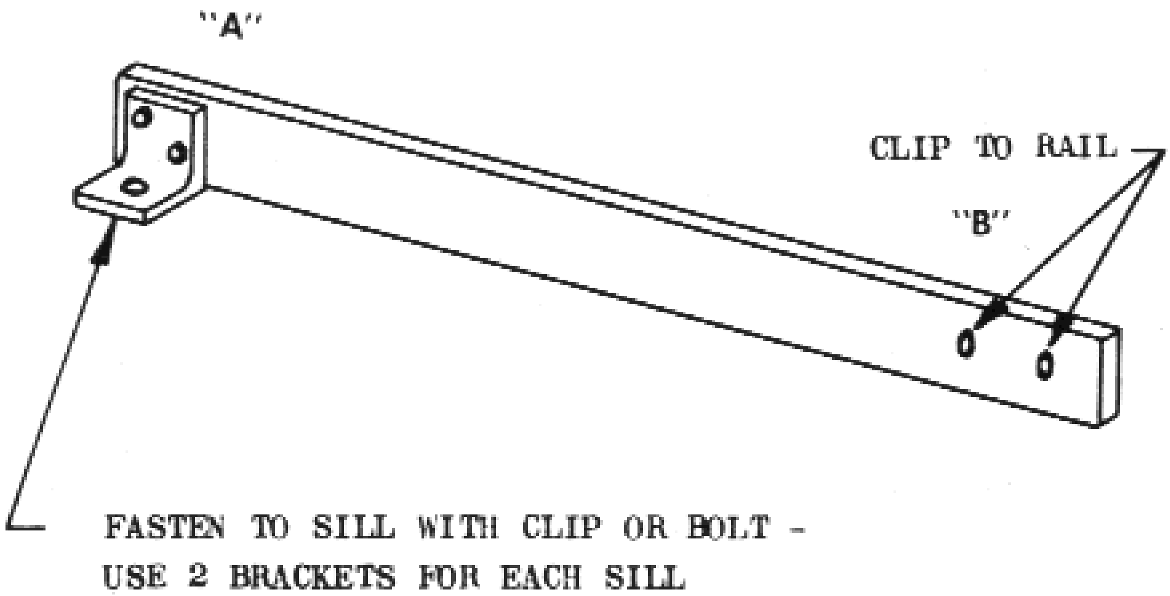
7. A mark should be placed on the hoistway edge of each sill to indicate the center of the opening of the door.

8. Once the sill brackets are installed, the sill itself is laid on them. The template is placed into position against the guide rails and the sill set to it. Shims or packing are slid between the brackets and sill, if needed. The bolts are installed and tightened.

9. During this procedure it is most important to recheck the level of the sill in both postwise and front-to-back directions. The distance from the bench mark to the sill top must also be confirmed again and, in addition, the alignment of the marks for centers of door openings.

10. These checks will permit the car and hoistway doors to align properly when door work is completed.

11. Where, for any reason, the sills are not bolted or grouted to a firm foundation, they must be securely braced so that they cannot move when they are grouted or bricked in during the completion of the walls. Some mechanics use flat iron braces and angle knees for this purpose. They clip the knees to the sill and flats, and the flat iron to the rail back. The braces can be made up in the shop from the layout. Such brackets could be similar to that shown in sketch *1.



Sketch #1

12. Use packing at "A" or "B," if required. (Offset brackets can be used on some installations.) Point "E" can be used to locate the headers and bucks when that material is to be installed, (see sketch in 11 -b2).

13. Be very sure to check the alignment of the sill with those sills of the other cars, if it is in a group installation. In theory, if the rails of all identical cars in a bank are aligned and the sill template is the same, all sills should be perfectly aligned. However, the erecting mechanic is still responsible for installing the job correctly. Therefore, test check all sills. If errors are found, discuss the problem with the superintendent before correcting them, if any great loss of time or use of materials would be involved when making necessary changes. The cost of altering the condition may be chargeable to others.

14. All floor sills are set consecutively at the earliest possible moment.

15. Sills are grouted in completely by the building contractor.

16. When sills are set for swing doors which have closers or checks concealed in the floor, it is very important to install the box for this closer at the same time the sill is placed. These boxes are in fact forms to keep the grout from filling up the space required by the closer. Review your door detail drawings carefully before installing this type of sill.

CHAPTER 11
Section -c1

DOORS AND OPERATORS

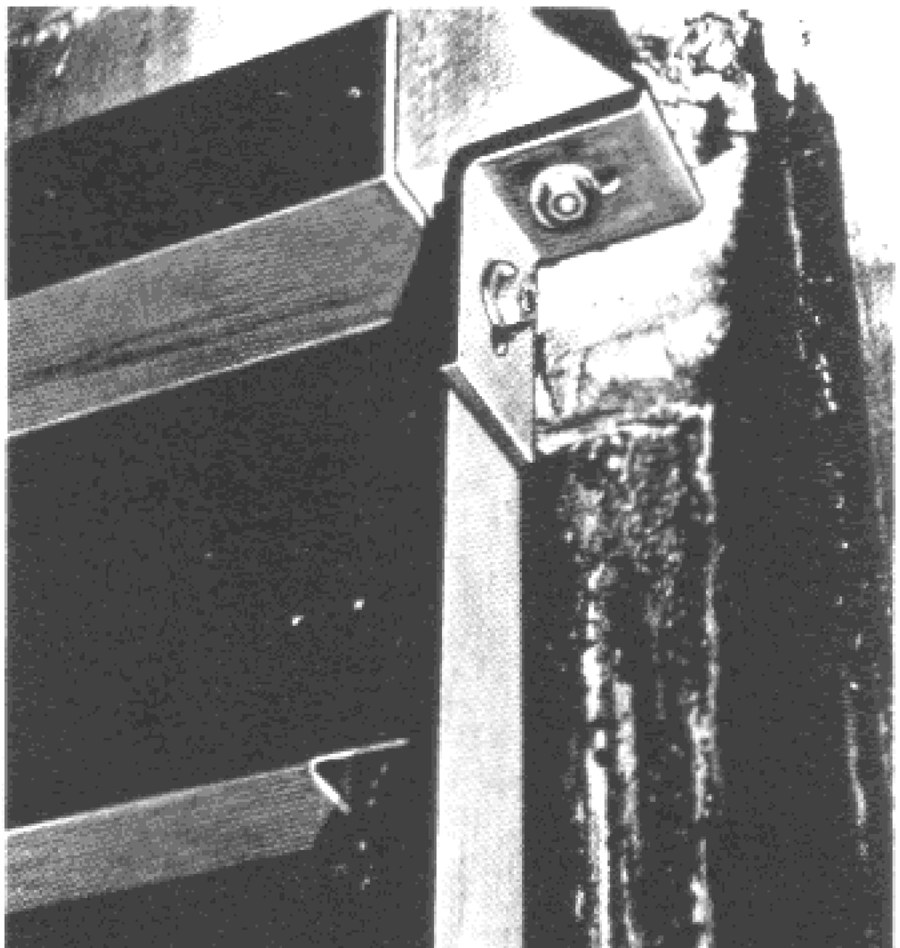
Headers and Supports – Sliding Doors

Suggested:

Materials –	Tools –
a. headers	a. hand tool kit
b. supports and clips	b. electric drill
c. bolts, nuts, packing	c. taps
d. masonry anchors	d. skip or scaffolding
	e. electric hammer (for concrete structures)

1. Just as the sills form the base for elevator entrances, the supports (or "struts") and headers form the frame in which the ornamental entrance frames and door panels are installed. The struts are generally upright angles which are mounted at fixed positions near the ends of the sills. They are normally secured by "clips" or knees that are bolted to the sills and to the struts.

2. The struts support the header. Sheet steel is formed by the manufacturer to make a header to suit his particular design of entrance. Usually the header is bolted directly to the flats of the struts. The door track (or rail) bolts inside the header. Entrance frames bolt to the header and the sill. Door contacts and lock parts, door closer devices and other items may also be fastened to them.



The Strut is Fastened to the Building Structure and the Header is Bolted to the Strut

3. It is, therefore, evident that proper installation of the header is very important.

4. After the sills are set, the door struts and headers can be installed. The sills are usually drilled or otherwise arranged for the strut knees. Where this is not done, detail drawings for the field drilling are supplied to the mechanic.

5. In steel buildings it is customary to fasten struts to the sill and to the next higher landing's steel beam. On concrete structures, they are fastened to the sills and rough walls, if the walls are reinforced concrete construction. The struts must be secured to the next beam, if the wall structure is not suitable. Struts are never fastened to hollow tile or similar materials.

6. The struts are secured to their sills in accordance with the layout dimensions (and the pre-drilled holes, if these are used). They are plumbed two ways and secured at their tops. This can be done by bolting or welding, if the beams are steel, or by means of masonry anchors in concrete structures.

7. After the struts are secure, the header is bolted to it in an approximate position. Some designs have the holes for strut bolts slotted horizontally in the header and vertically in the struts. This provides an area for adjustment.

8. When the header is approximately in place, plumb lines are dropped at each end of the sill. The height of the header above the sill is established and the struts are scribed at this height. (It should check level, if the work is properly done.) The header is then positioned with relation to the door sill tracks by means of the plumb bobs. Slight amounts of packing between struts and headers are permisslbe but, if all previous measurements and checks were correct, this packing should be required only to overcome variations in mill stock and manufacturing tolerances of materials.

9. Once the header is securely bolted, recheck dimensions, being particularly careful to assure that any pre-drilled holes are properly aligned with door opening centers.

CHATER 11
Section -d1

DOORS AND OPERATORS

Landing Entrance Frames — Installation

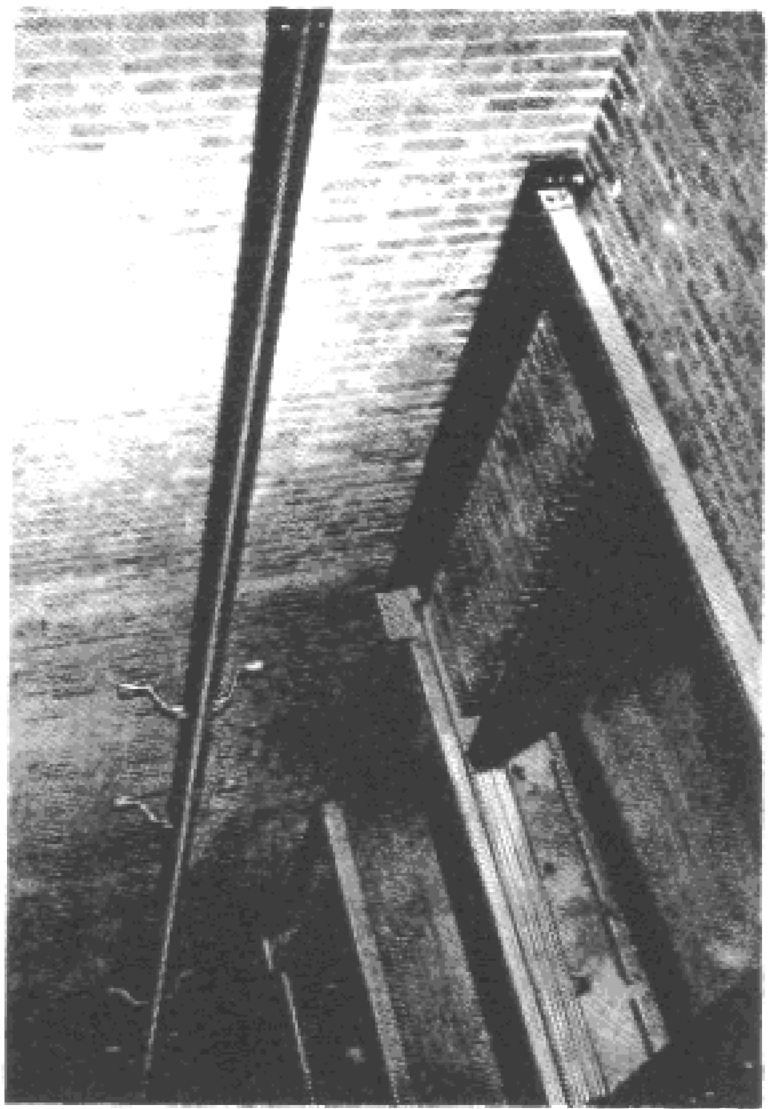
Suggested:

Materials –	Tools –
a. frames	a. hand tool kit including a ratchet socket wrench
b. clips, bolts, washers	b. electric drill
c. sundries	c. taps
d. 3/4'' x 6'' boards	

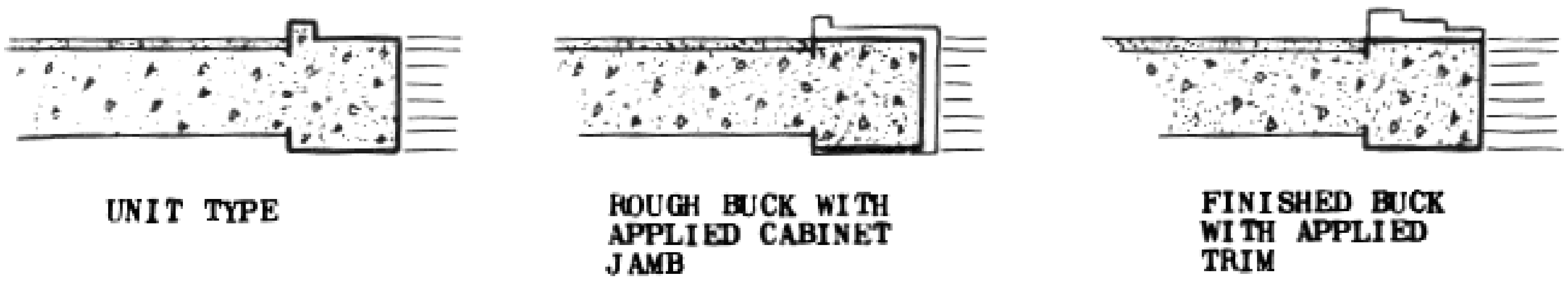
1. Entrance frames are both functional and ornamental. Among other functional purposes they serve to establish safe clearances between the walls and the moving door panels. Manufacturers have a variety of contours from which customers select the frames which correspond most closely to the general building architecture. Hall buttons, hall lanterns and position indicators are sometimes installed in the jambs or above soffits.

2. The passenger elevator entrance frame can be of the unit type, which consists of the finished jambs and soffit welded to form one frame, or can be a finished frame shipped to the job in sections. Both of these require care during and after assembling. The finished surfaces must be protected. Other styles of passenger entrances include the rough frame (or "buck") with trim applied after the walls are plastered and the "rough buck" with an applied cabinet jamb. The sketches in this article illustrate jamb sections of three types.

3. The illustrated types are common for passenger elevators, although fine woods are sometimes employed to "dress" entrances where codes permit wood to be used.



This Photo Illustrates Unit Frame Assembly and Its Relation to the Sill, Struts, and Header



Various Forms of Entrance Jambs

4. Frames for freight elevators are generally made of steel angle or channel. Service elevators use entrances similar to those for passenger cars.

5. Entrance frames for all horizontal sliding doors are installed in the same general manner. The sills and headers are predrilled or otherwise arranged to facilitate securing the jambs to them. The frames are set in their approximate positions on the sills and then loosely bolted to the headers. The bottoms of the jambs are equipped with angle clips or knees. The holes in these clips are slotted to permit a slight amount of front-to-back movement. Bolts are put into these clips and the sill holes. They are snugged up approximately in their permanent position.

6. The distance from the sill door track centers to the jambs is determined from the layout or a detail drawing. The jambs are shifted enough to obtain the correct dimensions. The bolts are then tightened securely. A ratchet socket-wrench is very useful for this work since there is little space to swing an open end or box wrench.

7. Each jamb is plumbed two ways. It is allowable to use a slight amount of packing between the header and frame soffit to obtain perfect alignment.

8. When the jamb aligns with the sill and header, both jambs should be parallel to each other, plumb, and their edges square with the header. The frame openings should be perfectly aligned to the ''E'' marks on the sills which denote the centers of the open door spaces (see sketch in 11 -b2).

9. When a bank of elevators is being installed, the ''fronts'' (frames) should be checked by extending a line across the frames of all cars at each floor. This is important on all types of wall finish but is especially so when pre-cut facings, such as marble, are to be installed. If guide rails are correct, the door frames should be also.

10. After the frames are installed and secure, cover them with heavy paper or whatever material is standardized on by the elevator manufacturer. This covering should be kept in place while the bricklayers and plasterers fill in and grout the frames as well as while the walls are being finished. It is advisable to leave this protection on as long as possible to save the claims and counterclaims that develop when refinishing becomes necessary.

11. Where applied trim is to be used, install the trim brackets but leave the trim off until the wall is plastered flush with the buck.

12. Some types of applied trim ''snap'' onto their brackets. They are held against the jamb. A piece of 2'' x 4'', covered with cloth is laid flat against them and struck sharply with a hammer. It is very difficult to remove this trim once applied, so be sure to delay setting it until there is no longer any chance of it being damaged.

13. Vertical sliding door frame installation will be separately reviewed later in this chapter.

14. Frames for swing doors are installed essentially the same as those for horizontal sliding doors. However, some manufacturers ship the door panel, frame and sill as a unit. These are installed by first setting the sill brackets as described in chapter 11 -b3. The frame (or door unit) is then set on the brackets and aligned to a template indexed from the elevator guide rails or car sill.

15. Since no struts are used on these doors, it is necessary to fasten the top of the door frame to the floor beam above or to the building wall with knees or angle brackets.

16. When walls are not in place and floors are high, the frame tops can be supported to the guide rail backs by special temporary brackets. These are generally offset.

17. It is necessary to support either swing or slide door type of frames very rigidly since the grouting in process could disturb their alignment. Correction of the error could be very costly and time consuming.

CHAPTER 11
Section -e1

DOORS AND OPERATORS

Hoistway Door Panels – Sliding Type, Installing

Suggested:

Materials –	Tools –
a. door panels	a. hand tool kit
b. hangers	b. taps
c. tap bolts	c. ratchet box-wrenches
d. lock washers	
e. sundries	

1. Sliding door panels for hoistway entrances are usually made of steel, although some wood or metal covered wood panels are used. Regardless of material, the installation procedure is similar.

2. Sliding door panels are suspended from the tracks located in the header. The tracks are blocked (or packed) out from the header to provide running clearance between the door panels and the frame. This is usually about 1/4'' but door drawings show the specified distance. Two-speed doors require double tracks and blocking is provided between the two tracks. Three-speed doors are infrequently used. Since they require triple tracks, they take a considerable header and sill depth.

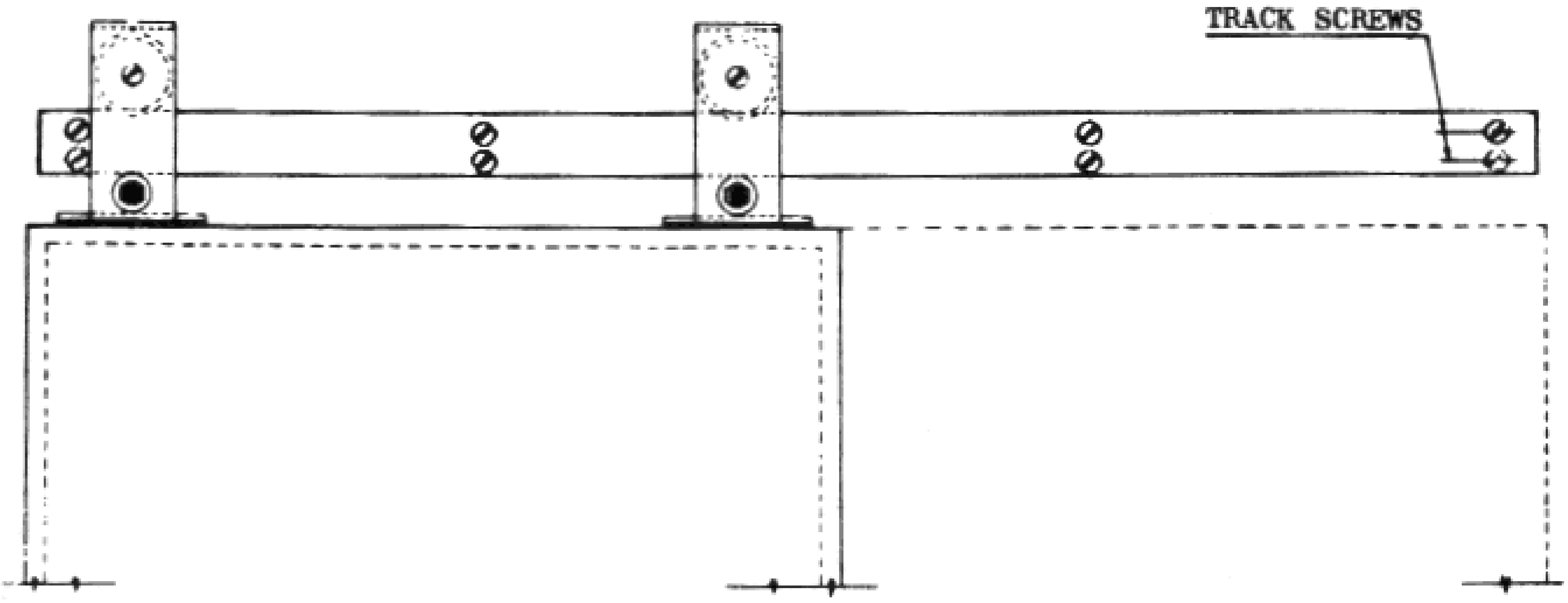
3. Refer to the hoistway entrance-door drawings supplied by the manufacturer of the equipment you are installing.

4. When door panels are suspended from overhead tracks by roller hangers, the track support bolt holes are tapped into the header at the factory. The assembly is checked in the factory and there should be no trouble in assembling it in the field. If the mechanic discovers an error, he should correct it, but report the trouble to the superintendent. Despite the fact that installing door panels and hangers is in the nature of an assembly job, the mechanic should assume responsibility for completing the job right.

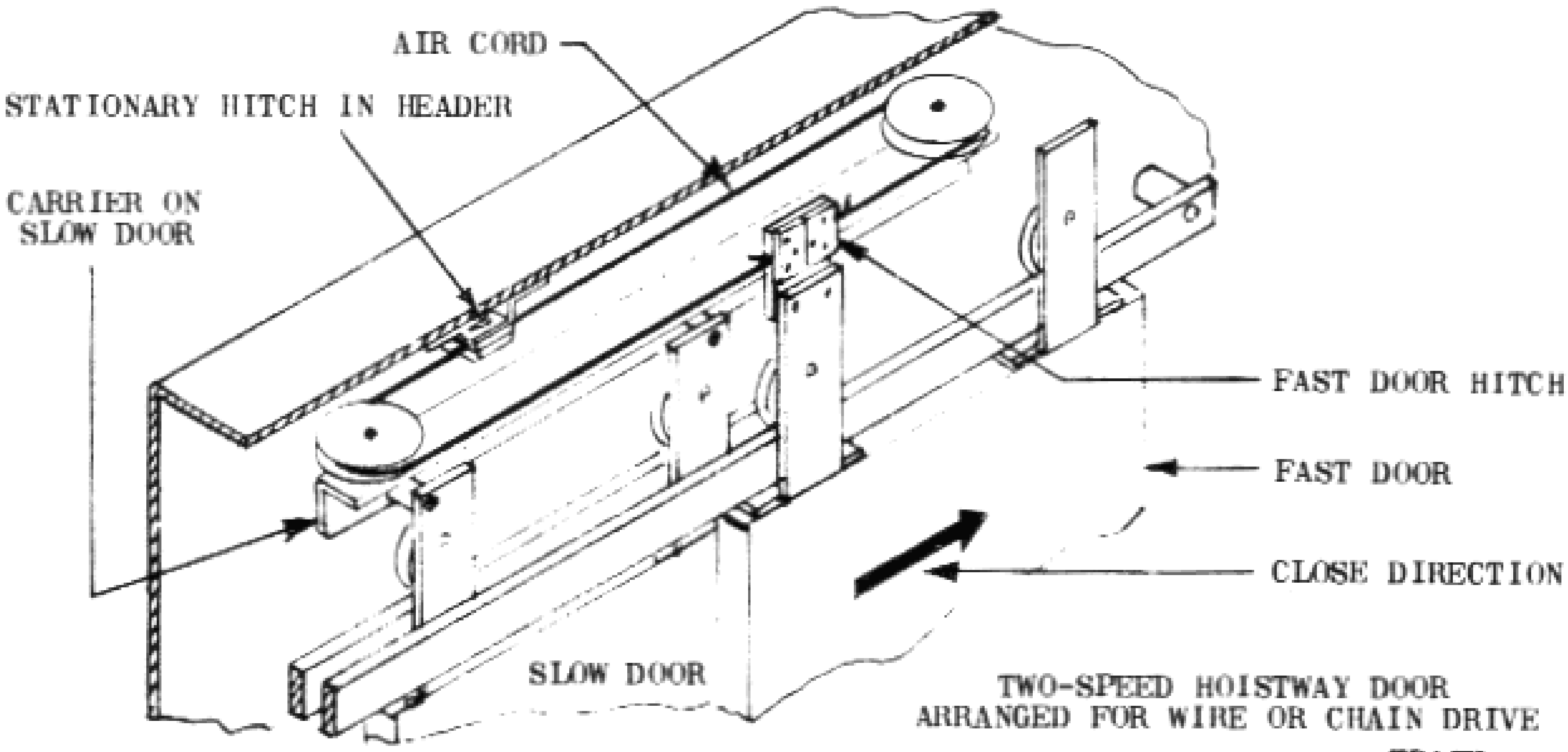
5. As a rule it is good practice to complete all work on headers and then install the door tracks (or hanger rails). After the rails are in place, the panels can be hung at a convenient time. In a rough building this may be delayed until danger of damage to panels is at a minimum.

6. Clean the paint off the riding surfaces of the hanger track with emery paper or another abrasive before installation. Fine emery paper soaked in oil is suitable for this purpose.

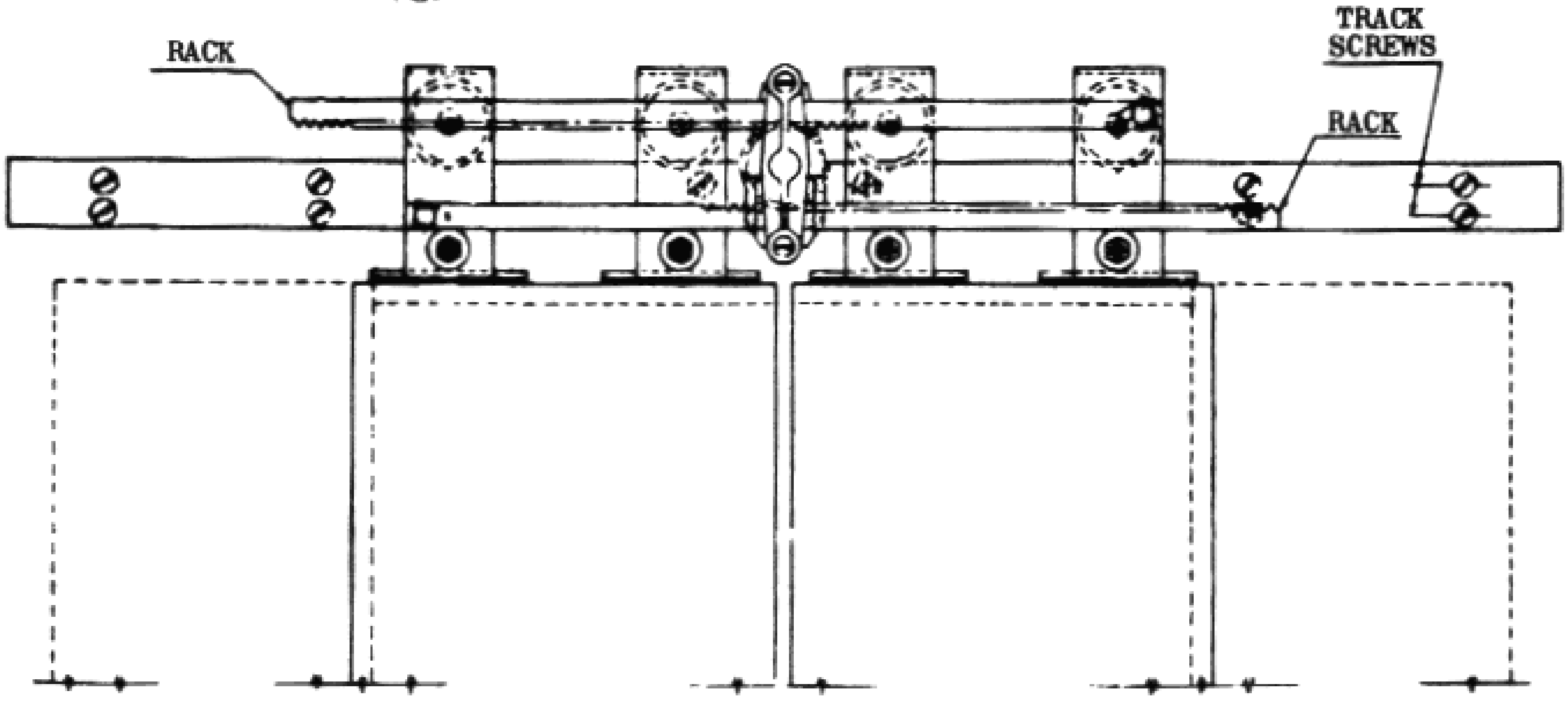
7. If doors with center openings are to be installed, the hanger track and header



SINGLE SLIDE HOISTWAY DOOR



TWO-SPEED HOISTWAY DOOR
ARRANGED FOR WIRE OR CHAIN DRIVE



Center-Opening Hoistway Door With Rack Drive

centers are at the same point. Install the rail, setting the blocking or ''fillers'' in place behind each support bolt. This establishes proper clearance between header and rail. Use lock washers on all bolts. Level the track. Check its alignment with the sill tracks by means of plumb bobs. Obtain relative dimensions from the door drawings.

8. If field working conditions are bad, allow time between installing the hanger tracks and hanging the doors, to permit the hoistway walls to be bricked or filled in before the panels are in place. This may keep the door finish from being marred.

9. Be sure the sill track and the door shoes are clean. Check the shoes to be sure their brackets are tight on the panels.

10. There are some types of hangers that are set in place with the rails. The doors are hung from them later. However, most types are installed when the door panels are hung. Check to see which you are to install. Hang each door panel and align it with the other panel(s) at the opening. Generally they are hung so the bottom of the panel clears the sill by approximately 1/4''. The edges must be parallel with each other and both panels must be in the same plane.

11. Generally door-hanger bolt holes are slotted to permit adjustment toward the front or back of the hoistway. This allows play for a plumb adjustment on each panel. The hangers are arranged to permit shimming or otherwise adjusting them up or down to provide the proper clearance between the bottom of the door and the sill. This also permits plumbing the front edges. Shims can be added or removed at the hanger bolts to obtain the desired alignment and clearances. (Shims can be removed from one hanger only, if this is necessary to obtain a plumb leading edge on the panel.) Each hanger must be square with its door panel and the track.

12. When the doors are hung plumb, aligned, and set with the proper clearance to the sill, the bottom eccentric rollers of the hangers can be adjusted. These require a minimum clearance to the bottom of the track, which eliminates the excessive end-thrust. It also eliminates the possibility of the door leaving the track. This last is a code requirement.

13. After all this is completed, the panel should move freely and should line up plumb and flush with the door bucks. Then the bumpers can be set in accordance with the drawing. Some manufacturers supply these mounted. Usually, however, they are field set and are adjustable.

14. If adjustable door closer or hanger chains, arms or racks are to be used, they can be installed after the doors are hung and inspected for freedom of travel.

15. After the door chains, wire drives or arms are completely assembled, the sliding motion should be smooth and easy. Be sure to eliminate any points of friction. Do not overcome friction with lubrication only. This is merely a temporary relief and will cause trouble later.

16. Lubricate the hangers with the recommended lubricant. Tracks for rubber-tired hangers should be dry. Those for steel rollers may be lubricated. Some companies supply composition rollers that do not require lubricated tracks. Follow the "supers" instructions in this point.

17. Car door panels are hung in a similar manner as described for the landing doors. However, be sure to check the car door detail drawings to insure obtaining the proper clearances.

18. Note that door panels overlap the frames. Panels of two (or more) speed entrances also overlap each other. Hold door adjustment to proper "lap" dimensions as shown on the drawings.

CHAPTER 11
Section -e2

DOORS AND OPERATORS

Hoistway Doors – Swing Type

Suggested:

Materials –
- a. door material
- b. closers
- c. bolts, lockwashers, sundries

Tools –
- a. hand tool kit
- b. taps
- c. ratchet box – wrenches

1. Elevator hoistway doors of the "swing" type are manufactured to meet the same general code requirements as those for sliding doors. Metal entrance frames are usually bolted to a metal sill, in the United States and Canada. The code permits only single swing doors on passenger elevators used by the general public. Double swing doors can be installed for certain types of elevators that are used by special employees.

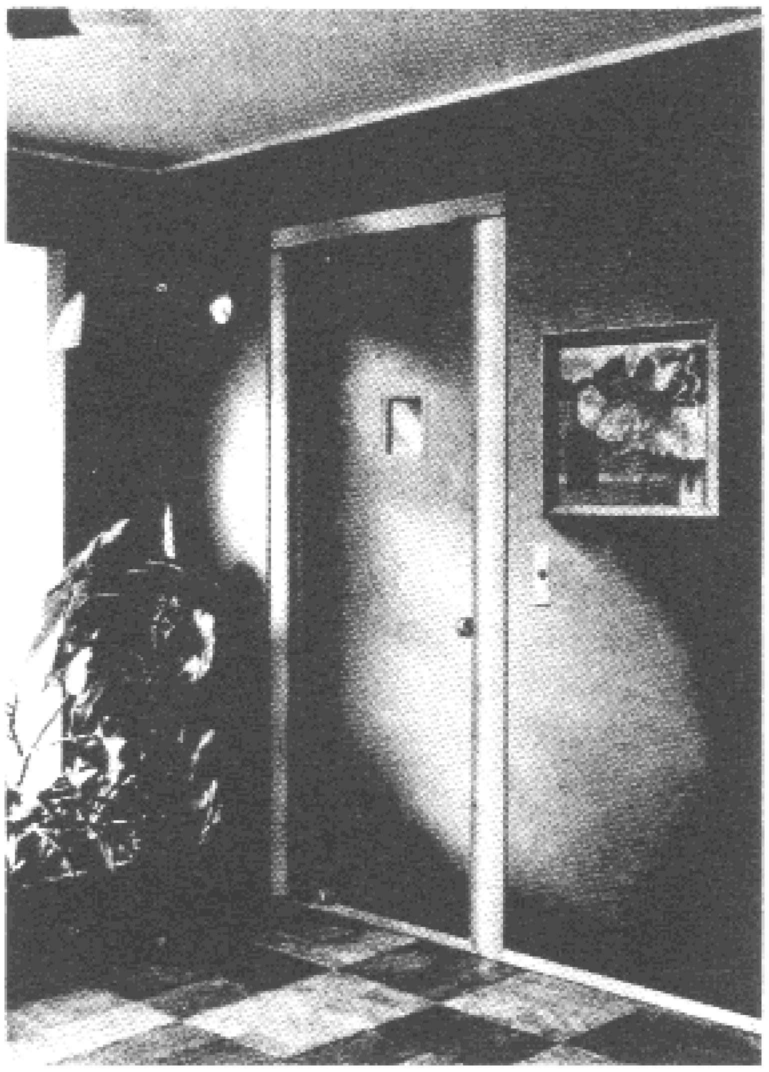
2. Most installations require fire resistant door material. The few exceptions are noted in Section 110 of the code.

3. Swing doors must have interlocks that are functionally the same as those for sliding doors.

4. Closers are usually of the spring or spring and oil type, although, spring and pneumatic closers are sometimes used. The closers may be mounted in the sills, on the entrance jambs, on soffits or in the top edges of the doors. The photos in this section illustrate the sill mounted and soffit mounted types. Both are adaptations of commercial door closers or "checks" and most mechanics are familiar with their operation.

5. The external hardware of swing doors includes either a door knob or a door pull. Some of the closers form the hinges. Other types require separate hinges, which are generally butt types. The internal hardware may include a push plate to open the door. In some applications this can be arranged with a door pull as long as it does not project into the hoistway beyond the sill.

6. At present the swing door is the most common on private residence and small apartment elevators. Controller types may be single automatic push button or simplex collective. Often there are no hall position indicators on the less expensive installations. This dictates the use of vision panels in the hoistway doors and provision for these panels in swing doors is specifically required by Rule 110.11 of the code.



Typical Swing Door for Small Elevator

Soffit Mounted Oil Check on Swing Door

7. Installation practices for swing doors parallel those for sliding doors. The sill is set first on brackets fastened to the floor beam which may be steel or concrete. The sill is leveled at the proper distance below the bench mark and is aligned to the center mark of the car entrance. The distance from the center of guide rails is checked with a template or from the car entrance sill. The sill is bolted down in the conventional manner. The center point of the sill is generally marked lightly with a center punch.

8. Since there is no need for door tracks the sill is only long enough for the entrance frame to be bolted to it. The frame is set in its approximate position as determined by the layout. The bolts holding it to the sill are installed and made hand tight, with the jambs placed equidistant from the center-punch mark on the sill. The jamb faces are squared to the hoistway edge of the sill and the jamb clip-bolts tightened.

9. Usually there is no "header" on swing door frames. However, it is necessary to

support the top of the frame until the wall is filled in. As a rule, flat or angle steel knees are bracketed from the top of the frame to the next higher floor beam for this purpose. The brackets are frequently supplied by the factory and are arranged to be bolted to the hoistway side of the frame.

10. The door frame is plumbed both front-to-back and on the jamb postwise faces. The brackets are then fastened.

11. The door panel is hung on its hinges once the sill and frame are secured. The "check" or closer may be adjusted at this time but must be re-tested when the elevator is put into operation. The door interlock is normally installed in or on the strike jamb of the frame. It may be installed with the frame or with the conduit work, according to company standards.

12. The door frame and panel should be protected from damage. This is sometimes quite difficult to accomplish. The regular practice followed by many firms is to secure heavy builder's paper or corrugated cardboard to the panel and frames. Masking tape can be used to secure the paper on most painted finishes.

CHAPTER 11
Section -f1

DOORS AND OPERATORS

Closers – Manual

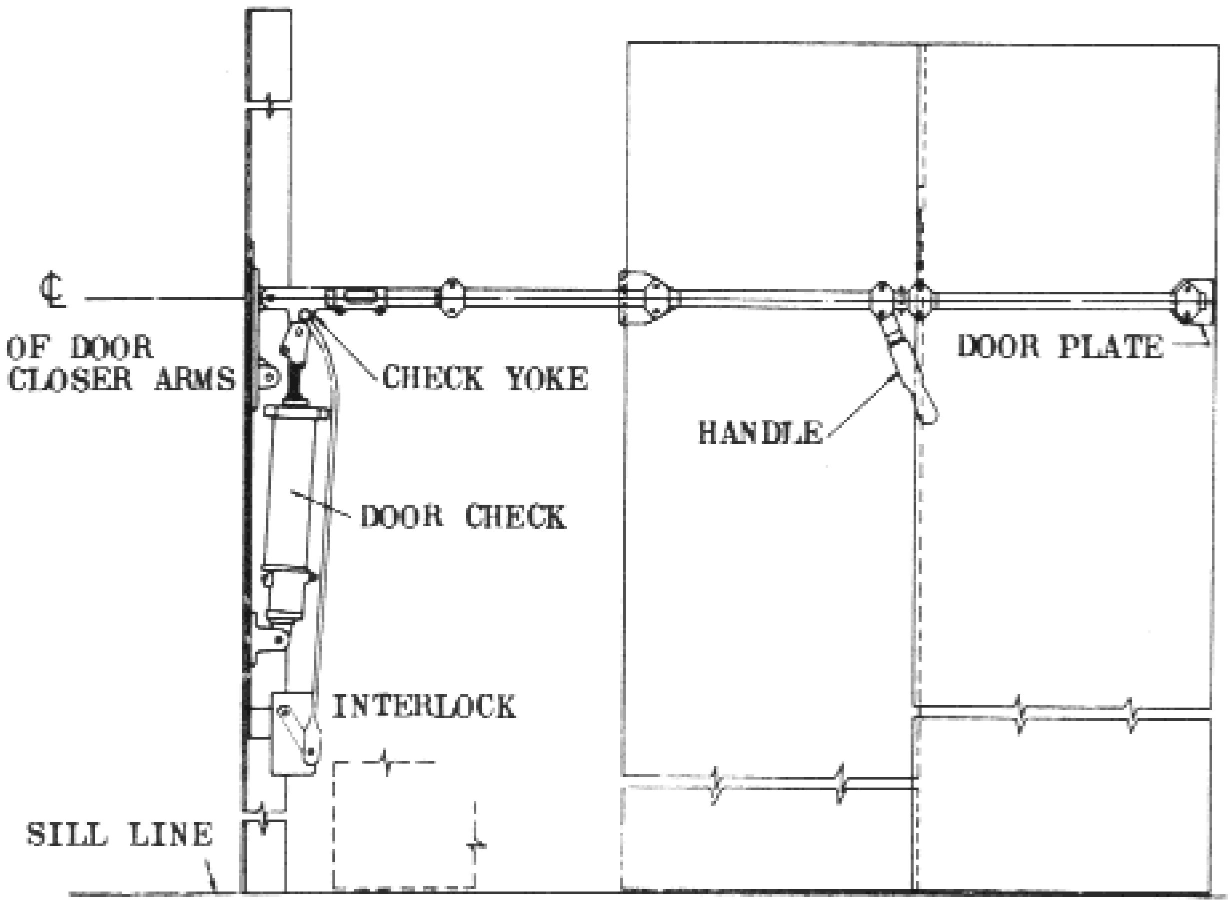
Suggested:

Materials –
- a. door closers
- b. tap bolts
- c. machine bolts
- d. cut washers
- e. lock washers

Tools –
- a. hand tool kit
- b. taps
- c. drills and electric drill

1. Manual door closers are made in so many types that it would be a physical impossibility to write a detailed description of how to install each. Since there are many variations of the "broken arm" or "jack knife" closer, a brief description of this type and its installation is included herewith.

2. Horizontal arm door closers are usually installed on panel doors in either, one panel – one speed; two panel – two speed; or three panel – three speed types. The general arrangement is similar for all. There are two basic types of this closer.



TWO PANEL - TWO-SPEED DOOR CLOSER
FOR CAR-SWITCH ELEVATOR

Sketch #1

3. The first has "straight" closer arms which are designed to be self-locking, in one manner or another. Most state codes require the addition of an electrical interlock switch to the closer arm lock. These switches or "contacts" are operated by levers, arms or cams from the closer arm or its check. Should the door closer remain unlocked or the interlock contact not close, the elevator would not run.

4. The other general type of horizontal arm closer is known as the "broken arm" closer. It operates in the same general manner as the straight arm closer but must have a supplementary latching device as a part of its assembly. This latch is operated by a sill trip or some similar device. The sill trip, which is a crank arm, roller and lever arrangement, is bolted onto the sill with the roller arm extended into the hoistway. The roller is moved by a fixed or retiring cam that is mounted on the elevator car. The type of cam is determined by the applicable code. However, fixed cams are usually restricted to elevators with only two or terminal stops on the side on which the cam is installed. Its installation will be further described in the next section of this chapter.

5. Straight arm closers are used on cars with regular elevator attendants. Broken arm closers are used on self-service or "dual control" elevators. Both are losing popularity due to greater interest in power operated doors.

6. Hoistway door contacts are set to ensure that the doors are not more than 2" from closed when the circuit is established. This is a "code" requirement. When the door is within 2" of closing, the interlock contact "makes" and the elevator can run. However, a rack and pawl or similar device to prevent the door from being reopened, must be a part of such an assembly.

7. Detail drawings are supplied for each installation. The door closer yoke or arm, hinge pin and the check are usually mounted on a backplate. This backplate assembly is held in place, its hole locations scribed on the door strut, and then removed.

8. The required holes are drilled and tapped into the strut flange, then the backplate assembly is bolted in place, plumbed, aligned with the sill track, and the bolts then made up tight.

9. The exact dimensions to the sill and sill track vary with most manufacturers, and are given on the detail drawings. The holes in the backplate are slotted to permit proper alignment.

10. On single panel doors, once the backplate is installed, the door panel is wedged closed with a small wood block. The closer arm is set in its backplate yoke, and the arm held level across the door. (In some cases the arm is shipped assembled. In others it is ''knocked down.'' We assume that a mounting plate is supplied on the closer arm and is to be bolted to the door panel.) Measure up from the sill and set the plate level at the proper height above the sill, as noted on the drawing.

11. Install the plate by scribing the location of the fastening bolt holes, removing the plate, then drilling and tapping the machine bolt holes. Finally, the plate is fastened in place.

12. The important point is to keep the ''hinge center points'' of all the pivot pins at the correct height above the sills. These locations are generally indicated on the door drawings.

13. Most closer arms have slides or ''knuckles'' to permit an adjustment on the door panel. This makes it possible to slide the door panels a slight distance in open or closed positions in order to obtain proper overlaps between the door panel and jambs or ''returns.''

14. The door check, whether pneumatic or hydraulic, is adjusted to cushion the door in closing a few inches before it reaches the strike jamb bumpers. If two adjustment screws are supplied, the first usually slows the door speed at about 12'' from the closed position and the second cushions it about 3'' or 2'' from the strike jamb.

15. As noted in earlier paragraphs, the door contact is adjusted to ''make'' or close when the door panel is about 2'' from the strike jamb (bumpers). This distance can vary according to the code applying to the individual installation or design of the contact.

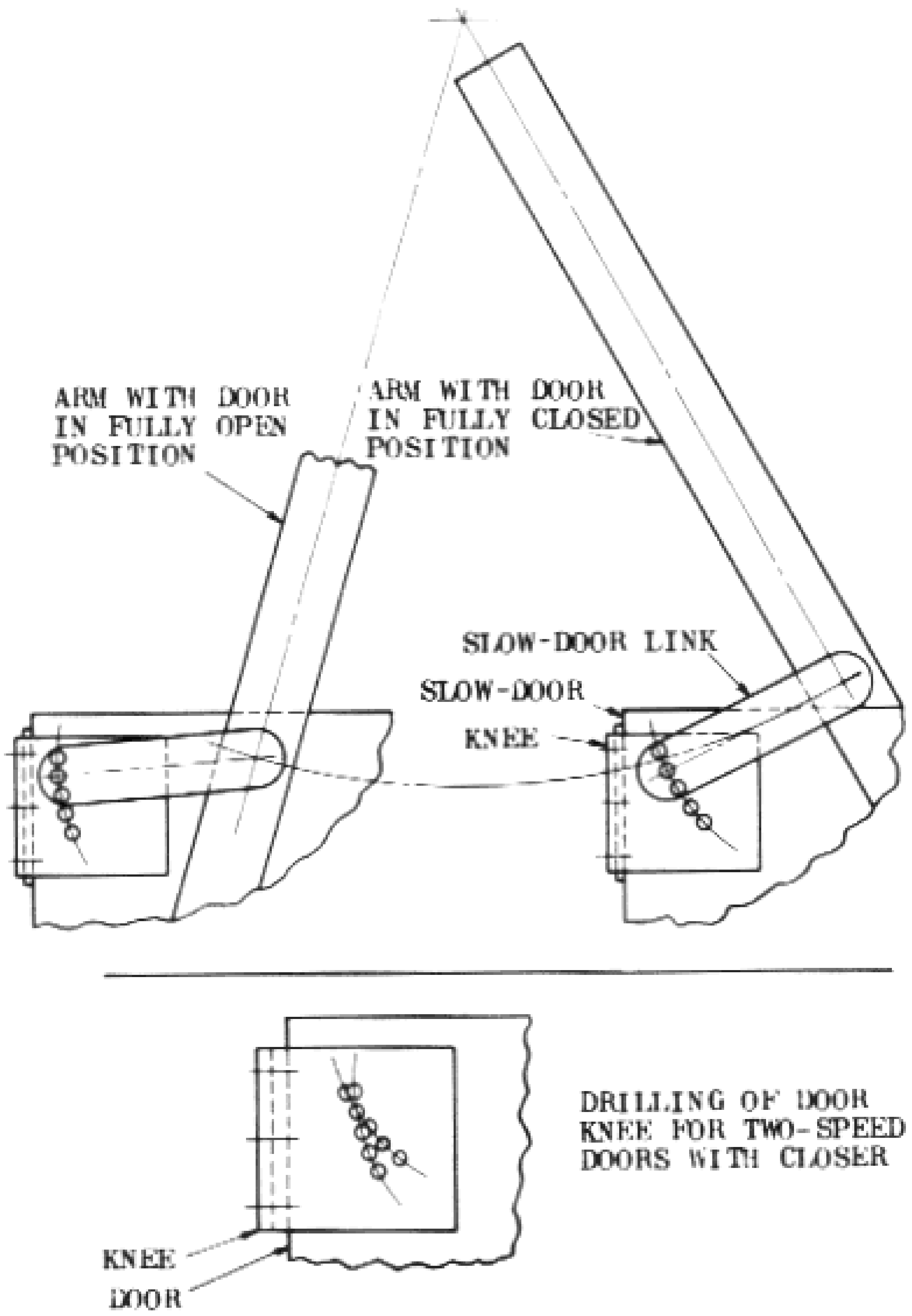
16. Racks and pawls are sometimes required to prevent a person in the corridor from reopening a hoistway door, if the elevator starts to leave while the door is in the 2'' contact ''making'' zone. The rack is set on the sill and the pawl on the panel. They ''engage'' about an inch before the contact makes, i.e., about 3'' before the panel strikes the bumpers.

17. The entire door installation should be checked for loose bolts, and to ensure proper alignment, as well as to eliminate chance of friction and other possible faults. It should be lubricated, wiped clean and left operating smoothly.

18. Two-speed doors are handled in the same general manner. The two panels, however, open at different speeds, inasmuch as one door has twice the distance to travel. Because of this, some form of differential connection is required to move the two panels to fully opened or fully closed positions at the same time.

19. The length of the arms between pivots governs this. The lengths are adjustable.

20. The "slow-speed" door is usually connected to the closer arm by means of a knee bracket. The pivot bolt for this knee is field installed.



Sketch #2

21. After the arm is installed on the fast-speed door, close the doors. Scribe the location of the hole for the slow-speed pivot bolt on its knee. Be sure the arm is level, and the doors closed with the specified overlap.

22. Open both panels and scribe the second location of the pivot bolt hole onto the knee. Center punch the knee where these two scribed marks meet, then drill and tap the knee for the bolt.

23. This pivot bolt often has an S.A.E. (fine) thread and requires an S.A.E. thread tap. Be sure to use the right size.

CHAPTER 11
Section -12

DOORS AND OPERATORS

Closers – Manual With Sill Trip

Suggested:

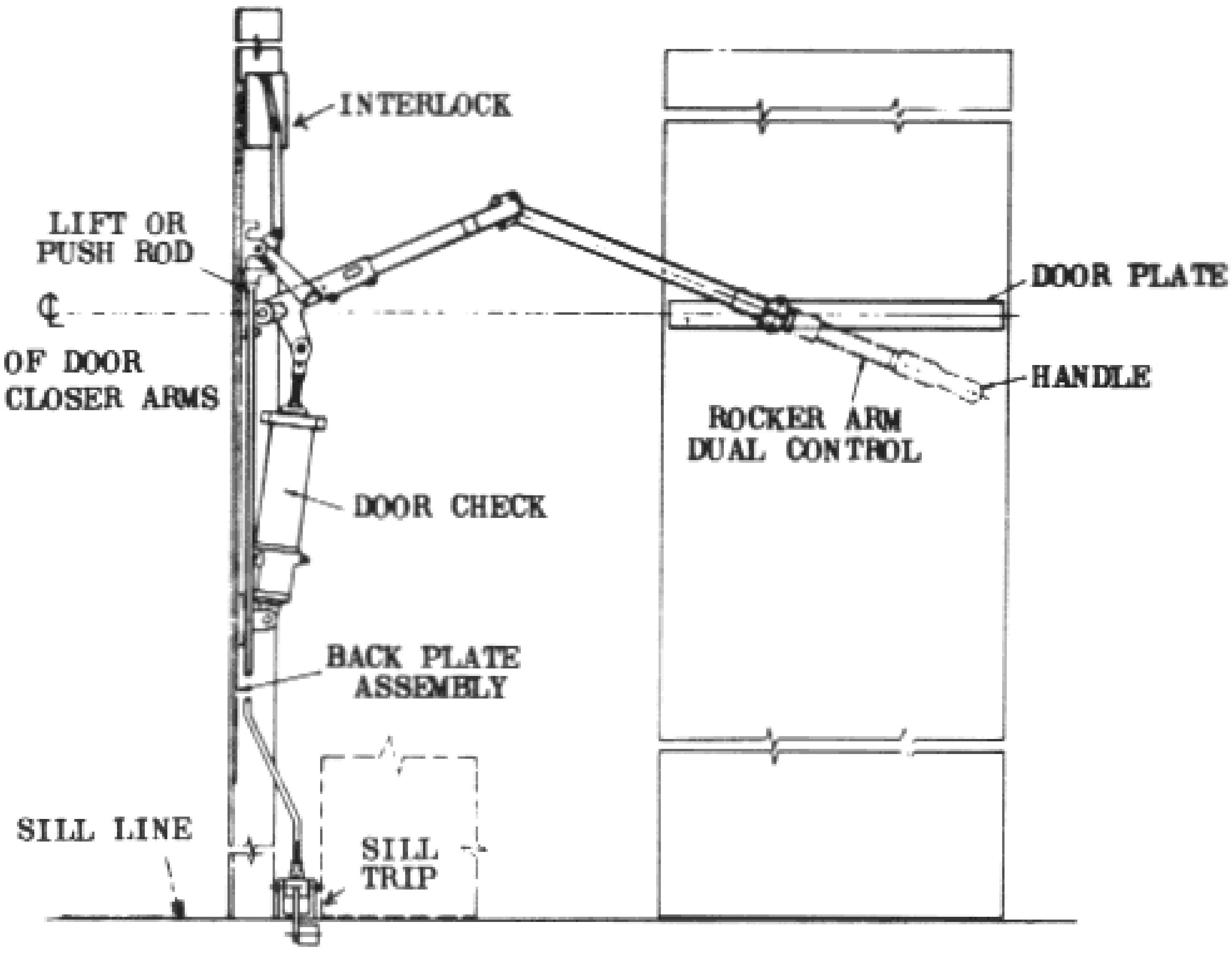
Materials –
- a. door closers
- b. bolts
- c. cut washers and lock washers
- d. steel shim stock

Tools –
- a. hand tool kit
- b. taps
- c. drills and electric drill

1. Self-service elevators have entrance door closers that are arranged to lock the door mechanically, except when the car is at that floor. It is necessary, therefore, to include some sort of unlocking device that will permit the door to be opened from the corridor at the desired time.

2. This is often done by means of a sill trip on the landing sill, which is engaged by a car cam when the car arrives at any landing. This cam forces the sill trip roller forward, and, by means of crank arms and levers, unlocks the door closer mechanism thus permitting a waiting passenger to open the door from either the landing or car side. In this it differs from the type used on cars with attendants. In these latter, the entrance door remains locked until the attendant unlocks it from the hoistway side.

3. Either type may be opened from the landing at any time, if emergency or service keys and key holes are supplied. This feature is restricted to special landings, usually terminals. It is important to instruct anyone who opens a hoistway with an emergency key to use all possible caution. The elevator should be stopped. No one should



ONE PANEL - ONE-SPEED DOOR CLOSER
FOR SELF-SERVICE ELEVATOR

Sketch #1

ever enter a hoistway under such conditions without checking to be sure of the car's location and that it is not moving. Contacts can short out!

4. The sill trip is best set by making a template to correspond with dimensions shown on the door drawings, scribing marks on the sill for tap bolt holes, and drilling and tapping the holes (see sketch). The sill trip is then mounted and the "lift rod" adjusted to give the proper amount of "lift" to the latch. The car is brought to the floor and the trip checked. With the cam in the "door unlocked" position, there should be at least 1/8" available extra movement on the trip arm roller. This is needed so the arm will not break, when the cam is extended.

5. As noted in chapter 11 -f1, there are two common types of sill trip cams. One is the solid cam and is generally used on slow-speed freight elevators or self-service cars with only two stops. Since it automatically unlocks each door as it reaches a floor, it is not too desirable for multi-landing elevators. Therefore, a retiring cam (i.e., one that moves away from the sill trip) was developed and is ordinarily used for the higher rise, self-service elevators. This type permits a car to make a non-stop run of several floors without unlocking each door as it passes. Both types of cams are mounted on the elevator car. The code makes the use of the retiring cam mandatory, if the elevator has more than two openings on any one side.

6. In certain types of locks the releasing device is mounted at the header. Essentially the operation is the same as when the "sill" is utilized as a support. The door drawings provide details for mounting and setting such devices. The lock may also be integral with the door closer mechanism.

CHAPTER 11
Section -gl

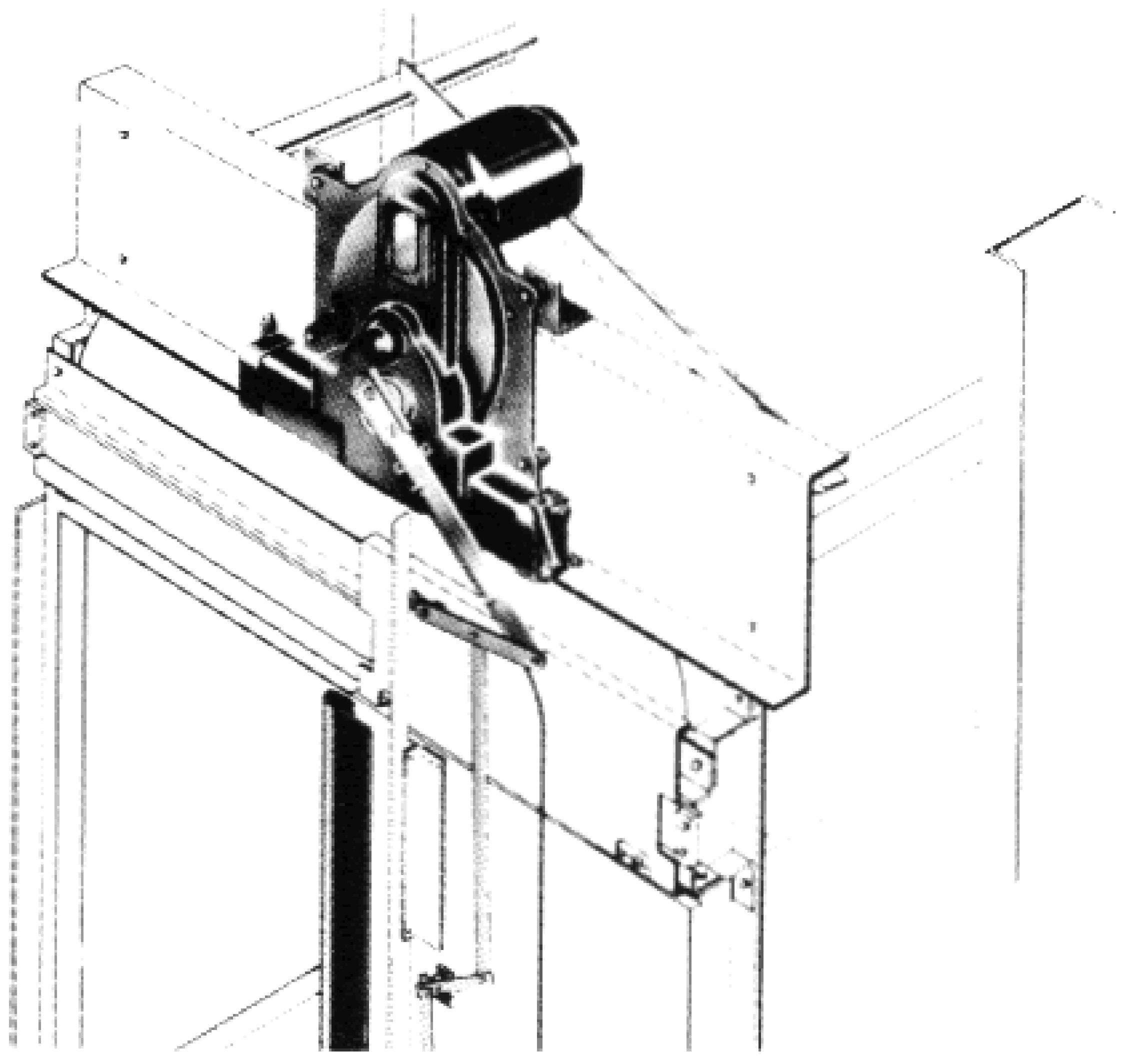
DOORS AND OPERATORS

Electric Operators

Suggested:

Materials –
- a. door operator equipment
- b. bolts, nuts, washers
- c. emery cloth
- d. cleaning compounds & other sundries

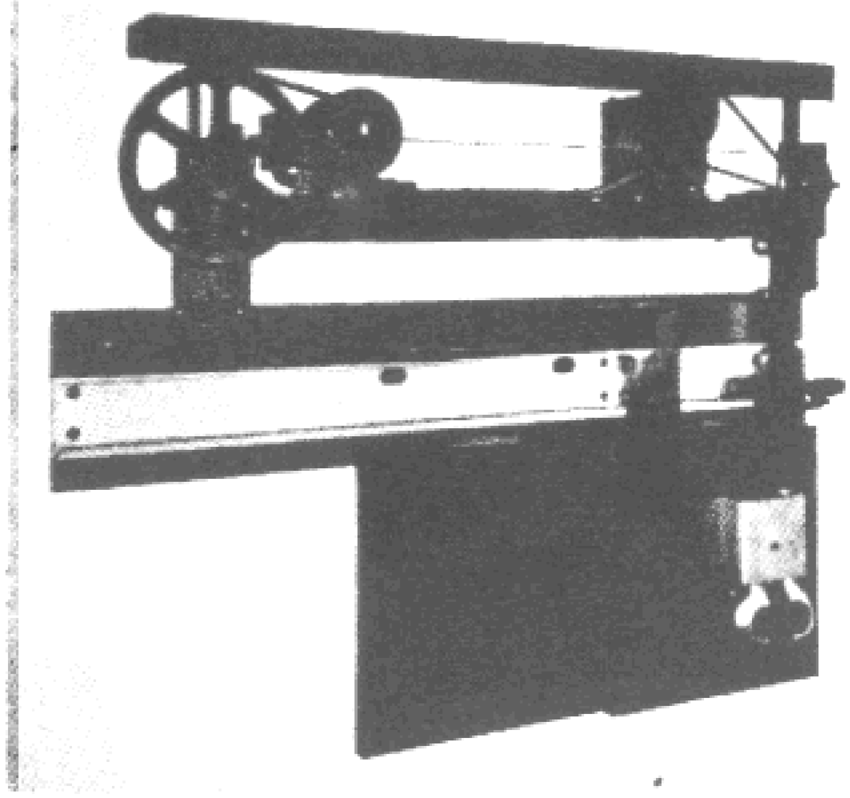
Tools –
- a. hand tool kit
- b. electric drill
- c. taps



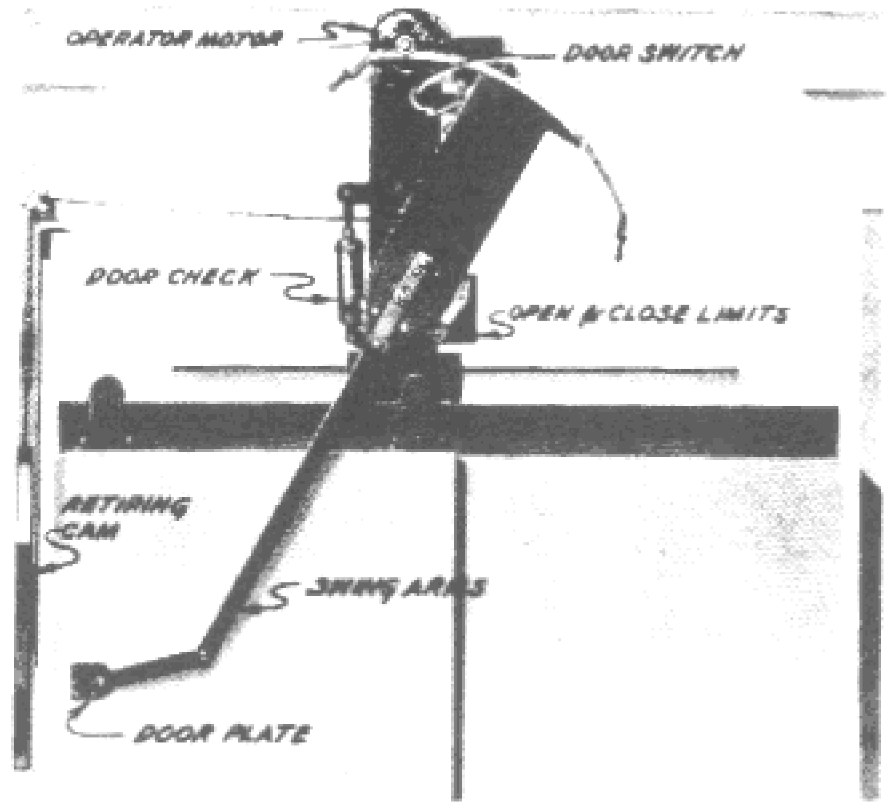
Otis Door Operator

1. There are quite a few different applications for power operated elevator doors. The elevator companies have each developed one or more designs for the individual kinds of application so there are many variations of these electric door operators.

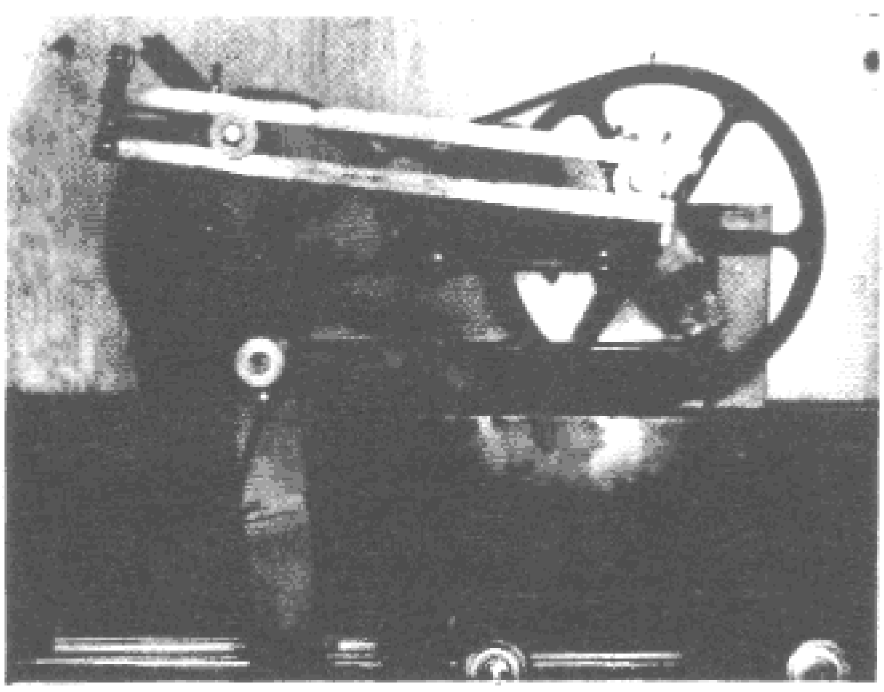
2. Classifying rather broadly we can say that there are three essentially different types. One field of electric operation is for car doors or gates only. These are used



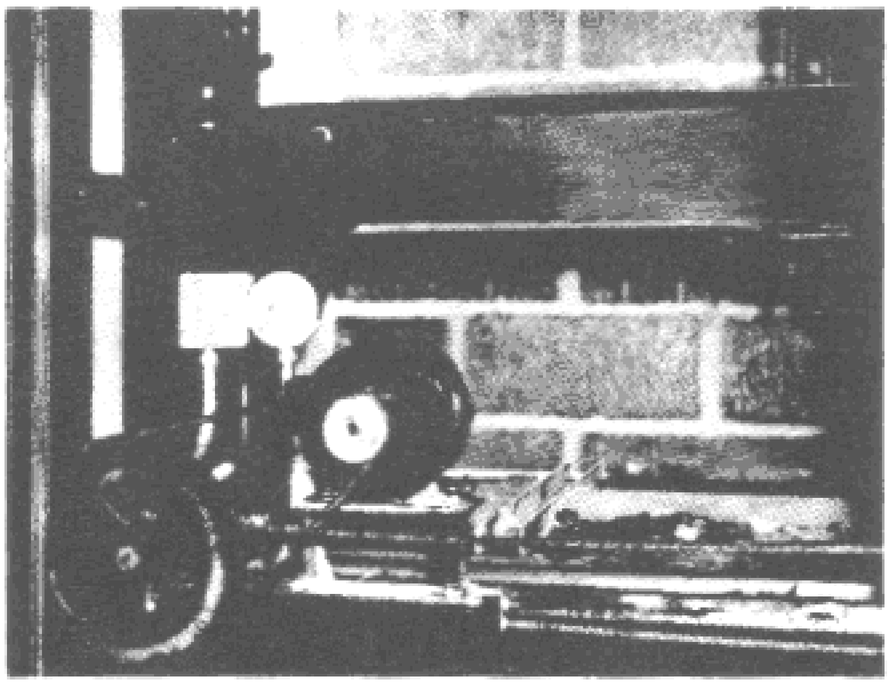
Haughton



Otis



Montgomery



Westinghouse

where the hoistway is equipped with swing doors and the car with a sliding door, a collapsing gate or a safety gate. These electric operators are usually slow speed and when used with collapsing gates, can open by power only one third of the gate travel. This is a code ruling designed to reduce hazard to passengers.

3. A second electric operator application is in their use to open and close vertical sliding doors and gates. This type of equipment is generally restricted to freight elevators but is occasionally used for special dumbwaiters. The type will be reviewed in the next section of this chapter.

The Door Operator Support is Often Bolted to the Carframe

4. The third and widest area where electric operators are utilized is their application to sliding hoistway and car doors. In this field it has practically eliminated its predecessor, the pneumatic or "air" door.

5. Elevator companies have designed these operators from two rather diverse approaches. One uses a swing arm from the electric operator to move the car door and a separate drive device from the same door engine to operate a cam on the car, which in turn depresses a hoistway sill trip. This trip opens the hoistway door and its electric interlock. Several companies still make operators of this type but they also manufacture another style in which the car door is equipped with a cam or "vane" placed on the hoistway side of a door panel. This vane engages a device on the hoistway door that unlocks the door, opens it, then closes and locks it.

6. Some variation of this last method is sold by most elevator contractors at present.

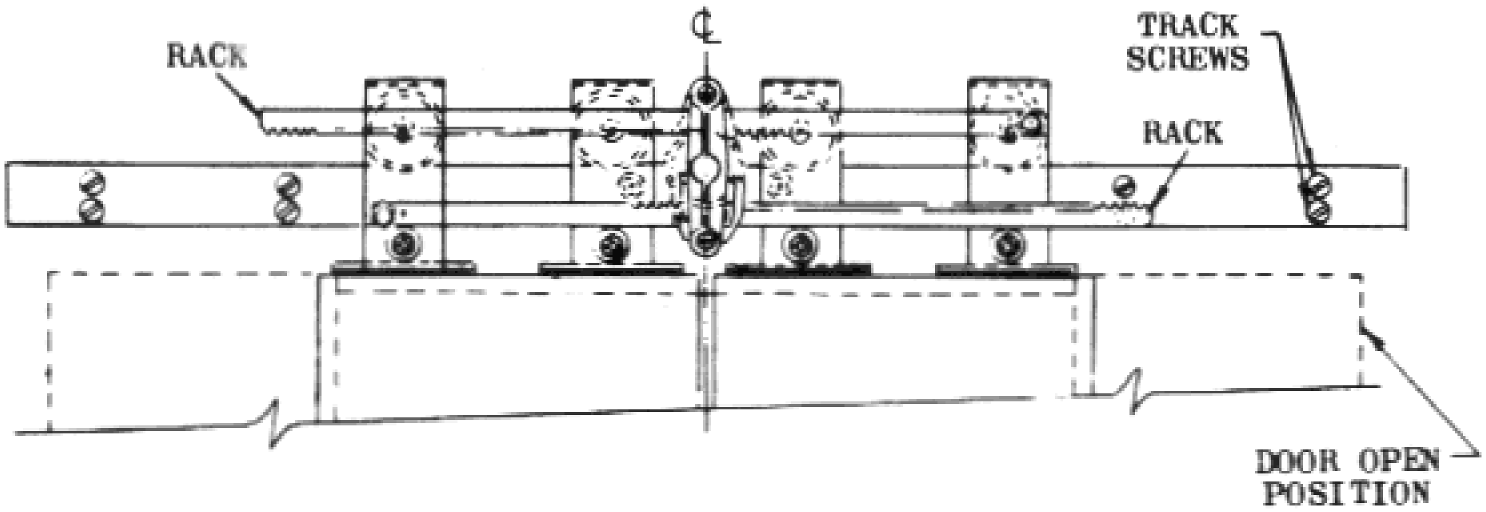
7. Supports for electric door operators for sliding doors are mounted on the elevator carframe, the car door track support or a car enclosure extension. The arrangement is designed by the manufacturer and outlined in detail drawings. Usually the car engine is set on a frame supported from the carframe and isolated from the car enclosure when the enclosure is sound isolated. This type is installed before the car enclosure is set in place.

8. A study of the photos in this article will demonstrate several methods in which the engines are supported.

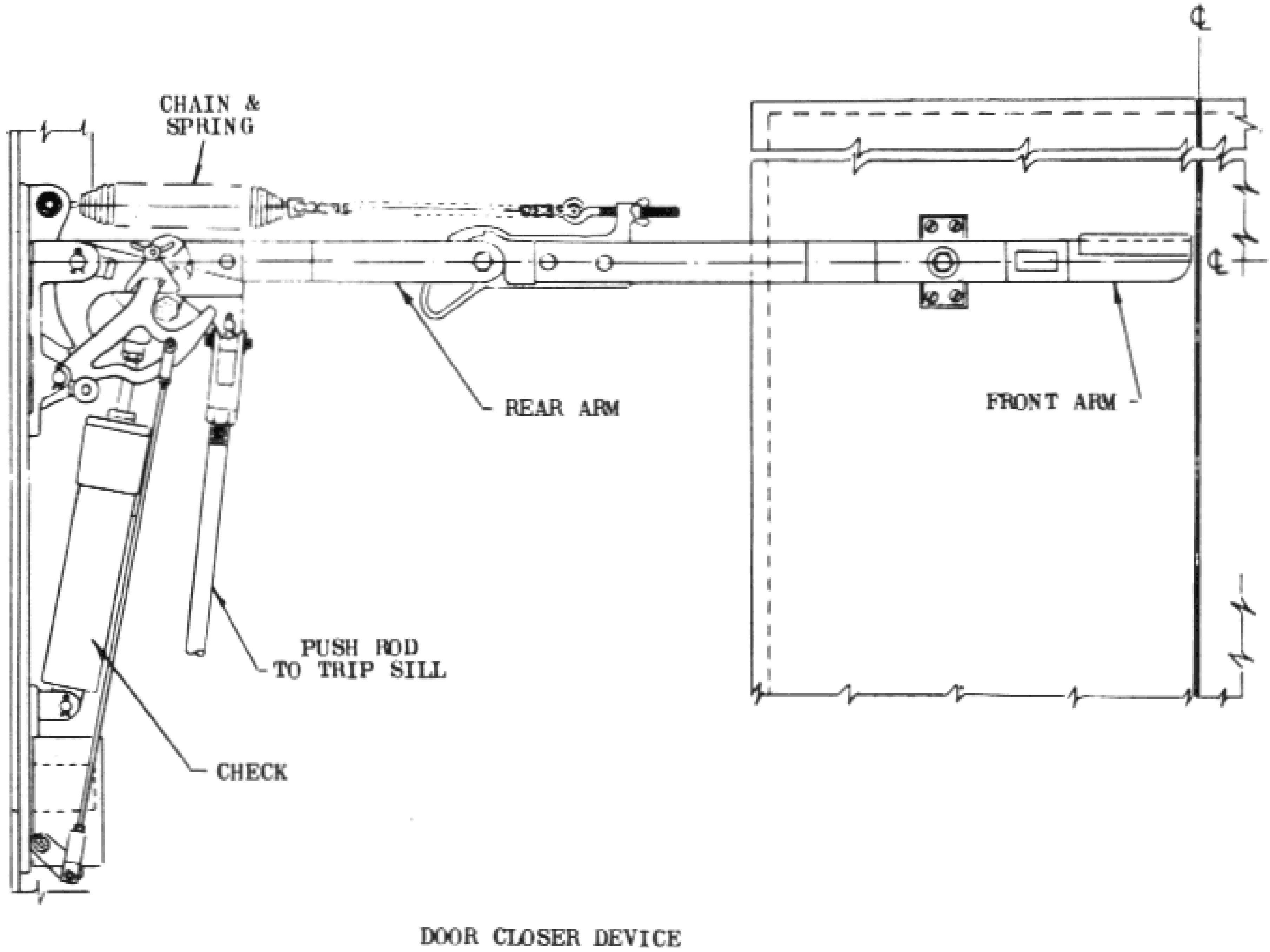
9. Installation of the last equipment mentioned is performed in a sequence that begins when the engine support is installed.

10. The support frames for the type are pre-fabricated, and require careful installation and assembly. The carframe and stiles are drilled to receive the support frame bolts.

11. Hang the support frame from the crosshead. Drop plumb lines from each front corner to check the alignment with the car platform sill. This alignment must be made in accordance with the car door detail drawings. Steel packing plates can be used to shim the supports to the desired position. The locations in which the shims are placed varies according to engine design.



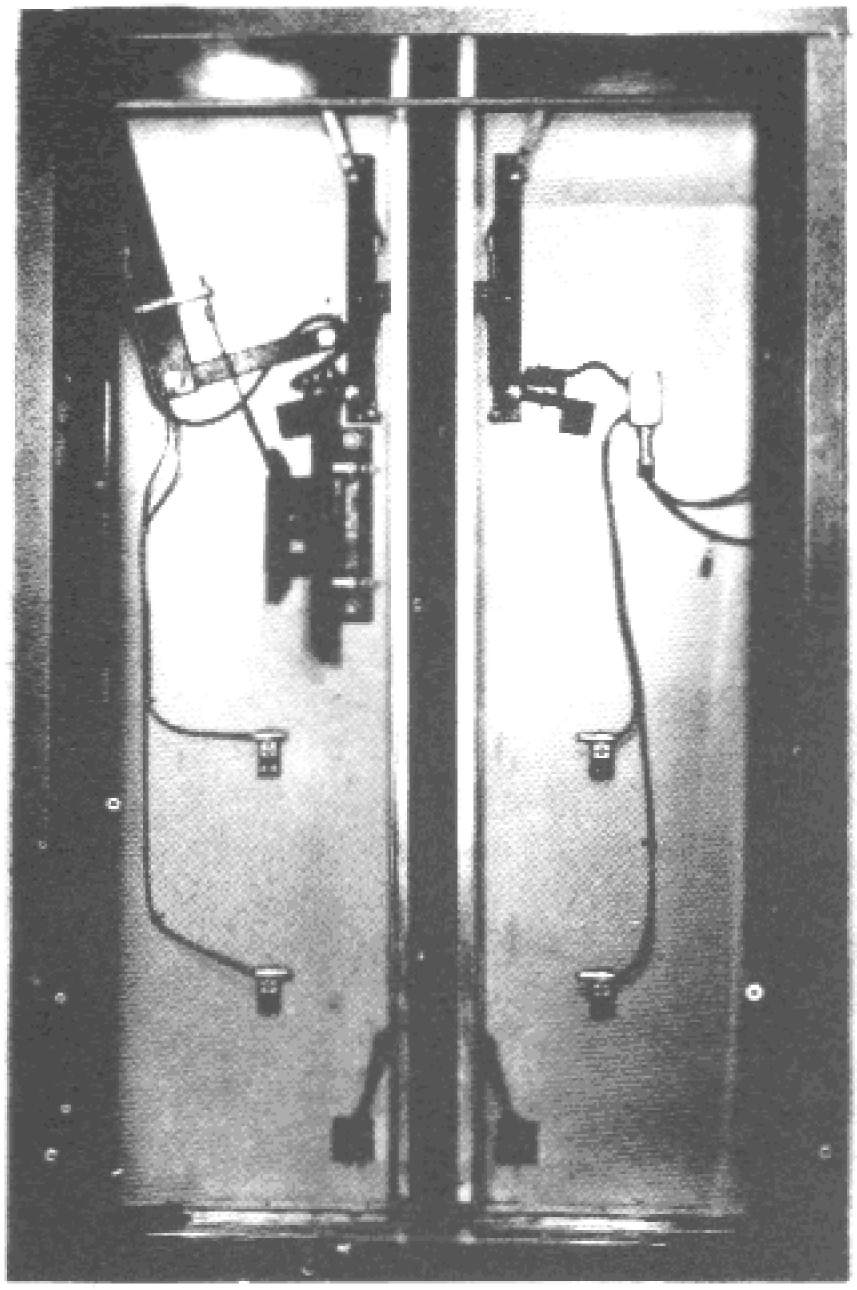
TRACKS WITH RACKS AND HANGERS



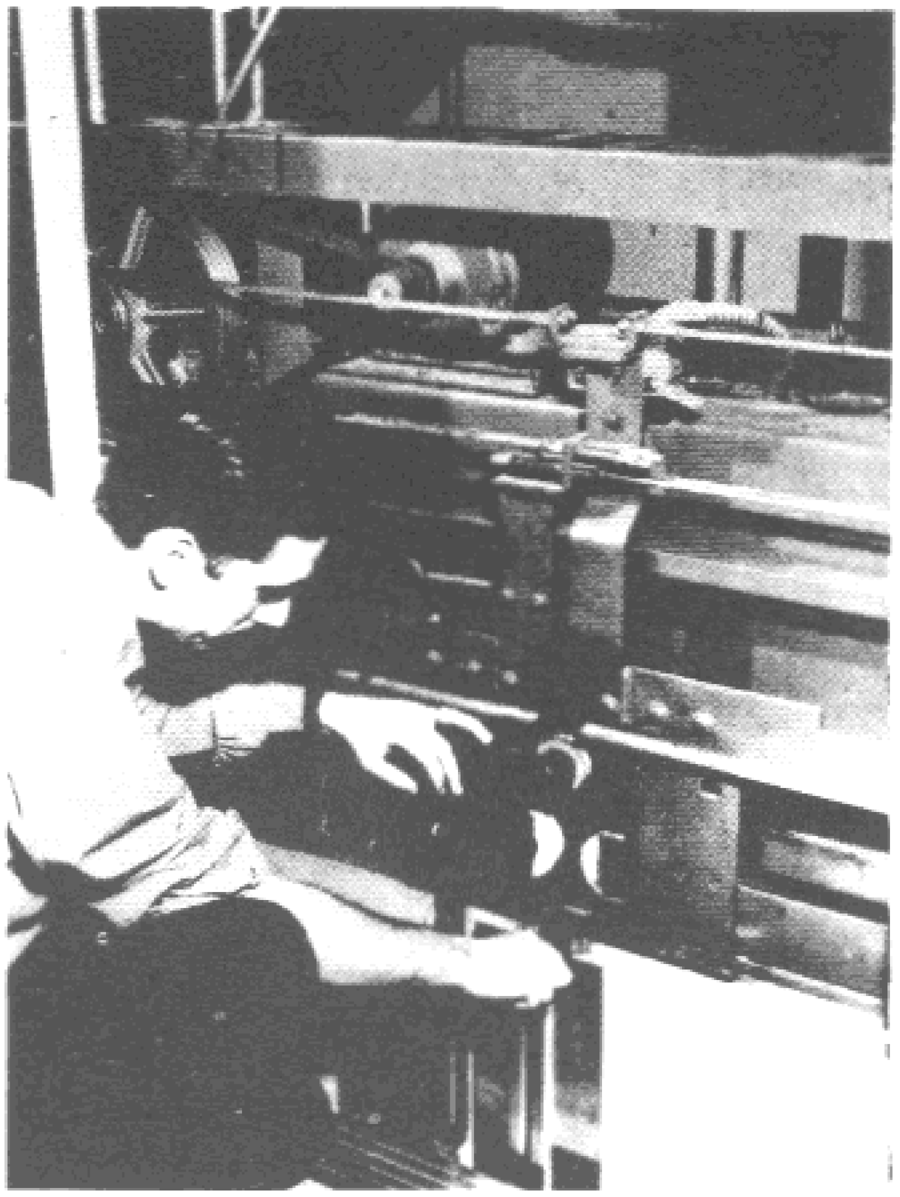
DOOR CLOSER DEVICE

ARRANGEMENT FOR CENTER OPENING DOORS

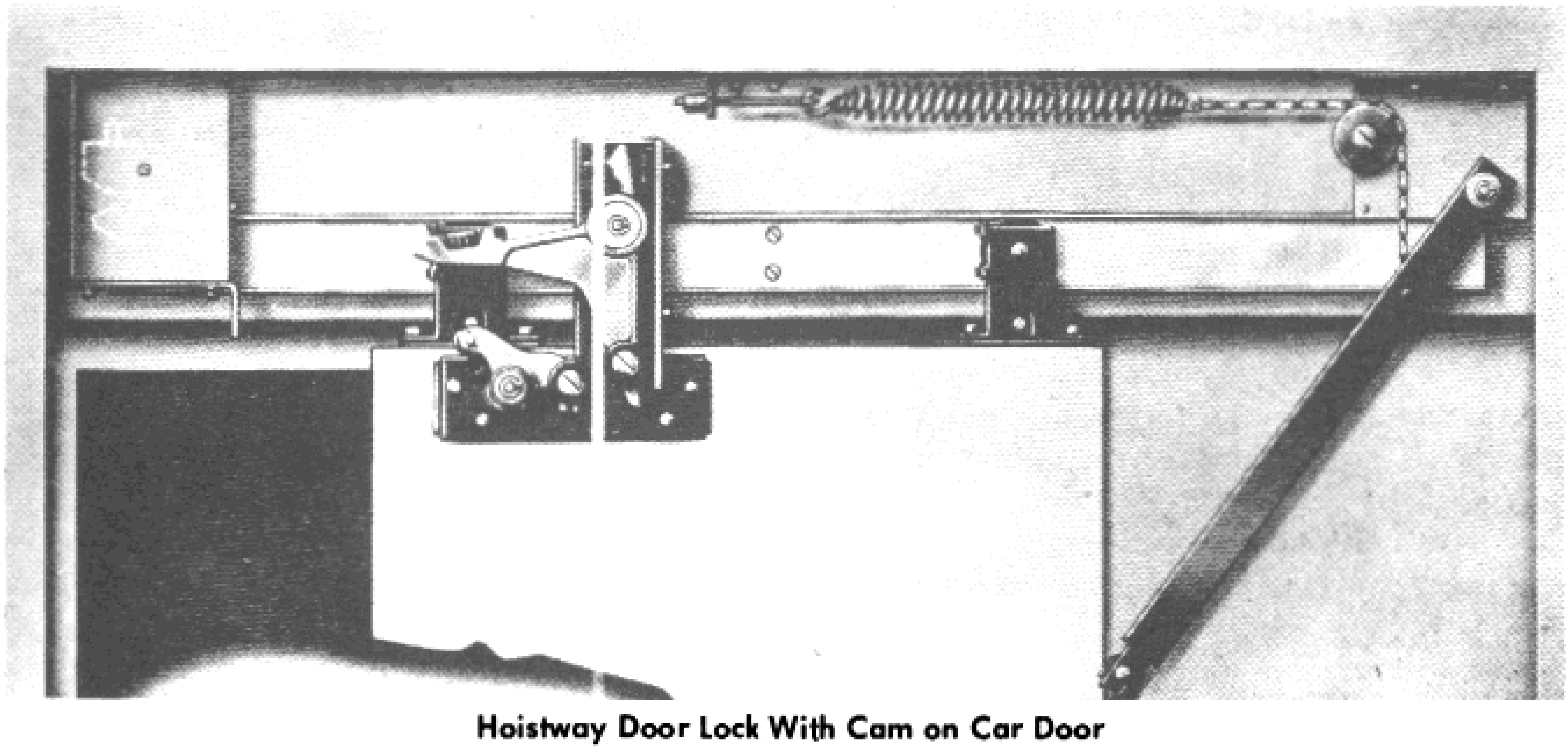
Hoistway Closer for Operator With Separate Car and Hoistway Drives



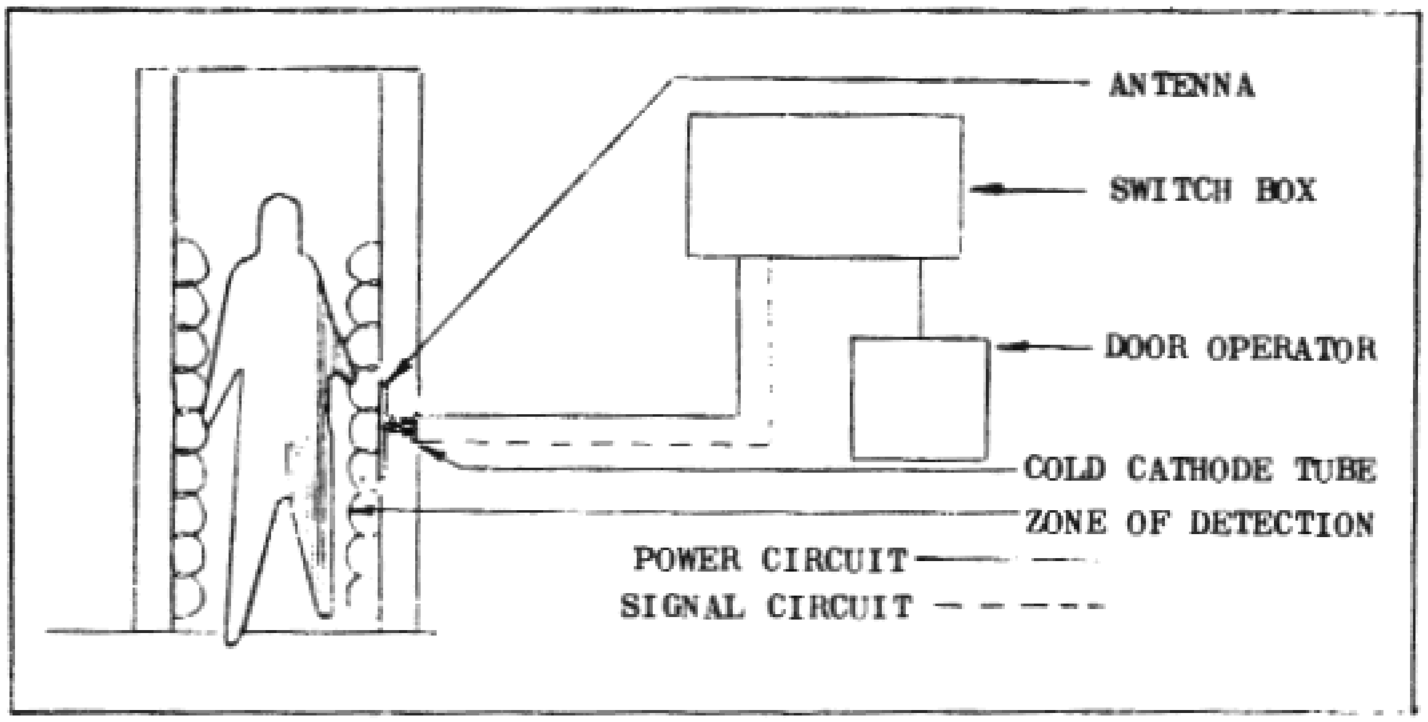
Montgomery Door With Safety Shoe and Electric Eye



Adjusting Hanger on Haughton Car Door



Hoistway Door Lock With Cam on Car Door



Schematic Arrangement of an Electronic Door Protective Device

12. Once the frame is installed, the operator unit may be set in place and aligned. It is very important to follow the drawing dimensions in this phase of the work. Faulty door operation may result from poor operator alignment.

13. One of the most important points is to be sure that engine drive arm motion is exactly parallel to the face of the car door panels. Lock washers should be used under all tap and through bolts.

14. The swing arm(s) for the car door is installed, after the enclosure is completed and the car door panels are installed. Be sure the panels are properly hung, and that they operate freely by hand. Installation methods are similar to those used to erect hoistway door panels.

15. The long swing arm is installed on the operator and moved to the door closed position. Close the door. The arm is connected to the door by means of a door plate or swivel plate. Hold this plate on the door in accordance with the drawing. Scribe the panel for the holes.

16. Move the door panel and arm to the fully opened position. Scribe the swivel plate holes a second time. Where the two marks coincide, center punch, drill, and tap the panel for the specified size tap bolts or machine screws. Install the plate on the panel.

17. If the door is two panel, two-speed type, or is the center-opening type, install the link arms to the other panels in the same general manner. (Refer to sketch shown for installing the slow-speed panel arm on "Two-Speed Hoistway Doors.")

18. Install the proper grade of lubricant in the operator motor and gear case (if any). The instructions regarding lubrication are supplied with erection data.

19. On some operators switches are provided at each extreme of the travel so that power is disconnected when doors are fully opened or closed. These switches are given a preliminary setting after all mechanical assembly of the operator is completed. The doors are opened fully and the "door open" limit cam set to conform to door adjustment instructions. The doors are fully closed and the "door close" limit set.

20. Other door engines are equipped with torque motors and maintain power on in both open and closed positions as well as during door travel.

21. Both types have specific advantages that are favored by their particular manufacturers.

22. Door speeds are fixed on some equipment but are changed during travel by harmonic action of the engines. Others are electrically adjustable, whereas some are "single speed" throughout travel.

23. The door brake (when used) is set mechanically.

24. After the mechanical work is done, the rotation of the motor is tested electrically and when correct, the door brake and speeds are set. Door contacts are adjusted to comply with the governing code rulings.

25. Safety shoes, photo cells and other door protective devices are installed physically along with the other mechanical parts and in the sequence laid down by the company's erection data. Final adjustments are usually made after the doors have operated under power for enough time to free-up operation.

26. Smoothness of door operation probably has more impact on the public which uses the elevator than almost any other individual function. It is, therefore, very desirable to obtain the best door and operator installation that can be made.

CHAPTER 11
Section -h1

DOORS AND OPERATORS

Vertical Travel Gates and Doors

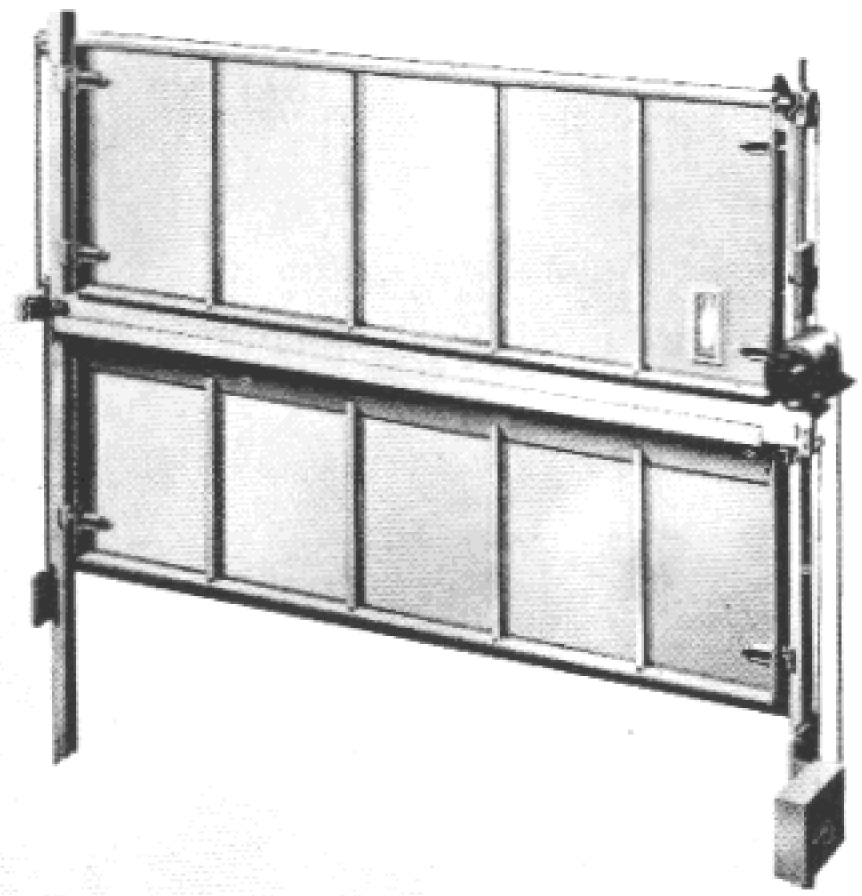
Suggested:

Materials –
- a. door equipment
- b. self-drilling masonry anchors
- c. bolts
- d. washers and packing
- e. sundries

Tools –
- a. hand tool kit
- b. electric drill
- c. electric hammer
- d. chain hoist or puller
- e. slings

1. Access to passenger elevators need only be wide enough to ensure a reasonable traffic flow of people. The nature of passenger elevator equipment makes it unlikely that bulky articles will be carried in the cars very frequently. On the other hand, freight elevators must be designed to take full advantage of all available space for easy loading as well as for cargo carrying.

2. It was natural to develop vertical opening doors and gates that can open to the full width of the elevator without requiring extra hoistway space on either side. This form of entrance protection has evolved through a period of years from wood slat, counterweighted gates that traveled on simple, vertical tracks to the fireproofed, steel, vertical lift and bi-parting doors that are so common today on freight elevators and dumbwaiters.



Vertical Travel Hoistway Doors Can Provide Maximum Entry Width

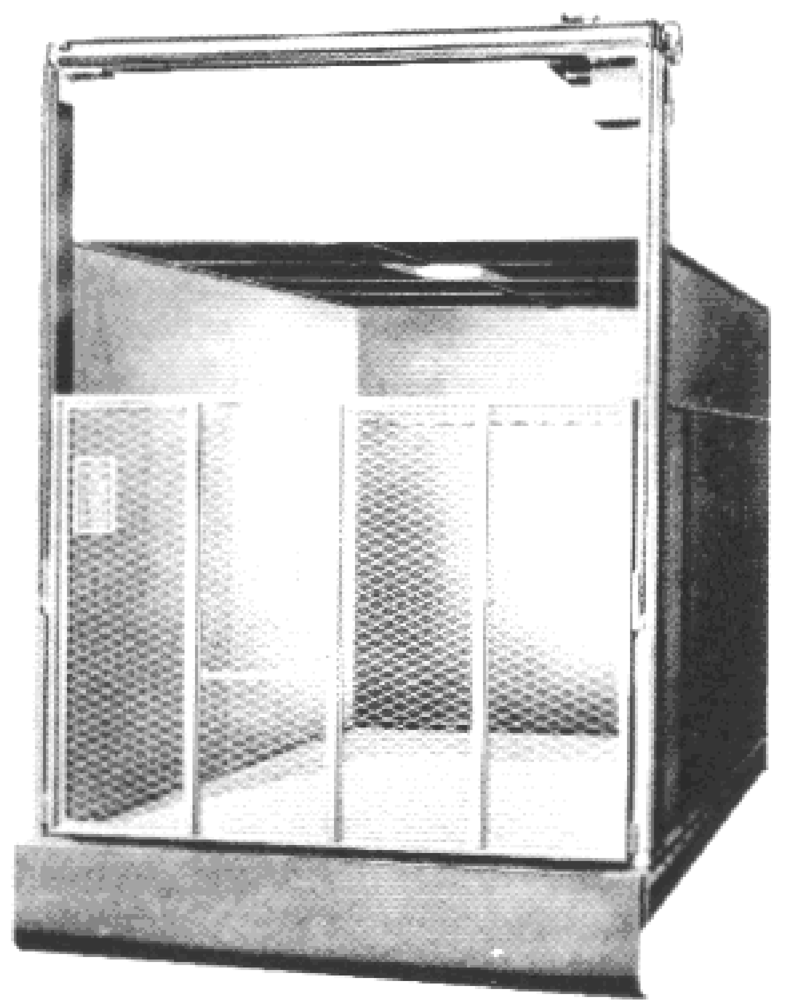
3. There are several types of vertical lift gates and doors commonly used at present. Some are single panel, either wood slats (or dowels) in a frame, wire mesh, or sheet iron. All are counterweighted. They travel vertically on steel angle or wood guides that are supported by gate posts or "boxes." A variation of this is the two or three panel vertical lift gate, which is used where headroom is limited.

4. Bi-parting gates and doors are somewhat similar to their single slide counterparts in appearance, but the lower section acts as a counterweight for the upper. The "break" or dividing line of these doors is approximately in the center of the door opening. Small weights are sometimes added to one or the other to obtain the balance condition. Balance is especially important for the heavy bi-parting doors. The A.S.M.E. Code requires that counterweights on these doors be attached securely so they cannot be dislodged.

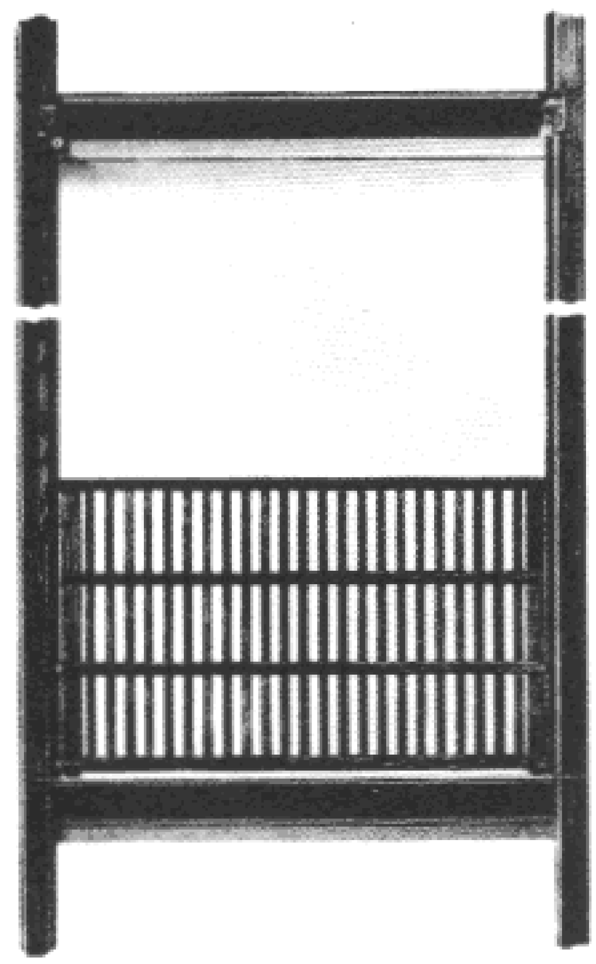
5. Vertical lift doors and the top upper sections of bi-parting doors must be equipped with pull straps, to facilitate their closing. The bottom of the strap must be no more than 6'-6" above the landing.

6. Although some wooden doors and gates are still used, especially in overseas, non-code areas, the great majority of freight entrances today are of steel. They are fire resistant and, therefore, fill the openings completely when in closed position. They can also be arranged to be watertight when installed on outer walls, such as at a truck loading dock. The door panels are generally galvanized and then paint finished. Vision panels are common and are considered to be a necessity for self-service elevators.

7. Door sills are usually heavy steel angles and the jambs and soffit are steel channels. These are often supplied as part of the building structure. The door tracks can be formed of flat steel and angles, channels or of bent steel sections. They are bolted to the hoistway flanges of the jambs or sometimes to the hoistway walls. Where floor heights are low or entrances relatively high, the door rails are most likely to



Car Gates are Generally Wire Mesh or Expanded Metal



Wooden Hoistway Gates are Still Used in Some Applications

be continuous. Where the space from one door soffit to the next door sill above it is very high, the door rails may be in individual pairs for each door.

8. "By-pass" doors are required where limited floor heights exist. In this type the upper panel of the door at the lower floor is equipped with a special track arrangement and other features that permit it to travel up and on the hoistway side of the lower panel of the door above. This requires that the hoistway depth be increased an amount about equal to the thickness of the door panel. The arrangement needs particular care in installation.

9. Bi-parting doors can be and frequently are manually operated but the trend is to supply power operation for larger sizes. This is particularly true on heavy duty freight installations where doors are wide, high, heavily braced and equipped with "truckable sills." This last feature involves design and manufacture of a heavy angle and bar sill on the upper edge of the lower panel. When the panel is fully opened and level with the landing sill, the "truckable" sill of the door rests on steel stops that are bolted or welded to the door rails. This transfers the load to the building structure when the concentrated load of truck wheels is imposed on the door. Bi-parting door panels are connected together by adjustable chains or wire ropes that are located at each side of the doors and operate through pulley systems. Some pulleys are power driven. Others have chain and sprocket drives for power operation. The code requires that the bottom edge of the upper panel of bi-parting doors be equipped with a non-shearing, non-crushing member to provide a spacing of not less than 3/4" between rigid members of the doors when closed. The code prohibits the use of overlapping, rigid astragals on the meeting edges.

10. Locks and contacts used on these gates differ in appearance, installation and adjustment, not only according to the manufacturer's design, but also with the various governing codes. They have, however, the common object of complying with the codes to insure safe operation of the elevator.

11. Many locks of this type are separate from contacts. The lock may be on the opposite side of the gate from the contact or may be adjacent to it. Mechanical latches are usually centered. They are used on manually operated doors. (Refer to the contract's door drawings for details.) Emergency opening devices can be provided.

12. When installing single or double panel, vertical lift landing gates (or doors), first study the drawings to determine the location in relation to the car sill center.

13. If the elevator can be operated, mark the center of the car sill, and use this mark to establish a reference point at each landing.

14. If the elevator cannot be moved, extend a wire from the top to the bottom landing sills to establish this common center.

15. At each floor, measure from this point to set the door guides (sometimes called boxes, tracks or posts). Set these door posts plumb in their proper locations. This may be inside or outside the hoistway walls but modern door tracks are normally inside the hoistway. Scribe the points where the bolts are to be installed. Remove the boxes (posts) and drill the holes. Use the type of fastening specified. If fastening to wood with through bolts, be sure to use cut washers and lock washers under the nuts.

16. Install the gate on the angle guides (or "tracks") by removing the shoes from one side of the gate, sliding the opposite shoes onto their track, moving the gate into position and then installing the second set of shoes.

17. If the shoes are "fixed" and cannot be removed, it may be necessary to remove one angle rail, install the gate, and replace the rail.

18. Mount the overhead pulley(s) then rope the gate to its counterweight. Try the gate to be sure the counterweight doesn't bottom before the gate lifts to its full travel. Adjust weight location if necessary.

19. Install the contacts and locks in accordance with the instructions given by the manufacturer. Be sure side movement in the panel is not sufficient to disengage the latch of the lock or damage the contact. Adjust rails or shoes to eliminate these hazards if they exist.

20. Installation procedure for bi-parting doors or gates is very similar, except that they are always set on the inside wall of the hoistway. The reason for this is that the TOP edge of the LOWER section of each door travels down to become a sill for the entrance. Obviously, therefore, the door must pass below the floor line and it must, of necessity be inside the hoistway.

21. Doors of this kind are usually heavy, and require chain hoists to lift them into place.

22. The rails are installed plumb. The "DBG" of the door guides should be carefully set in conformance with the drawings and carefully located with reference to the door center. Be sure to check the door track alignment. If the hoistway wall is irregular the rails can be packed away from the walls for plumb alignment, but only steel shims should be used. As stated in paragraph 7, the door tracks are bolted to the steel channel jambs so it is evident that the flanges and the angle sills must be closely aligned, both side to side and from top to bottom landings. If they are not plumb, this makes it mandatory that packing be installed under door tracks to obtain a plumb condition. This is especially true where door rails are continuous but even where they are not, car to sill clearances would be affected by an out of plumb condition.

23. The pulleys are mounted after the tracks, if they are not a part of the track assembly.

24. If the doors are very heavy, it may be preferable to remove all door shoes, set the doors in place, and then re-install the shoes. This will reduce the chance of damage to the shoes.

25. Rig the chain puller at the floor above the door. (Some mechanics set up a frame for this purpose and move it from floor to floor.) Sling the lower half of the door in place and set it on its "stops" temporarily. Adjust stops so panel sill (or top edge) is level with landing sill. Once the lower panel is secure, sling the upper panel into position. Reeve the support chains or wire ropes through the pulleys and secure them to each door panel. Adjust them to obtain full opening in accordance with the detail drawing and also to have both door panel edges level.

26. Try the door operation manually. If the top and bottom sections are not evenly balanced, add some of the extra "counterweights" that are supplied with the doors until a balanced condition is obtained.

27. Lubricate all chains, pulleys, and slides with the recommended lubricant.

28. Install all hardware such as handles, door pulls and mechanical latches.

29. Install door locks, contacts, and cams, if used, in accordance with the drawings.

30. Install the unlocking cam or sill trip on the car, after all hoistway landing door work is completed. Follow the manufacturer's instructions for its adjustment.

31. Vertical lift car gates are generally used in conjunction with bi-parting hoistway doors. They are installed in a manner similar to that used for hoistway gates of the same type. See paragraphs 12 thru 20 of this article.

32. Hall control button devices for power operated doors may be included in the hall-button fixture. This is traditionally set in the wall near the door vision-panel. However, the door controls and hall-button fixture is often suspended in a pendant fixture on elevators used to transport power trucks. This fixture is placed so that the truck driver can operate it without leaving the truck control position.

33. Door control buttons are always provided in or adjacent to the elevator car operating panels also.

CHAPTER 11
Section -il

DOORS AND OPERATORS

Toe Guards and Facias

Suggested:

Materials –	Tools –
a. guards, facias	a. hand tool kit
b. masonary anchors & bolts	b. taps, drills
c. screws	c. electric drill

1. The leveling action of most elevators equipped with this feature is independent of the position of the car and hoistway door contacts when the elevator is within the leveling zone. If a car door should open and a passenger attempt to leave the car while it was still leveling, the passenger might catch his foot under a hoistway door sill projection.

2. To eliminate this type of accident, the code requires that elevators equipped with leveling must provide toe guards under all hoistway and car door sills. The guards must be effectively flush with the hoistway edges of the sills, must span the full width of the opening and be of a length equal to the leveling zone plus three inches. The bottom of the guard must be beveled at an angle of not less than 60°, if it is designed to be secured to the hoistway wall. It can be extended straight to the soffit (or header) of the door below, if this is preferred, in which case it is generally termed a ''facia'' plate.

3. The rule has been extended to require these guards or facias on essentially all elevators in code territory regardless of whether they are self-leveling or not.

4. The guards can be installed at any convenient time after the entrances are complete in every other respect. However, if hall lanterns, position indicators or other devices are to be installed over door soffits, be sure to complete the conduit work as well as pulling wires and testing them before installing facias.

5. The hoistway toe-guards are designed and formed to fit in shallow recesses at the hoistway edges of the door sills. They are pre-drilled for small machine-screws which fit into factory prepared holes in the sill edges.

6. When designed to serve both as facias and toe guards, the bottom ends are generally arranged to ''slide fit'' or clip to the header of each floor below. The bottom is set approximately in place and the facia plate then shifted as required to permit installation of the screws in the facia plate and the sill edge.

7. Where the guards return to the wall they are set on their sills and two screws installed temporarily to hold the guard in position. The location of the bottom holes (which are factory drilled) is then scribed on the wall. The guard is removed and masonry anchors or other appropriate fastenings are placed in the wall. The guard is then installed permanently and all bolts and screws made up tight.

8. The facia plates and guards must all be checked carefully to be sure they are secure and that they have the proper clearances, to the car sills.

9. The car sill toe-guard installation is similar to that for the hoistway sill guards. The top edge is fastened to the car sill with machine screws. The bottom is steadied to the car platform or sub-frame by means of special brackets supplied by the factory.

CONTENTS

CHAPTER 12

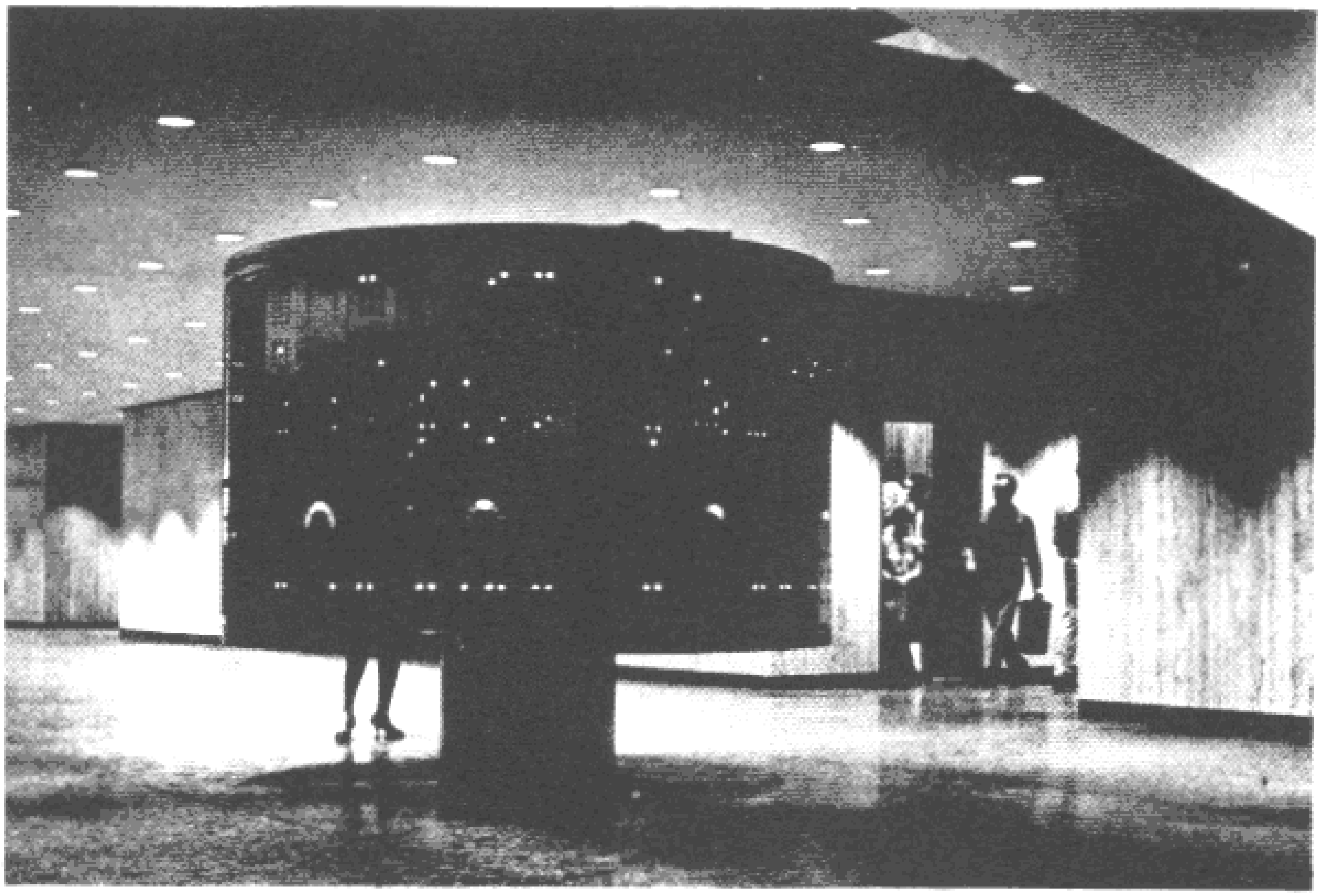
Section No.	Description	Page No.

ACCESSORY PARTS AND SCHEDULING SYSTEMS

CHAPTER 12
Section -a1

ACCESSORY PARTS AND SCHEDULING SYSTEMS

General



Elaborate Scheduling Console in the New Chase Manhattan Bank Headquarters Building

1. The title of this chapter is rather inadequate. The modern elevator can have so many complex components that it is difficult to draw the line where the basic elevator installation terminates and the "appliances" or accessories begin. No modern conventional elevator would be considered complete without hall buttons, signals of some sort or a car light, yet these were once unknown and later considered accessory parts. Direction indicators in the car or hall were crude contrivances until only a relatively few years ago. Scheduling was essentially a manually controlled device supplied only on highest quality of equipment.

2. The progress in applications of new materials and engineering concepts to elevator equipment has been more impressive during the past ten years than in any previous decade in the history of the elevator industry. The larger companies have literally invested hundreds of thousands of dollars in research and development to forward new inventions and refine old ones. Smaller elevator manufacturers have done a proportionate amount of work, as well.

3. The purpose of this chapter is to review those articles listed as, "Accessory Parts and Appliances" in chapter 11, of the original N.E.M.I. Erection Manual. It will also outline some of the newer developments and quite frankly, serve as a "catch-all" to connect the basic work with the "appliances." There is no intention to imply that a component described in this chapter is unimportant or of minor importance. In general, however, the functions of such parts are not essential to the basic operation of the elevators to which they are applied.

CHAPTER 12
Section -b1

ACCESSORY PARTS AND SCHEDULING SYSTEMS

Car – Interior Accessories

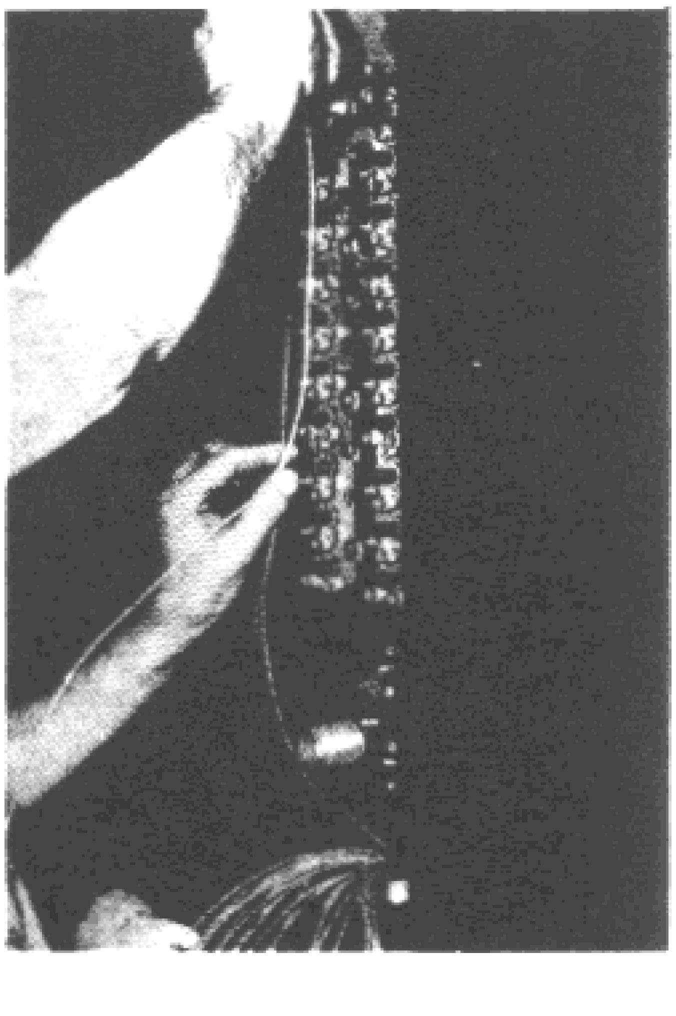
Suggested:

Materials –
- a. accessories and boxes
- b. bolts, screws, washers

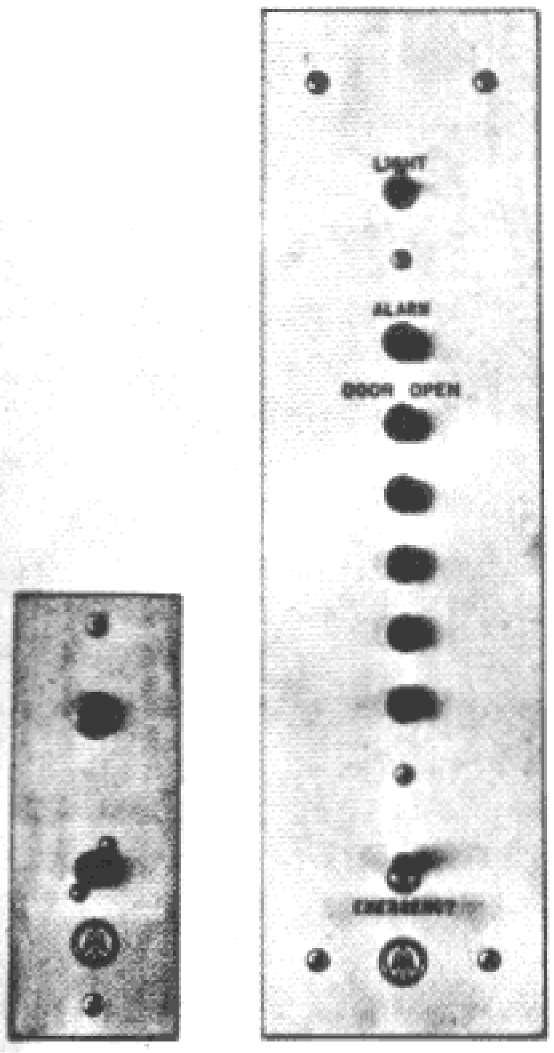
Tools –
- a. hand tool kit
- b. electric drill
- c. electric hacksaw
- d. special screw drivers or socket wrenches (as required) Allen keys

1. The accessory and the ornamental parts of modern elevator car interiors can be divided into operating and non-operating groups. Some of these items are combined in one cabinet or panel such as the car operating buttons and the car light switch, which are generally parts of the same panel or box assembly.

2. The operating parts are variable but among those most commonly found are the car operating buttons, emergency stop switch, key operated program switches, nonstop switch or button, direction (selecting) buttons, door operating buttons and leveling direction buttons. They are generally assembled in the same box or adjacent boxes with a common set of ornamental cover plates. (Other features are often included in the assembly as noted in paragraph 1.)



Mechanic "Hooking Up" a Westinghouse Car Operating Panel



Murphy Hall Button Fixtures and Car Operating Panel for Collective Control

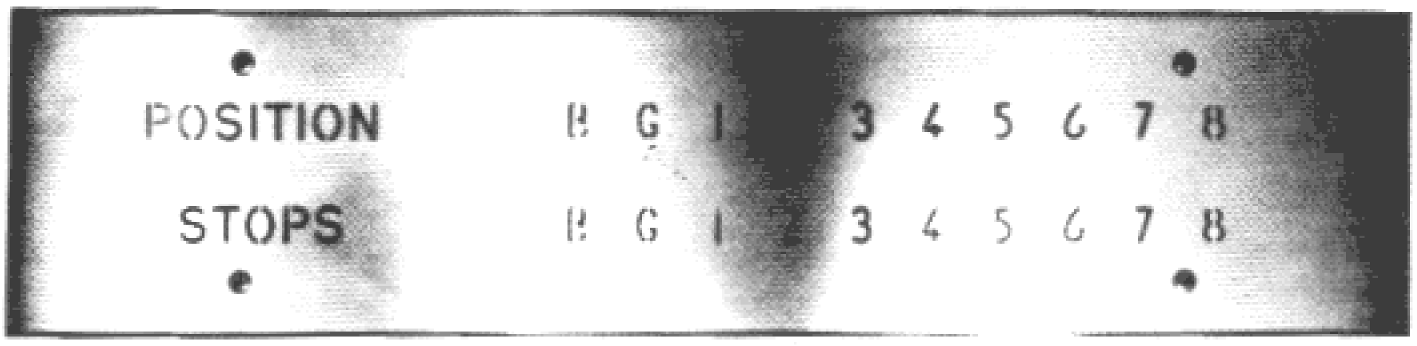
3. Basically, the devices needed for controlling action of an elevator are grouped in one location. Generally, this is on a front panel of an enclosure or on a side panel adjacent to the front and at a convenient height to permit ease of operation. High speed and better quality modern cars have one common exception to this rule. Where self-service car platforms are large and speed in handling traffic is important, a car-button operating panel is installed in each of the front enclosure return panels adjacent to the center-opening doors. This arrangement provides passengers with quick access to the car buttons and thus aids in expediting traffic handling. The buttons on this type (and on some single operating box installations) are generally illuminated indicators so that passengers entering after a button is once pressed do not repeat the procedure. This further speeds passenger handling of course. The Otis "touch button" is one variation of the self-illuminating feature.

4. Car position indicators, direction (of travel) indicators, car lights and ventilators, their switches and alarm bell buttons are examples of the "non-operating" accessory features.

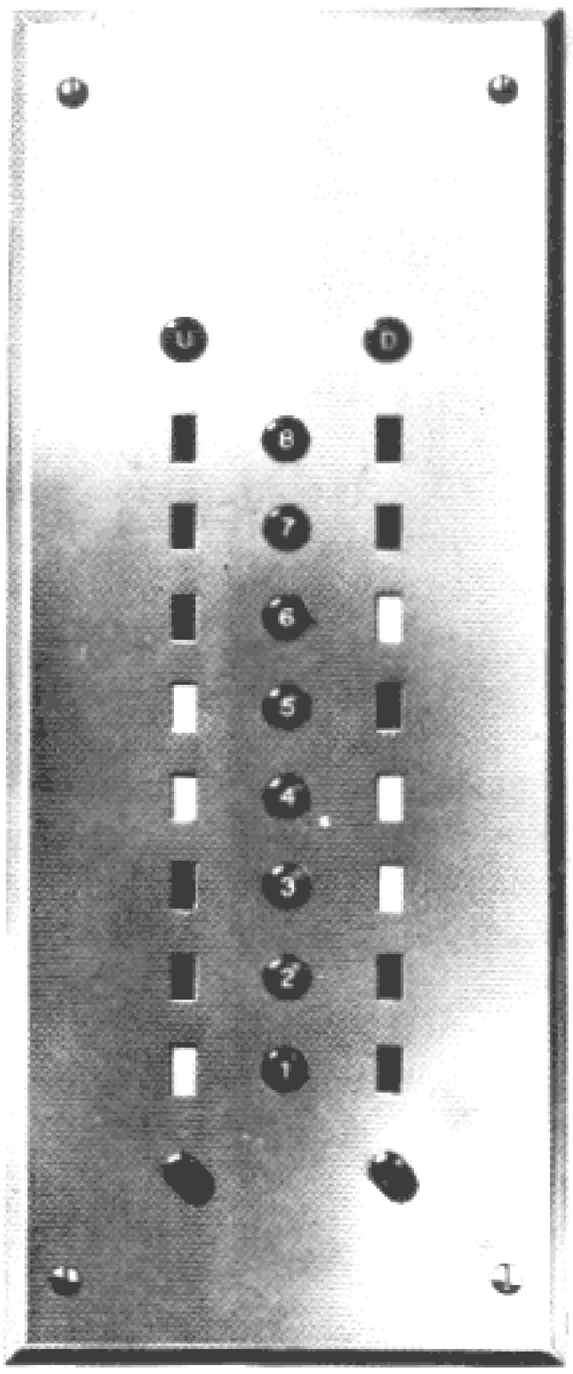
5. Car position indicators are usually electrically operated at present. The most common type is one in which a series of sockets are mounted in a flush type wall box. The sockets are separated by "barriers" of steel, fibre or some similar opaque material. The cover plate is arranged with a row (or rows) of translucent numbers corresponding to the sockets. They are usually installed in panel or car dome cutouts above or near the entrance.

6. Direction indicators consist of two lamps and a barrier suitably mounted in a wall box and covered by an ornamental plate. Generally, they are used on collective or push-button elevators which are not equipped with hall lanterns. They are usually placed in cutouts in rear panels of the car at a position high enough to be seen by passengers waiting in corridors to enter the elevator. Their purpose is to inform the waiting hall passengers of car direction and thus aid traffic regulation.

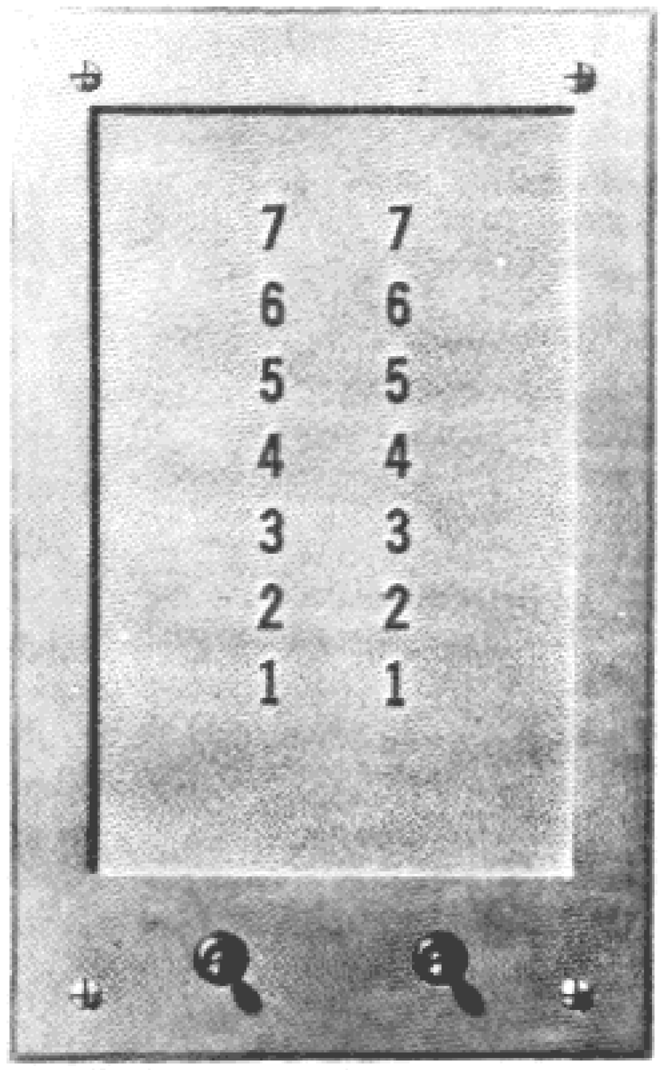
7. Car lights are extremely varied in pattern. Although many elevators still use some form of direct incandescent lighting, the fluorescent tube has become increasingly popular and is used in both direct and indirect applications. Concealed lighting fixtures range from simple troughs at one point in a car ceiling to elaborate grilles or translucent or even opaque plastic shades behind which the full ceiling area is lighted. Light fixtures are generally factory wired and bear the "UL" seal of approval.



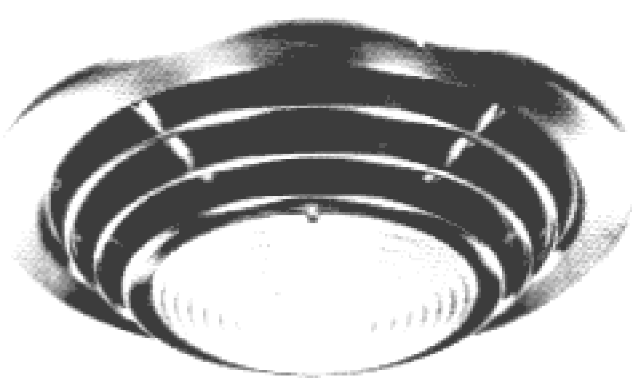
Several Companies Supply Car Position and "Registered" Stop Indicators Similar to this Haughton Fixture



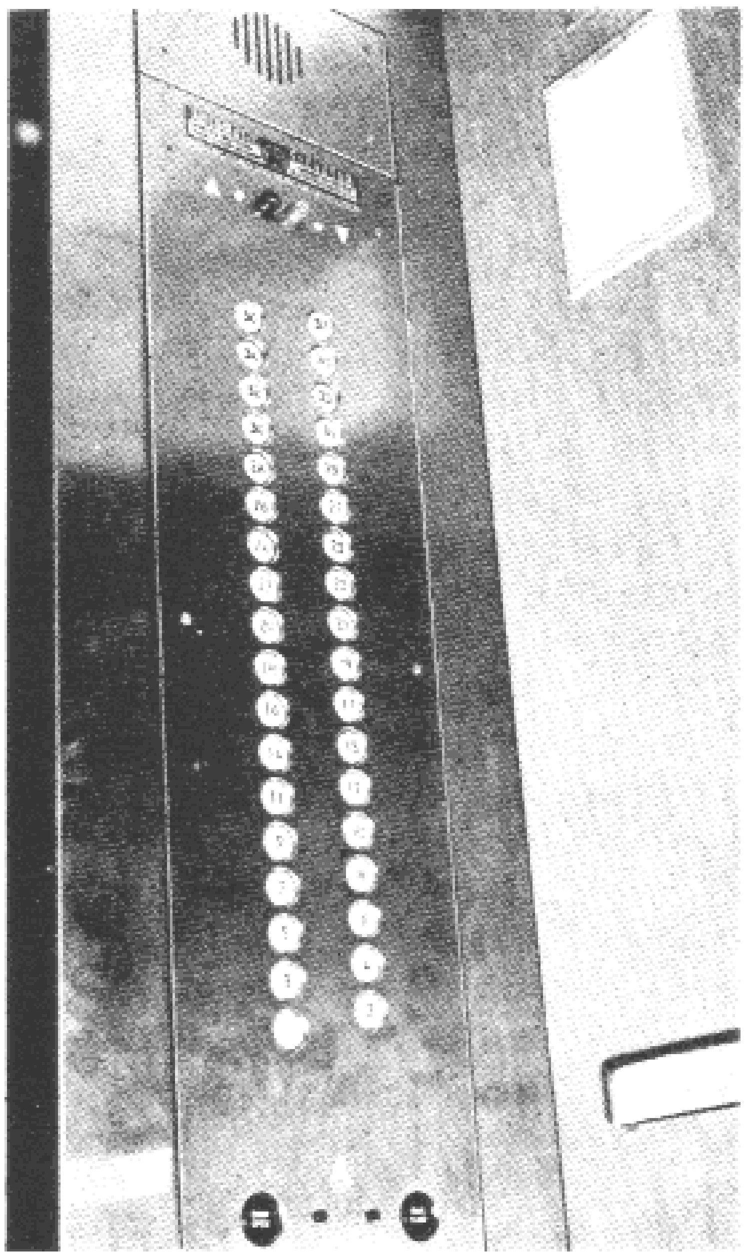
"Target" Annunciators are Still Used on Some Car-Switch Installations.



An Example of a "Flashlight" Annunciator



Typical Car Fan Fixture



Car Operating Panel of Modern Haughton Installation

8. Car ventilation may be provided by louvers that force air through the car while it is in motion, supplemented by natural circulation from the building as the doors open and close. Conventional fans are used in inexpensive cabs where ceiling heights permit this. Special vertical shaft fans are supplied by some manufacturers. These are mounted above the ceilings, often under the crossheads, and only a grille is visible within the car. Modern high-speed cars are generally ventilated by blower systems that are mounted on the car top. The car dome contains a plenum chamber formed by having in effect, a double ceiling. The blower forces air through the chamber formed by the double ceiling and vents it to or from the car through ornamental louvers. Air can be drawn from the hoistway into the car or exhausted from the car according to blower system design and ambient conditions. Louver grilles for the blowers are provided in the car dome, as a general rule.

9. Alarm bells are generally placed in a building engineer's or custodian's room or at some other point where they can be heard in an emergency. The latter location is often near the main landing entrance, either inside or outside the hoistway.

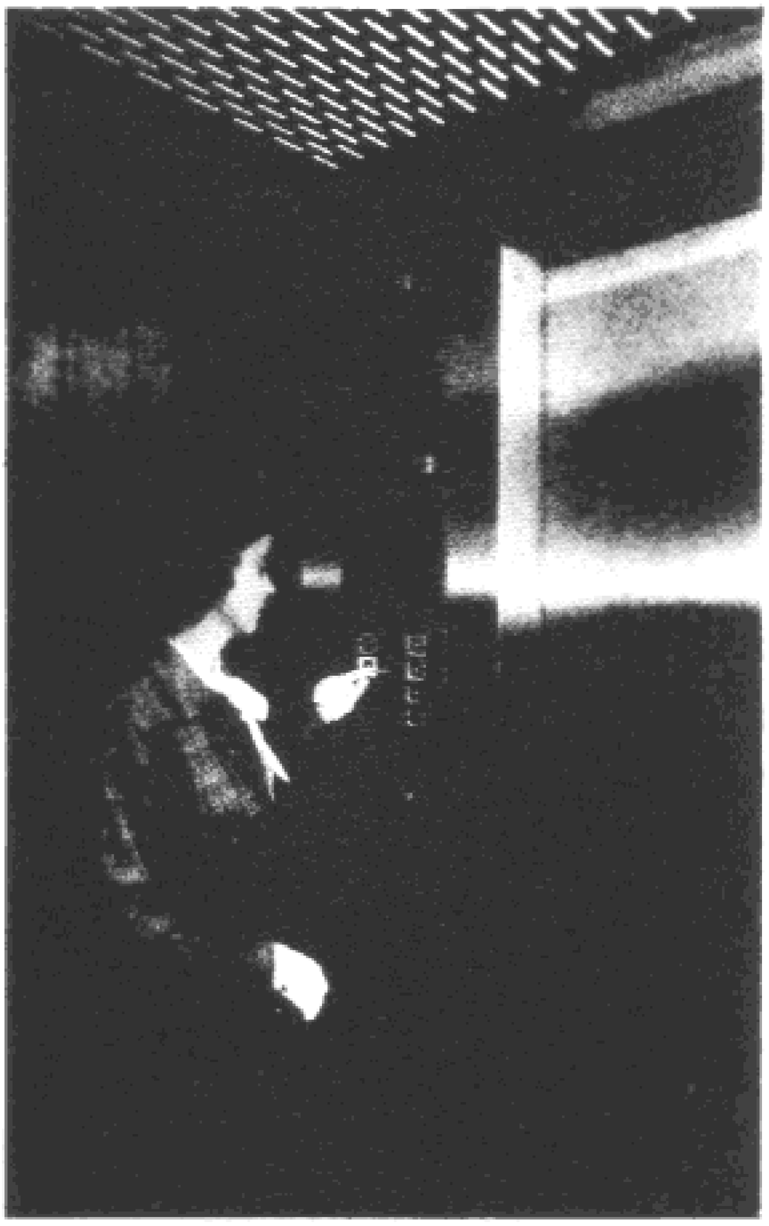
10. Special service switches are key operated and permit use of some operative device such as the "with attendant" feature on self-service cars. They are not used by the general public.

11. "Wall" boxes for all of the devices mentioned are shipped with groups of elevator material. They are designed to fit into cutouts in the enclosure walls. The cutouts are provided with angles or brackets welded to the enclosure and drilled to receive the wall box bolts.

12. The boxes are bolted in place per detail arrangement of each company. They are kept plumb and flush with the surface of the panel in which they are mounted. Some slight adjustment is provided in the bolt holes.

13. After installation, the boxes are connected to the wiring raceways by troughing, conduit, flexible tubing or a combination of these. The conduit drawing indicates which method to use but care must be exercised so that the sound proofing of the enclosure is not ruined.

14. Wires are pulled into the boxes and identified. The box switch assembly is then secured to its mounting brackets in the box. The parts are then wired. Twisted eyes or terminal eyelets are used if the wire is stranded. Solid wire is merely formed into an eye. It is important to make all wire connections clean and tight, and keep the stacks of wires clear of moving parts.



Otis "Touch Button" Car Operating Panel

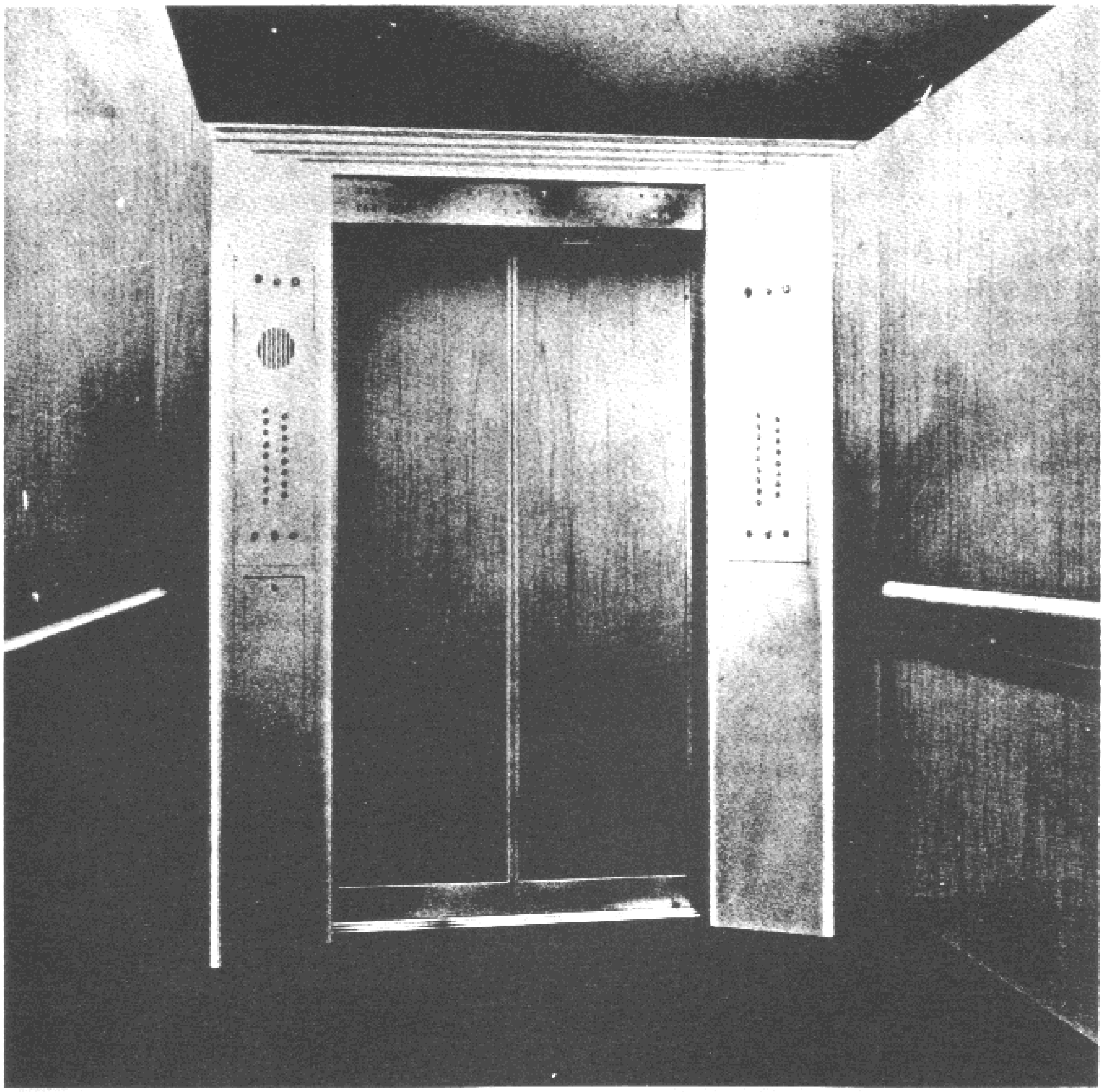
15. The wires are connected so that the longest wires in the stacks are in front in order to present a neat appearance. The stacks are corded or "laced" with twine or tape.

16. Although comparatively few car-switch elevators are now installed, the type will probably never become completely obsolete. Because of this a few comments on the equipment is warranted.

17. The switch is mounted in an enclosure, generally flush with the car panel. The "handle" is connected to the conducting "quadrant" directly or through a shaft. As the handle is moved either way the quadrant bridges the feed contacts to direction (and acceleration) contacts. This can initiate door operation indirectly or by means of auxiliary contacts in the car switch. (Doors are manually operated on many car-switch elevators.) Light, emergency and other switches may be in the same wall box.

18. Car-switch elevators are equipped with annunciators. These are devices that register the calls for service. They may be either flashlight or target type and also, as a rule, are mounted in boxes similar to the operating panel boxes. The design of the faceplate is chosen to harmonize with the other car fixtures. Annunciators are wired to landing buttons either directly or through some form of relay. They can be reset manually or electrically by the attendant. Automatic resets are also available.

19. Handrails are supplied on many cars. They may be on any one wall or on three walls. They are secured to mounting brackets which, in turn, are through bolted to the car panels.



Modern Car Arrangement With Position Indicator, Double Operating Panel, With or Without Attendant Control and "PA" Speaker.

CHAPTER 12
Section -b2

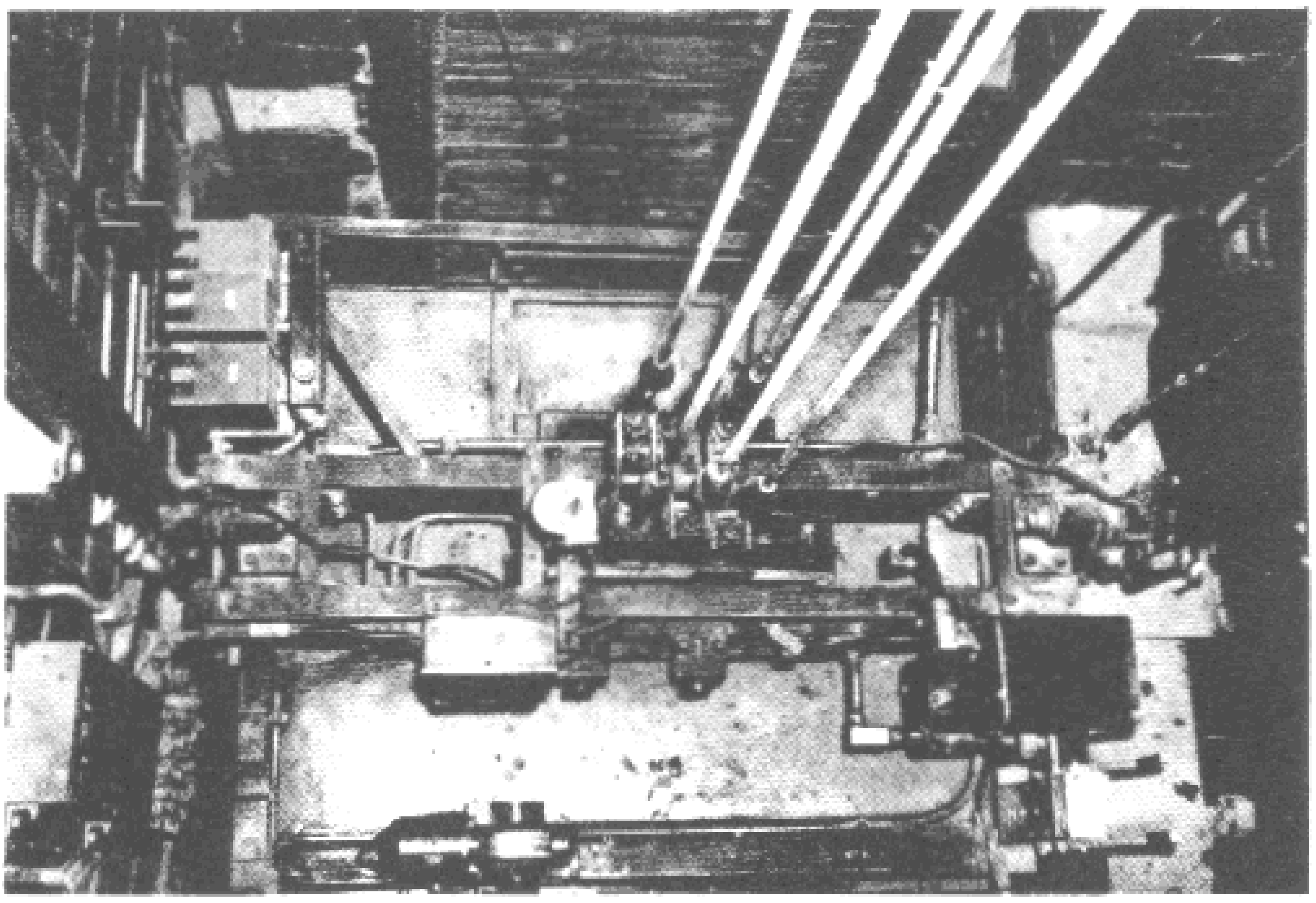
ACCESSORY PARTS AND SCHEDULING SYSTEMS

Car – Exterior Accessories

Suggested:

Materials –
- a. accessories to be installed
- b. sundries
- c. wiring material

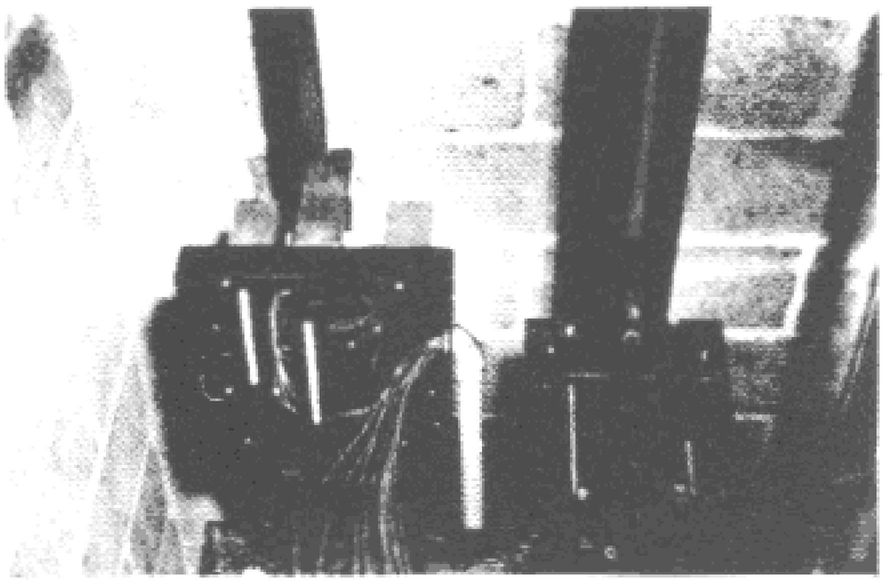
Tools –
- a. hand kit
- b. taps and wrenches
- c. electric drills
- d. Allen wrenches



Westinghouse Car Top Showing Inductor Switches, Top Left; Stopping Switch, Bottom Right; Rope Equalizer at Hitch and Door Operator in Bottom Center

1. A number of switches and other devices are attached to the carframe or outside of the car enclosure. Arrangement of frames was described in chapter 8, wherein the "sling" was referred to as the base of the car assembly.

2. Auxiliary switch and cam installation are facilitated by using the center lines of the guides as index points and placing the parts on the carframe. Among equipment so located on all cars are the final limit cam and safety operated switch. Some elevators may have "stopping switches," mechanical or inductor switches for leveling or slow-down operations, as well as floor-switch cams, load weighing (on car top or bottom), side emergency exit contacts, broken-tape switches and door-zone switches. Other items used on car tops may vary with the requirements of the governing code.



Leveling and Door Zone Inductors Being "Wired"

Examples of these are the contacts for top emergency exits, top of car operation switches and car top lighting.

3. The stopping switch (also called "automatic slow-down" switch, "TM" switch and "musicbox") is mounted on a bracket that is bolted to the crosshead. A roller arm is fastened to a shaft that extends from the switch box so the arm is beyond the car line. Contacts in the box are actuated by rotative movement of this arm. Cams are mounted from a rail at the top and bottom of the hoistway and arranged to engage the arm roller as the car approaches either terminal landing. This action opens the switch contacts controlling each direction of travel and thus prevents the car from running by the terminal floors under power if normal circuits fail.

4. The switch is adjustable in two directions. It is set to detail drawings and positioned from the adjacent guide rail face. After bolting the switch in place, the box is connected to the wire raceway. Wires are pulled in and identified. Connections are made in accordance with company standards.

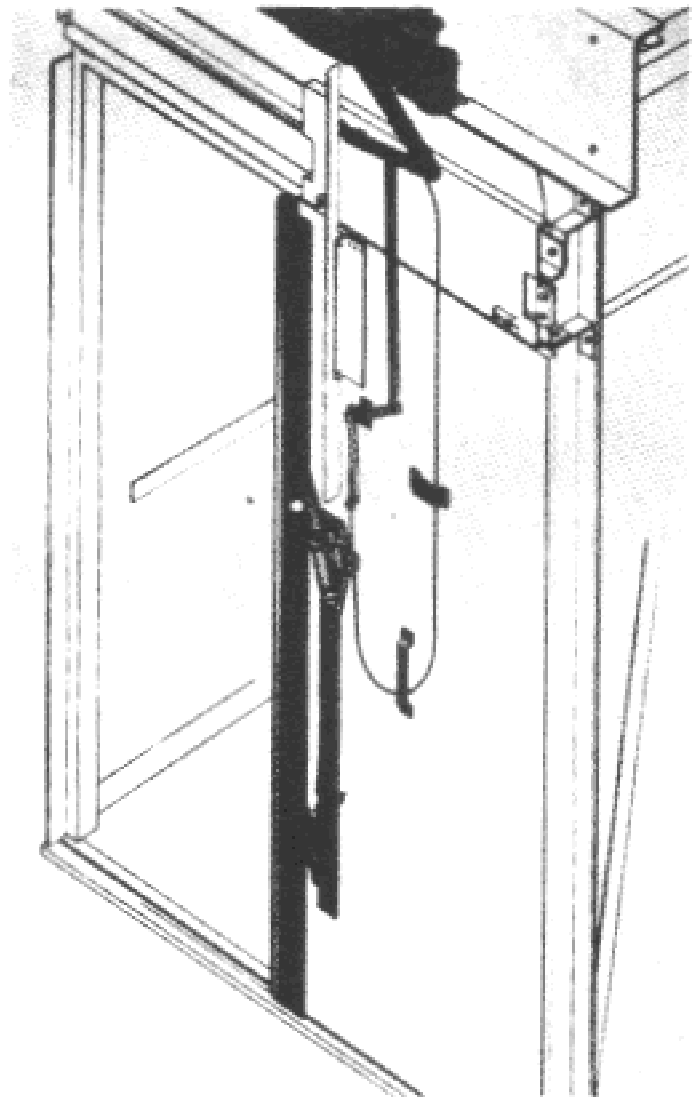
5. The cams are installed at specific locations related to terminal landing levels. They are adjusted postwise and in the angle of ramp, per company design. Cam lengths vary according to car speeds. The important points to determine are that the switch roller strikes each cam at the calculated position and that, as the car is moved up and down in the areas of the cams, the switch roller has full bearing on the cam faces. The roller should not leave the cam, if the car overtravels.

6. The final-limit cam should be carefully located from the guide rail as indicated on the layout or detail drawing. The cam should be positioned on the carframe, bolted tight and made plumb in two directions. The location of the cam in relation to the switches must be checked. The switch rollers must have full bearing on the cam and open wide enough to break any possible arc across the contacts. The rollers should not leave the cam, if the car should run to pit or overhead. Some companies have cams on the car that operate both the final limit switches and the floor stop switches. These cams are "combination" design and include ramps that "trip" the floor stop switches while straight cam faces operate the final limits. Other companies designs utilize one cam for the final limits and a separate one for floor stop switches.

7. Two-speed A.C. and other elevators often are equipped with slow-down limits and direction limits at terminal landings. They are usually operated by the final limit cams.

8. Leveling and other switches are often set in factory prepared brackets. They must be plumb as well as properly located according to their drawings. The "vanes" or cams are mounted on brackets from the guide rail, or wall. These must also be plumb and at the correct distance from the guide rail faces. They are individually adjusted for proper location in the inductor air-gap (or switch rollers), with the elevator car level at each floor in turn.

9. The switches are connected to the wiring system by short sections of flexible tubing so some adjustment can be made to the leveling zone. This work is finalized by the man who adjusts the elevator. The lengths of the cam or vane is one of the factors that determine the length of the leveling zone. For example, elevators with 24" leveling vanes could have a 12" leveling zone, i.e., 12" above and 12" below the landing. If two vanes were used, the zone would be about doubled. Interlocking contacts on the controller or floor controller would also affect the effective length of the leveling zone.



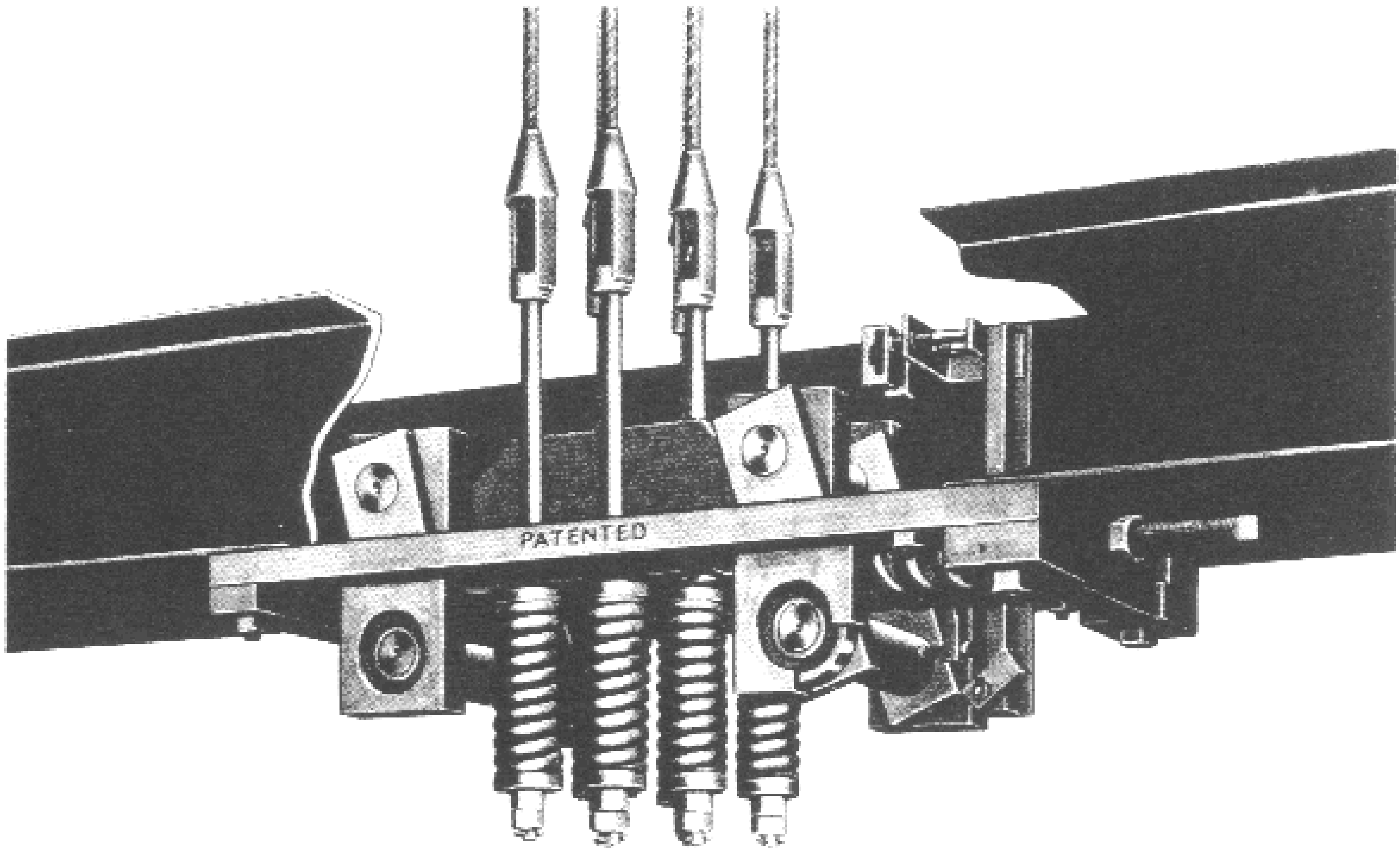
One Type of Car Door "Safety Shoe"

10. Safety operated switches, door limits and other items such as car-top operating buttons, and emergency exit contacts are placed on brackets supplied by the manufacturing company. They operate in conjunction with some specific piece of equipment. Their approximate positions are shown on the layout or other erection data. They must be piped and wired into the raceway. The "safety-operated" switch may be located on the car top or bottom depending on the design of the safety. It should be adjusted to open when the safety device begins to apply. The contact, operated by a crank or cam, is in series with the line or potential switch of the controller. When the safety-operated switch opens, the car stops. It must be reset by hand. It cannot be reset until the safety has been released from the guides.

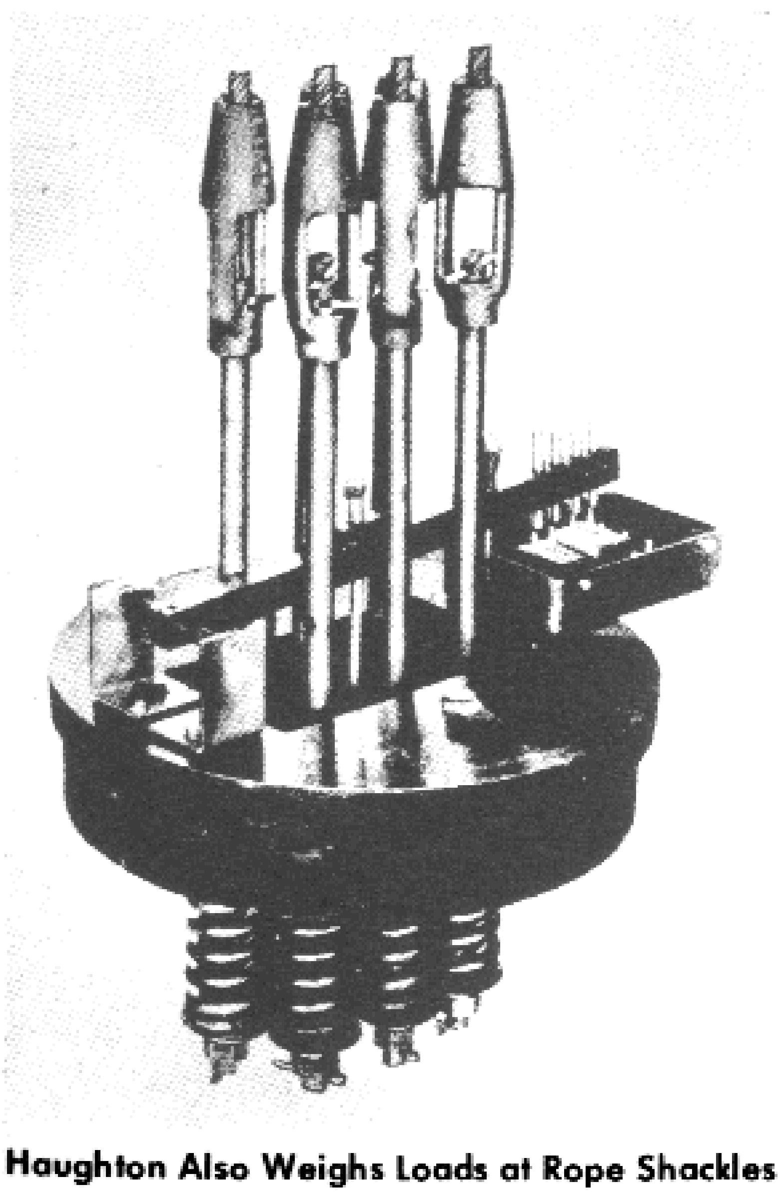
11. "Door zone" switches may be separate units or a part of the leveling switch assembly. They limit the scope of door operation to prescribed areas, usually somewhat less than the leveling zones.

12. The floor controller broken-tape or wire-drive switches are usually mounted on the car top. Their contacts are opened mechanically, if the tape or wire breaks. This stops the car, reducing the chance of unnecessary damage to equipment. They must be reset by hand, after the tape has been repaired.

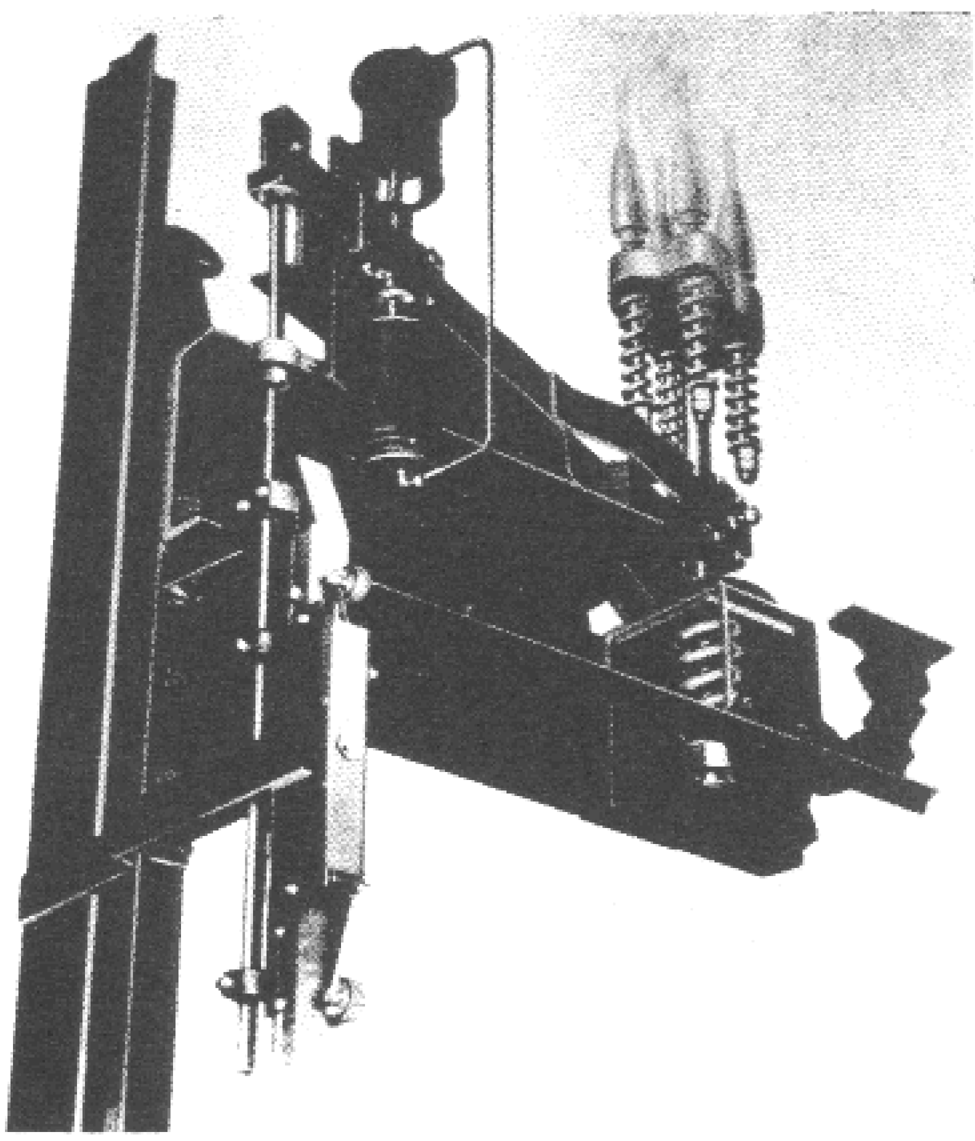
13. It is very important to test the operation of each switch and contact to be sure it functions properly.



Montgomery Load Weighing Device at Rope Shackles



Haughton Also Weighs Loads at Rope Shackles



Another Haughton Load Weighing Device

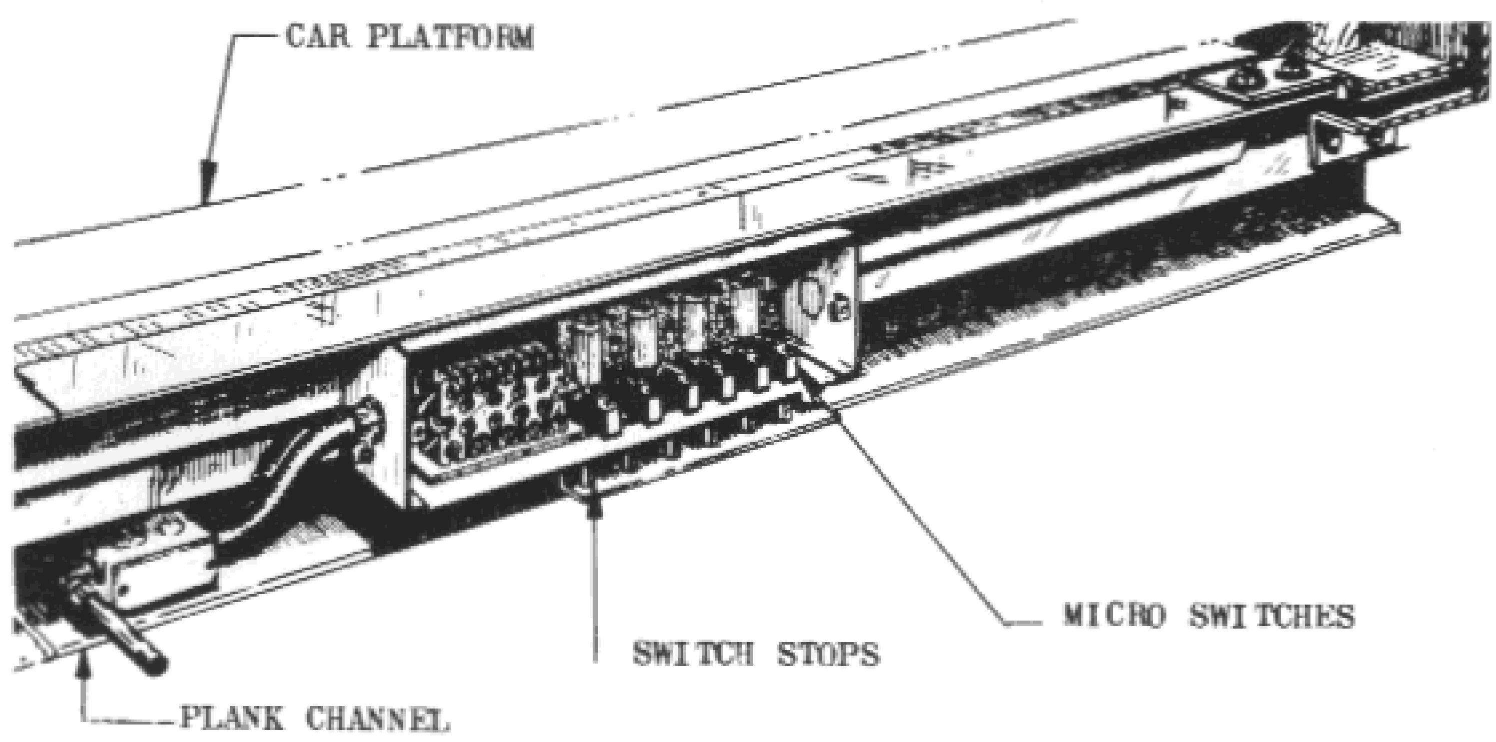
14. There are a number of different kinds of apparatus designed to protect passengers from door impact and to expedite door operation. Most of these devices are packed or shipped with car door equipment. They are arranged to mount on or adjacent to the car doors and their most essential function is to reopen the car and hoistway doors in the event that a passenger is in danger of being struck or caught by the doors.

15. The oldest and most common type is the ''rubber nosed'' ''safety shoe'' which is hinged to a plate that is mounted beside the leading edge of the door panel. This shoe travels with the panel and leads it by several inches. If stopped in movement, the shoe activates a relay that reopens the door, ''times'' out and then re-establishes door close circuits. This shoe requires more ''door open'' space than the regular door panel, if a clear opening is to be maintained. If hoistway space is available, this point is not too important, but retractable types have been designed to overcome the difficulty for ''tight'' space conditions and to reduce damage to the shoe. Both types are also made of aluminum, phenolic and other light materials.

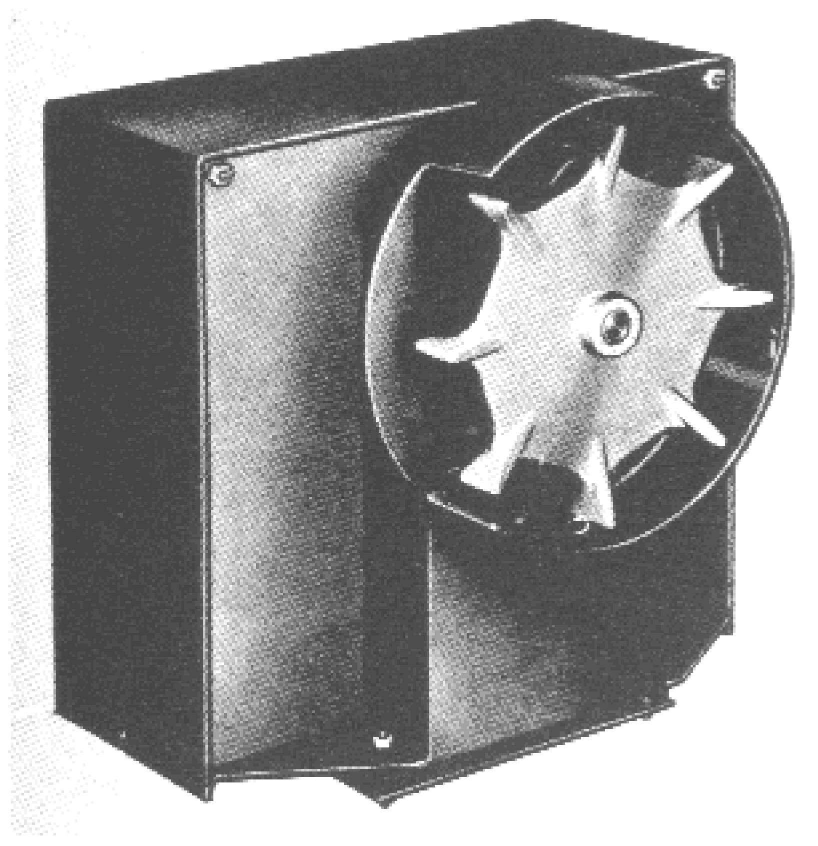
16. ''Electronic'' door protective devices are quite popular and efficient. Some are based on the use of photo-cells beamed at two or more levels in the door opening. Others are sensitive or proximity devices mounted in leading edges of car door panels. Both of these types involve more complex circuitry than the ''safety shoe'' and are often arranged to provide other features, such as ''nudging'' passengers who delay doors too long or for establishing ''annoyance'' buzzer signals for the same type of persons.

17. Elementary photo-cell devices are used on collective control or even push-button installations. The more complex equipment is provided on elevators with high intensity of service and high car-speeds.

18. Load-weighing devices are supplied for several purposes. Several companies have developed their load-weighing equipment on substantially different approaches.



Otis Micro Switch Load Weighing Device



Montgomery's "Star Wheel" Selector is Mounted on the Car Top

Some depend on rope tension, using springs and lever arms. Others work on the principle that compression of rubber sound-isolation can accurately measure load, so use carefully calibrated switches to "read" the compression.

19. Anyone of the types can be arranged to operate from the car top, car bottom or machine room. Most companies favor car-top devices at present but several utilize the other locations. The photos in this section illustrate three types.

20. Several companies have simple forms of floor selectors that mount on top of cars. They are limited in the number of stops they can serve but they eliminate individual floor stop switches when used. These selectors are installed on factory supplied brackets that fasten to the crosshead. They are piped and wired conventionally from the car wiring system.

21. These devices have a set of stopping contacts in the selector box. They are activated by movement of a shaft that passes through the box and extends beyond the car line. A special cam is mounted on the selector. Tripping devices are secured to the guide rails by brackets near each floor. As the car approaches a floor for which a button has been pressed, the device on the rail trips the cam, finds its circuit open on the selector and initiates the stop.

22. The photo of Montgomery Elevator Company's "star-wheel selector," shown here, illustrates one version of the type.

23. There are other elevator variables that are used on car tops but the foregoing descriptions outline functions and installation practices for some of the more common ones.

24. It is recommended that light sockets and convenience outlets be installed on top and bottom of all elevators as a matter of good practice. The cost of these will be repaid many times during the work of construction and maintenance.

ACCESSORY PARTS AND SCHEDULING SYSTEMS

Hoistway Switches

Suggested:

Materials –	Tools –
a. switches	a. hand tool kit
b. brackets	b. electric drill
c. wiring material	c. self-drilling anchors
d. sundries	d. electric hammer

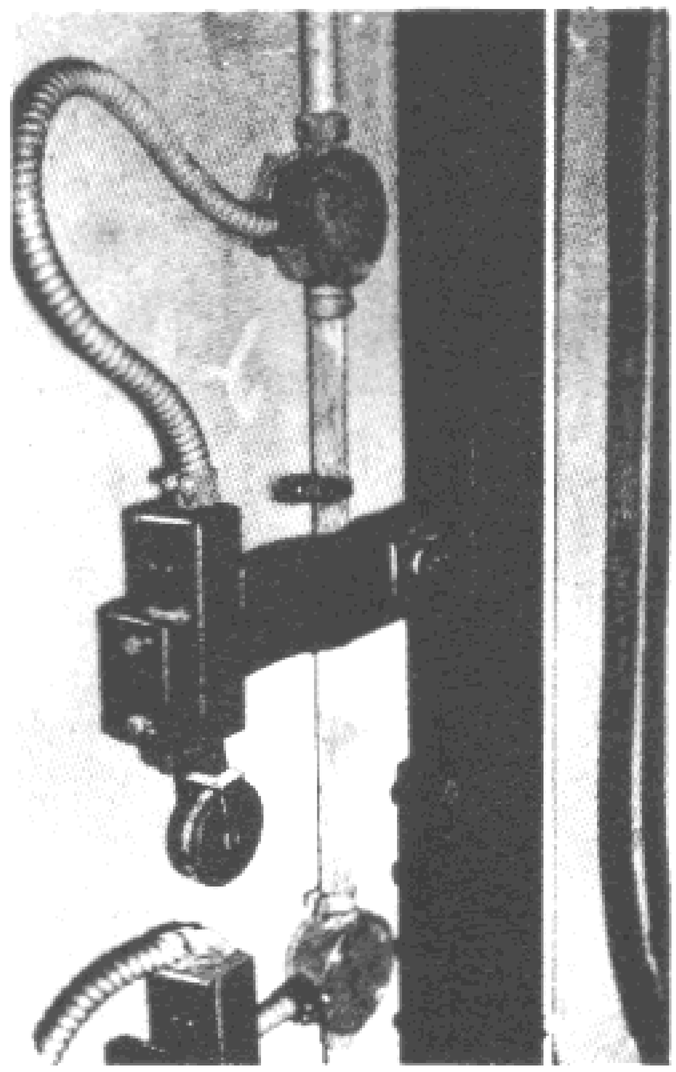
1. A considerable number of switches are used in an elevator hoistway. Among the most important of these are the "limit" switches of various types.

2. Limit switches were mentioned in chapter 12 -b2. They can be roughly identified by their protruding "roller arms." These arms are directly connected to a set of contacts which open (or close), when the rollers are moved by their cams.

3. Limit switches are characterized as "final," "slow-down" and "landing" (or "floor") types.

4. Final limits are required by almost all codes. These switches are bolted to brackets that are generally clipped to the car or counterweight guide-rails. Their setting in relation to the car is definitely fixed by company standard data.

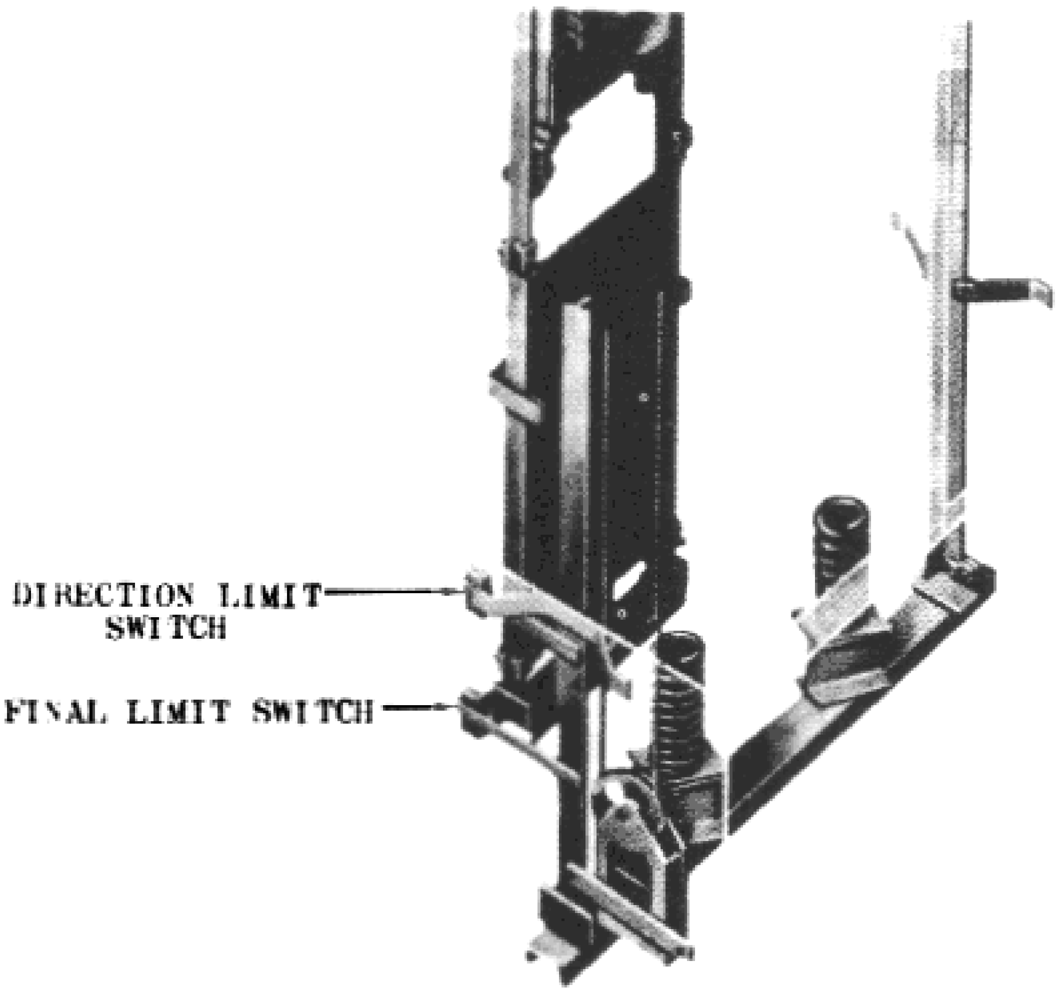
5. The final limit cam is securely bracketed to the elevator car. It is fixed in a plumb position (see section 12 -b2).



Final Limit Switch and "Direction" or Terminal Floor Switch on A.C. Elevator

6. The final limit switches are installed at the top and bottom of the hoistway in line with the cam, and arranged to stop the car a few inches beyond the normal terminals. The code specifies the settings in relation to car speeds. After being set, the switches are generally through bolted to the rail. When the switches are opened, the car cannot be moved in either direction.

7. "Stopping" limits is a term applied to sets of limits that are clipped to rails at the top and bottom of the hoistway, bringing the elevator to a gradual stop near



This Variation of Final and Direction Limits are Bracketed to the Car Guide-Rails

either terminal. The switches may be operated by the final limit cam or have a separate cam. They stop the car in one direction but permit it to operate in the reverse. "Directional" limits are really "terminal" floor stop-switches on single-speed units and the final stopping limit on two-speed equipment. They are set to operate ahead of the final limits, of course.

8. "Landing" or floor stop limits or switches are those placed at each landing to stop the car at those landings, for which the stop circuits are set up. They are often operated by specially designed cams which reset the switch for the opposite direction, as the car passes any landing. As a rule, these limits are bolted to brackets that are clipped to the car rails.

9. Some manufacturers mount final and slow-down limits on the car with cams fixed at the terminals. The great majority of elevators, however, have limits installed as described in paragraphs 1 thru 8.

10. There are many other switches in the hoistway and pit. These include compensating-sheave switches, buffer switches, broken-tape switches and the stop switch in the pit.

11. All are set in predetermined positions, as shown on erection data, and wired in the normal routine of the elevator company involved. Settings are important. Functions of several were reviewed in earlier chapters of this book.

12. The buffer switch is designed to prevent the car from running down on fast-speed, if the buffer piston fails to return to normal position after compressing. The pit located stop-switch is one required by code for protection of field men. When it is opened the elevator cannot run.

CHAPTER 12
Section -c1

ACCESSORY PARTS AND SCHEDULING SYSTEMS

Landings – Hall Buttons, Lanterns and Miscellaneous

Suggested:

Materials –
- a. accessory parts
- b. sundries
- c. wire terminals

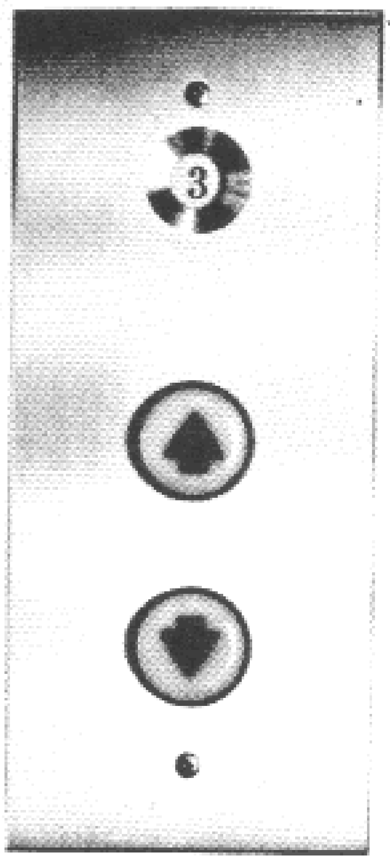
Tools –
- a. hand tool kit
- b. 8'' level (approx.)
- c. wire terminal crimpers

1. The need for some form of signal to inform the elevator attendant that passengers were waiting must have become evident at a very early stage in elevator development. When electric bells and buzzers became available they were soon installed on elevators. Old units equipped with these commercial door bell push-buttons can still be seen. Commercial lock-drop annunciators were adapted, also, and modern versions of these are still being installed for some applications.

2. Today's flush mounted, neatly designed hall-button fixtures are far more attractive than their predecessors but they serve the same general purpose. The modern hall-button fixture often includes extra or special features such as ''in use'' or ''car coming'' lights, electric or mechanical position indicators, ''tel-tale'' lights to show that the passenger's call has been registered and key-operated switches to restrict service to special individuals. Many elevator firms provide hall buttons that light where pressed. One has a self-illuminating ''touch-button'' which has no moving parts.

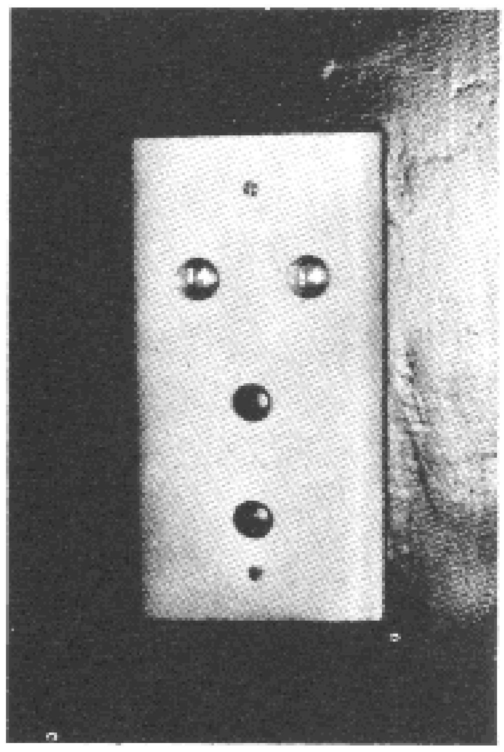
3. All of these buttons serve to register the fact that a passenger wants to use the elevator. On car-switch units this call is registered on the annunciator board in the car. On other types, from push button to the high-speed group automatic elevators, the call is registered on a relay panel and routed to proper circuits to provide earliest possible service. Cancellation of the call may be done either manually or automatically on annunciators of various types, after the ''call'' is serviced. On other types the cancellation is completely automatic, again, when the call is answered.

4. Simple hall buttons generally include one or two contacts assembled in a wall box and concealed by a faceplate equipped with the appropriate number of insulated ''push'' buttons. They are normally flush mounted in the wall near the strike jamb

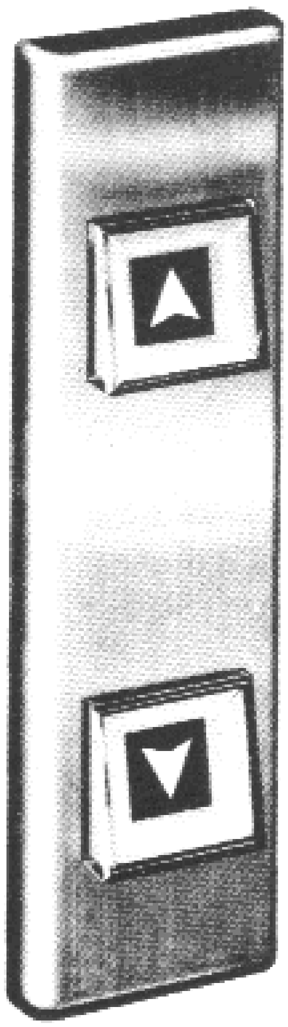


Haughton Single Car
With Position Indicator

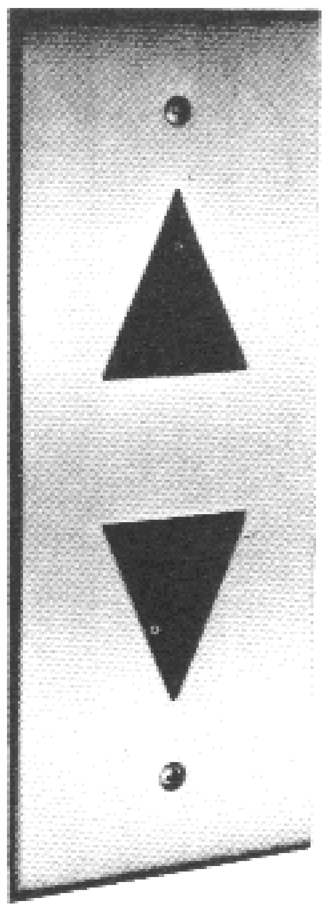
Otis Single Car Unit
With "Tell Tale" Lights



Westinghouse Duplex Car
Hall Button
with Position Indicators



Otis Electronic "Touch Button"
Hall Button



Haughton Illuminated
Hall Button

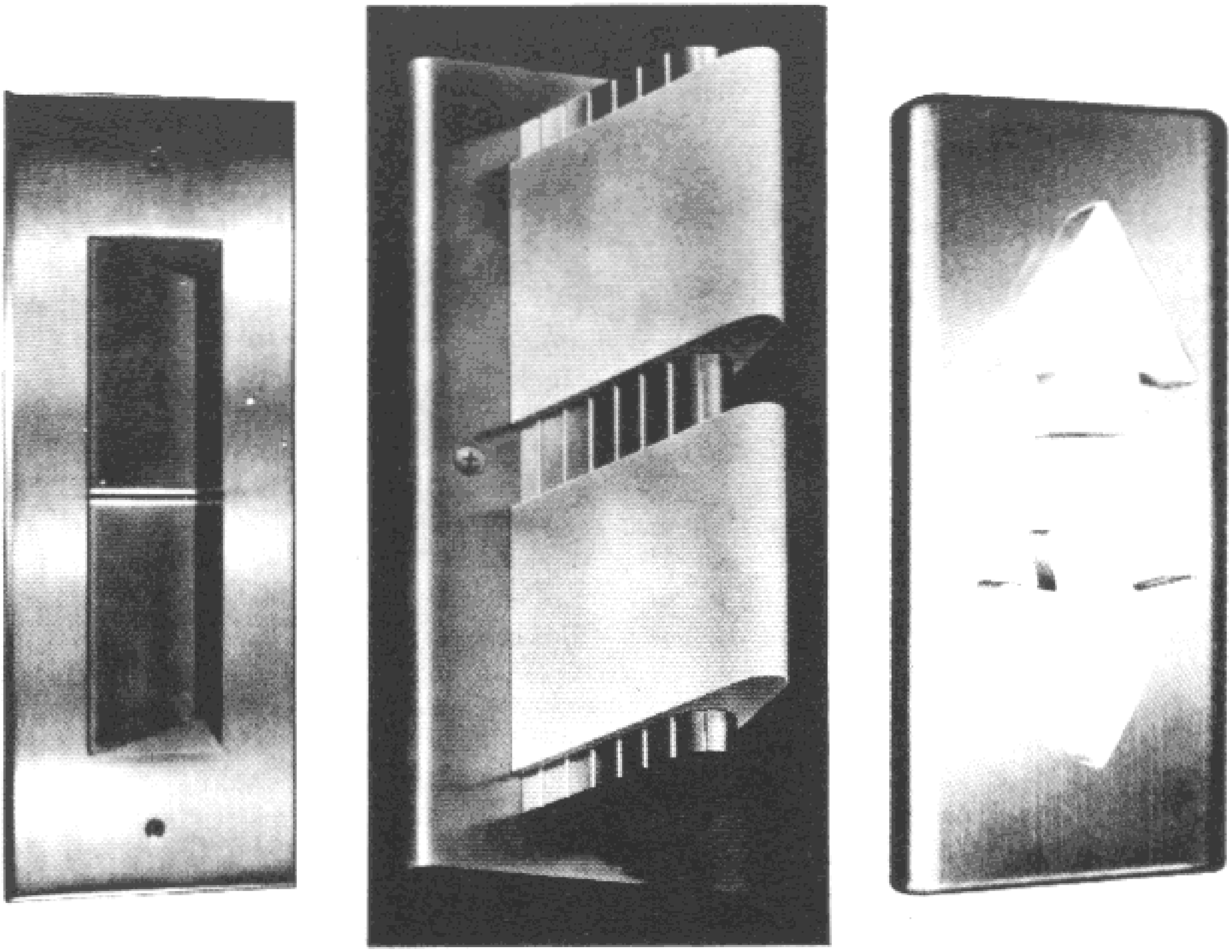
Five Types of Hall Buttons

of the entrance. Locations are shown on the layout. The wall boxes are set and piped to the wire raceway soon after the entrance frame is placed. The boxes can be secured by brackets to steel or plaster of Paris to rough walls. They are eventually grouted in the wall.

5. Wiring is pulled in from the main riser, then identified and connected in the routine manner. Faceplates are generally kept in the locker until corridor plastering and painting is completed.

6. Faceplates should be plumb and square with the wall. Buttons should compress the contacts firmly but should not bottom on them. They should move freely without friction or binding.

7. Hall lanterns are used on many elevators. They indicate in advance to waiting passengers which elevator will answer his call and in which direction an approaching car will travel.

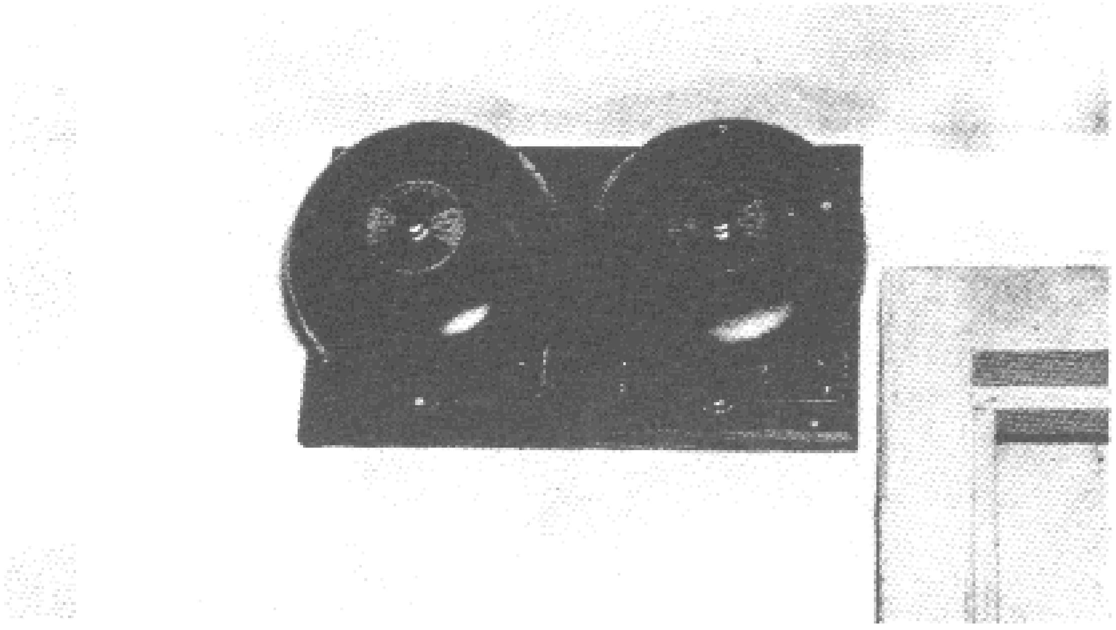


Hall Lantern Types

8. The lantern fixtures include "up" and "down" lamp sockets and sometimes a gong. These are arranged in a flush wall box, generally, and are covered by a faceplate that has translucent inserts of some shape that best suits the architects decorative scheme.

9. Although usually lighted by circuits from selectors, hall lanterns can be connected to hoistway switches or other special "feeds."

10. Installation practices follow those for hall buttons. Locations are shown on layouts or other construction drawings.



Hall Mounted Alarm Bells

11. Alarm bells are required on all self-service or automatic elevators by code rulings. These bells may be located almost anywhere adjacent to the elevator. Usually they are in the pit, the corridor near the main landing, a telephone room or the building "super's" office.

12. The bells are wall mounted and supplied from a source independent of the elevator power. They are operated by pressing an "alarm button" in the car. This button is connected to the supply and the bell by means of traveling cable and conventioncl wiring.

13. Alarm bells are intended for emergency use only!

CHAPTER 12
Section -c2

ACCESSORY PARTS AND SCHEDULING SYSTEMS

Landings - Position Indicators and Starter's Panels

Suggested:

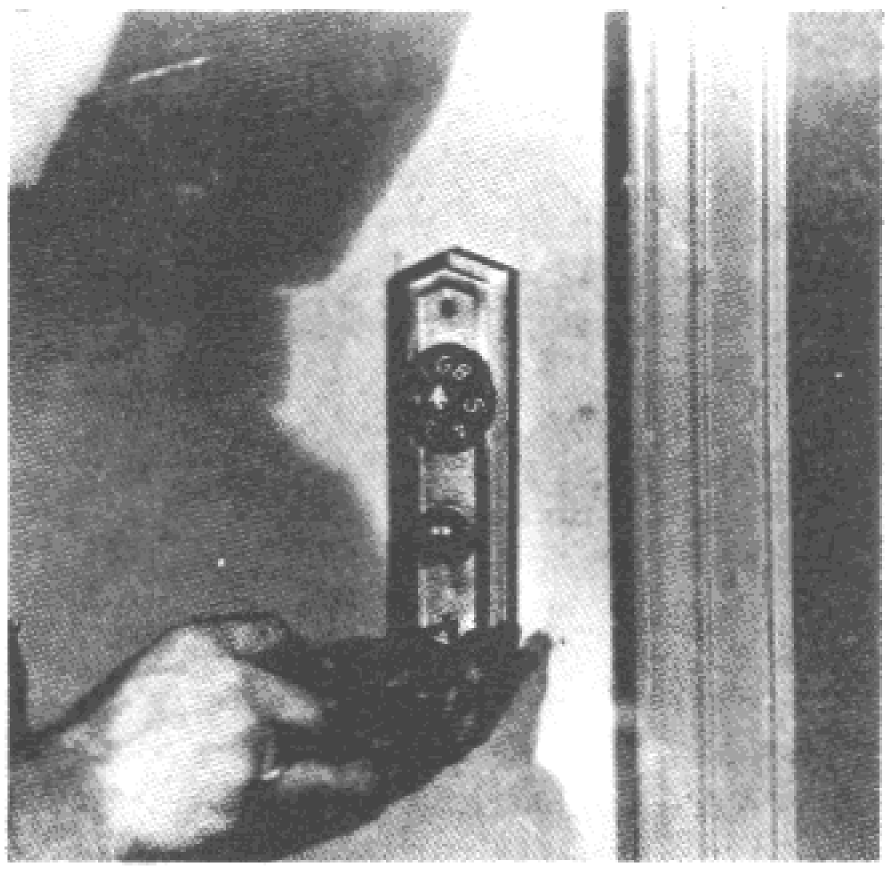
Materials –
- a. steel shim stock
- b. bolts, nuts
- c. cut washers
- d. lock washers
- e. self-drilling anchors

Tools –
- a. hand tool kit
- b. plumb bob
- c. electric hammer
- d. chuck for anchors

1. During the past fifteen years there have been a number of new developments in the "dial indicators." Some of these were purely mechanical but many involved electrical components as well.

2. In spite of this, the old mechanical dial drive machine is still being used by some companies. The form varies but the essential operation is similar to the one described in the first edition of this book.

3. Dial indicators were one of the first practical position-indicators devised.

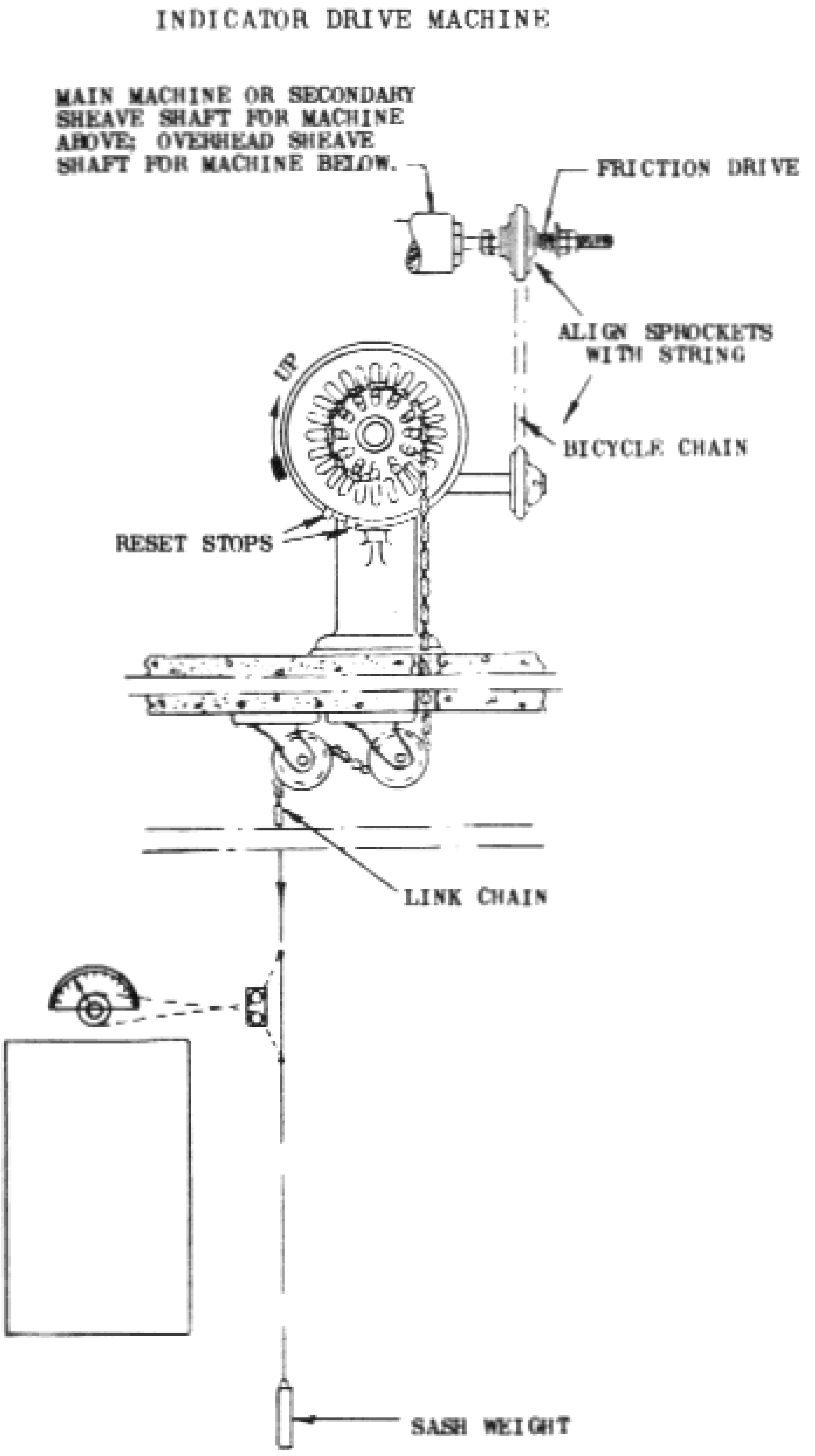


Installing Faceplate on Combination Hall Button and Dial Indicator

4. They are sometimes driven by the special device termed "indicator machine." This machine is usually a small worm-gear enclosed in a box and it runs in a bath of oil. The worm shaft is driven by the elevator machine on overhead installations or by the shaft of an overhead sheave in basement installations. The gear shaft drives an adjustable sheave to which the dials are hitched.

5. This machine is linked to the elevator machine (or overhead sheave) drive-shaft by a bicycle chain, sprockets, and a "friction drive" arrangement. This latter is on the elevator machine or sheave shaft and supports the "driver" sprocket.

6. The indicator machine is set in place in accordance with the location indicated on the final layout or detail drawing. The sprocket is aligned with the driver sprocket



Sketch #1 — Dial Drive

on the elevator machine with the aid of a plumb or chalk line. (Refer to sketch #1 as an illustration of this procedure.)

7. When the two sprockets are aligned, the positions of the indicator machine base bolt holes are scribed onto the concrete floor.

8. After this, move the machine and drill the holes, then install the anchors and replace the machine on its "marks."

9. Align the indicator machine sprocket exactly with the driver and tighten the bolts. Use lock washers on all bolts.

10. Some indicator machines are arranged with slotted holes or a tightener for adjustment in order to permit the drive chain to be tightened. Such machines should be set towards the elevator machine, leaving room for future adjustment of the chain tension.

11. Install the drive chain and adjust the friction device so the driver sprocket just slips on it when pulled hard.

12. Prepare the link chain or drive tape to be dropped to the indicator fixtures.

13. Be sure the chain is free of kinks and twists before passing it through the floor and over the pulleys, as illustrated in sketch #1. This sketch indicates that the dials are set in semi-circular arrangements above entrances. Another design is one where the dials are placed in a small fixture beside the hall button or in the button fixture itself.

14. Regardless of which type of dial is used, the fixtures are set as soon as practical, after the entrance frames are in place. The most modern units are assembled in wall boxes. In either type, hollow shafts or pipes extend through the hoistway wall and about an inch inside the clear hoistway line. These pipes carry the dial shafts which have the indicator at the corridor side and a pulley at the hoistway side.

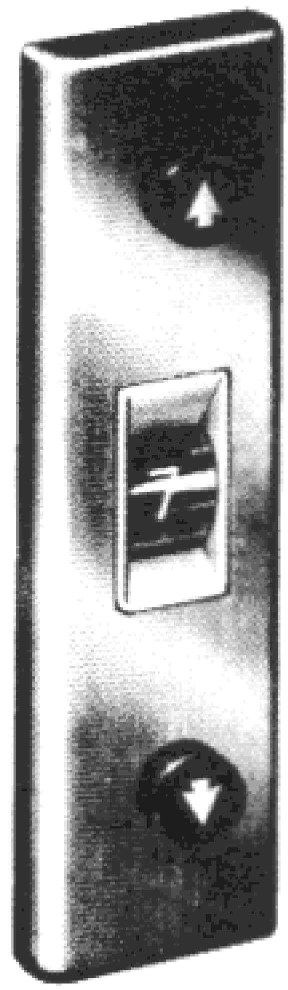
15. The wall boxes or fixtures can be mounted on light steel brackets for grouting in or can be held in rough walls by plaster of Paris, then grouted later. They must be in a plumb line vertically and at the distance above or beside the door frame as shown on the drawings.

16. The dial cord or tape is then dropped from the top of the hoistway. The deflector pulleys (when used) are carefully aligned with the lead of the link-chain from the drive machine, and the tape connected to the link-chain. A weight is hung in the pit from the bottom of the tape. It is secured against swaying by means of a bracket.

17. Connections to any one of the individual dials is made, and the elevator run from top to bottom and returned. If the indicator travel is correct, all dials are connected. If any error exists, this is corrected before the other dials are "hooked up."

18. When all dials are connected the individual "pointers" or discs may be adjusted to indicate properly.

19. The reset stops on the machine are then set. These are usually clamps or clips of steel, cast iron, bronze or similar material. They are designed to stop the motion of the dial indicator machine when the elevator has reached its normal limits of travel. (The friction device permits this to be done.) This then serves as an automatic reset, since the indicator is set "on the mark" each time a complete round trip is made.



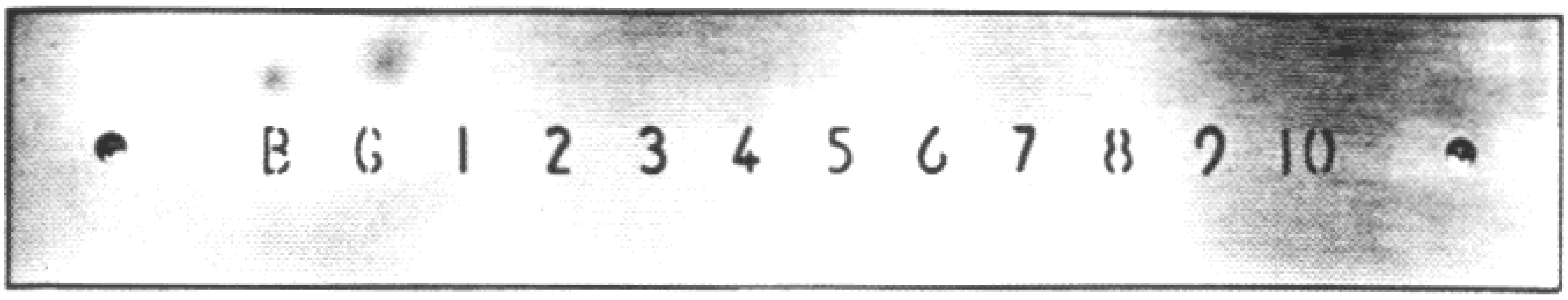
Combination of Hall Buttons With Electrically Driven Position Indicator

20. All moving parts of such indicators, such as pulleys and shafts, should be lubricated. Dial shafts should be coated with grease before being placed in the pipes. Leads of cords, tapes and chain should be as direct and friction free as possible.

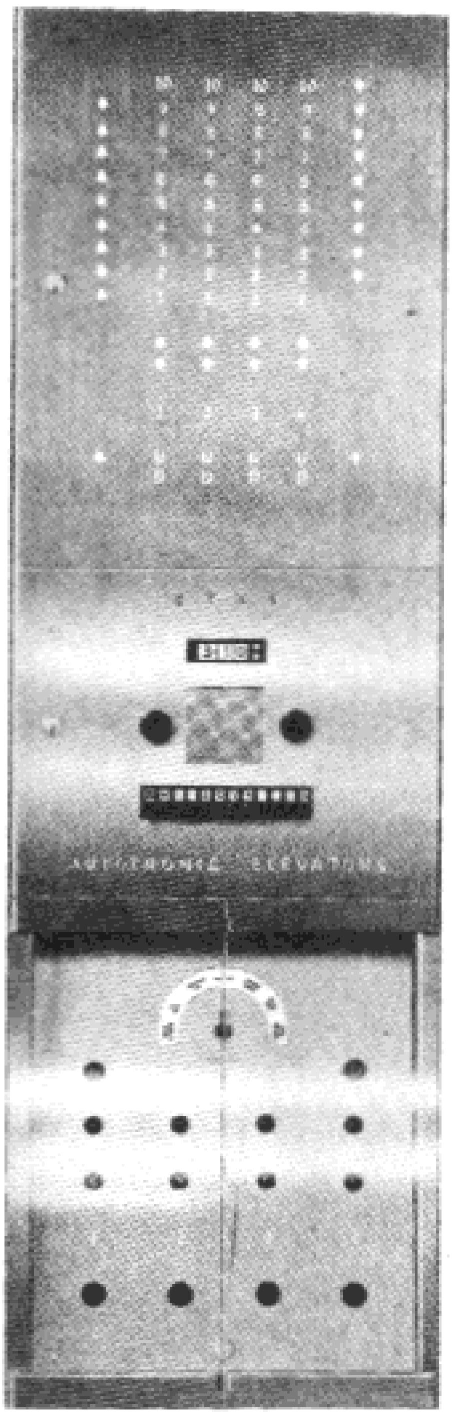
21. These same types of indicators are sometimes driven by selectors or floor controllers. The drive may be wire, wire rope or steel tape.

22. Electrically driven dials are installed by several companies. These consist of a rotating drum or dial located in the wall box of each landing fixture. The drums are arranged to center themselves at positive positions after each operation. This is accomplished by means of a ratchet device, as a rule. Movement in each direction is obtained by means of electro-magnets which lift the ratchet a fixed distance. The appropriate floor number appears in back of a window in the faceplate. Duplex installations often include two hall buttons and two of these indicators in the same fixture.

23. The magnets in these indicators are energized by circuits that are selected by some machine room device. This can be a drive machine similar to the one used for dial indicators, but at present it is common practice to use one or two rows of floor-bar contacts on selectors for this purpose. The "feed" end of the circuit is connected to a brush on the selector crosshead panel. As the selector is driven up or down by



This Type of Electrically Illuminated Hall Position Indicator is Operated by Selector Contacts



Hall Position Indicator For All Elevators in a Group, Combined With Scheduling Device Panel. It Includes an "Intercom" System

the elevator, the selector brush "makes" each floor-bar indicator contact in sequence. The drum is thus advanced to change the floor indications. Naturally the fixtures on all floors are wired in parallel to move all drums at the same time. Terminal "stop" arrangements reset the drums, if they get out of step for any reason.

24. Multilight hall (or car) position indicators are often controlled by selector contacts also. The base circuits are similar for both drum and multilight types. The multilight indicators are mounted on wall boxes usually above or beside the entrance frames. (They may be part of the hall-button unit assembly too.) All the light sockets have a common side or strip. The opposite side of each lamp is connected to one of the selector floor-bar contacts and to all identically placed sockets on all floors of that elevator.

25. All electrically operated indicators must be grounded and connected by conduit to the wire raceway. Wires are usually pulled in and identified when the other hoistway wiring is done.

26. Faceplate materials and finishes are ornamental. The faceplates are generally left off until plastering and painting is completed.

27. Modern office buildings of any size are equipped with "starter's" panels of one type or another. Such panels may consist of only position indicators for all elevators in a bank, plus a "buzzer" button for each car, or they may include these features in addition to a scheduling control-panel. The illustrations include a few of these types. As noted in chapter 1, these panels tend to become less functional in larger installations.

28. The starter's panels usually include a set of position-indicator lights for each elevator represented in the panel. The lights for these are connected at the selector in parallel with the car and hall position-indicators.

29. Telephones are practically standard equipment on elevators with panels like those described in the preceding paragraph. They may be surface mounted, but the present trend is to install them inside the panel itself and in a small, flush mounted box in the elevator.

30. It is customary to parallel connect all the telephones of elevators in a bank (or even in an entire building) to the starter's phone. This is a convenience in the normal operation of the elevators, and can be very valuable in the case of shut downs or accidents.

31. Telephone circuits are generally supplied by battery stations with rectifier chargers or by some other circuit independent of elevator power supply.

32. Public address systems are installed in high-speed, automatic elevators. They serve the same general function as the telephones but offer more versatility since passengers can be addressed directly by the starter. Variations of the "P.A." systems provide special announcements as in a department store, while others play "piped" music.

CHAPTER 12
Section -c3

ACCESSORY PARTS AND SCHEDULING DEVICES

Landing Switches

Suggested:

Materials –
- a. switches
- b. sundries
- c. cleaning materials

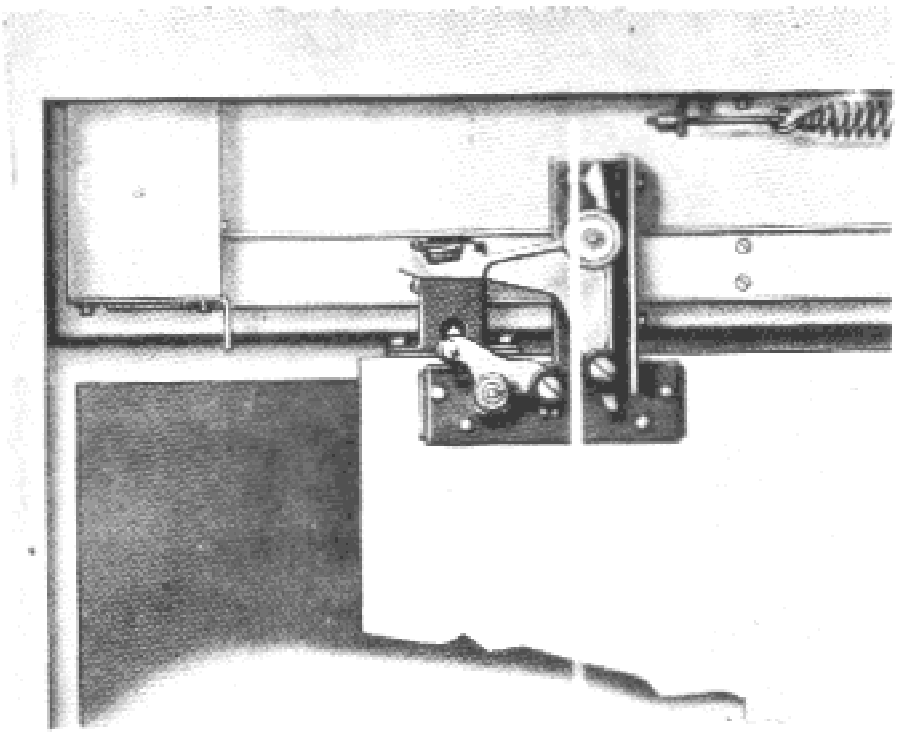
Tools –
- a. hand tool kit
- b. templates for locks
- c. electric drills
- d. taps

1. All landing doors must be equipped with interlocks. These are combined mechanical locks and electric contacts. An electric door contact prevents an elevator from moving if the door is open. A door lock prevents the door from being opened except from inside the elevator or with a special key. The interlock ties these two functions together. Section 3, Definition 3.31b of the code states that —"the interlock is a device having two related and interdependent functions which are:

1. To prevent the operation of the driving machine by the normal operating device unless the hoistway door is locked in the closed position, and

2. To prevent the opening of the hoistway door from the landing side unless the

car is within the landing zone and is either stopped or being stopped."



Hoistway Door Interlock

2. Interlocks provide safety by locking the doors and assuring that the elevator will not operate unless the contact is "made" and the door is in position to be locked. They are in series with the car door contact and operating circuits.

3. These parts are shipped with door material and installed by the elevator constructor, after the panels are properly hung and adjusted.

4. Each company sets its own standards of installation but conduit and wiring conform to the N.E. Code.

5. Another important landing switch is the access switch required by the safety code. One of these switches is installed at the jamb of the top landing and another at the bottom landing. They permit the elevator to be moved for access to car top or pit for servicing and in the event of an emergency.

6. The switch must be of the continuous pressure, spring-return type and be operated by a cylinder-lock key. The key is to be removable only with the switch in an "off" position.

7. The code restricts car speed and other features when this operation is being used. Rule 111, of the safety code, details the information.

CHAPTER 12
Section -c4

ACCESSORY PARTS AND SCHEDULING SYSTEMS

Scheduling Devices

1. Present day scheduling devices for elevators are manufactured in manual and in fully automatic types. Devices using the features of both are also being installed. However, there is little doubt that automatic operation is becoming more prevalent as time goes on.

Haughton Starter's Control Panel for Banks of Elevators, Doors are Open to Show Intercom and the Various Switches for Features of Operation

2. A good starter could watch his dispatch panel and signal to attendants on a four or six car installation, if this were all he had to do. Unfortunately his supervision of operating conditions is subject to countless interruptions so he cannot perform his prime function of monitoring the elevators.

3. Elevator attendants have the same basic problem. For example, they cannot close a door and leave an important tenant waiting so they ignore signals and thereby throw schedules off.

4. Automatic programing does not have these problems and, therefore, can generally maintain better schedules than manually operated installations.

5. Scheduling or programing can be simple or complex. Duplex operation of a pair of collective-control elevators is a relatively simple example of establishing an operating pattern for elevators. The group automatic systems that embody electronic computer functions for banks of four, six or eight high-speed, automatic elevators are obviously very complex in nature.

6. New men would not normally be assigned the responsibility to install this kind of equipment but a brief outline of some features may help in understanding the job, if such men are assigned to work on installations with programing.

7. All forms of programing have basic equipment in machine rooms, on cars and at landings. Controller and selector circuits, hall buttons, car buttons and load weighing are involved in the elementary processes. Programing circuits of "duplex"

equipment are mostly in the controller-selector area. The primary object is to station unused cars in such positions that they can respond to calls within a minimum elapsed time from when they are registered. All wiring is carried in conventional raceways and traveling cables.

8. Group manual control and group automatic systems have numerous inter-elevator circuits as well as many from machine room to car and the main hall panel. Both have starter's and dispatch panels in the main lobby and have dispatch and relay controllers (panels) in the machine room areas. These are connected with each other and all cars, controllers, selectors, hall buttons, directional signs, hall lanterns and other items by a trough or conduit raceway. Most wiring is conventional but certain circuits require special wire. These might include electronic tube wiring and P.A. system wires. The latter are often shielded to eliminate interference. Special traveling cables are used in these cases.

9. Normal practice is to run the raceway from the machine room to the center junction-box in common with other wiring. A branch is taken out at the hoistway center junction-box and continued to the wall box of the starting panel. Strain supports must be used in the raceways and these are held to one hundred foot maximum spacing intervals. The wires are pulled out to the wall box as soon as practical and when safety of the wires is assured. They are then identified and marked. They are connected when the panel equipment assemblies can be safely installed.

10. Faceplates for these lobby panels are complex and extremely expensive. They are not installed until the lobby marble (or other wall finish) has been installed and polished. Temporary plywood covers are often put on these assemblies to protect the equipment from damage.

11. Incidentally, it is very important to locate the wall boxes in their correct position when the lobby walls are pre-cut marble, glass, or any similar material. Be sure to have the builder provide accurate and clear bench marks to work from.

12. Specially trained men adjust these scheduling devices. The devices perform many functions. A few are:

a. Automatically start banks of elevator generators and open the doors at predetermined times.

b. Refrain from doing this on weekends and holidays.

c. Select and dispatch cars in accordance with availability and need.

d. Establish traffic programs for banks of cars to favor the computed traffic demand.

e. "Zones" (divides spheres of service) parts of groups of elevators so one part of the building does not receive all the service to the detriment of others.

f. Dispatches special car to any floor that has had a call registered for an excessive time.

g. Reverses the cycle and shuts down generators when no traffic demand exists.

13. The "P.A." systems permit the "lobby supervisor" or starter to talk with passengers of any car, in the event of delayed operation or in an emergency. He can also talk with the maintenance men in the machine rooms.

14. Efficiency and reliability of door equipment has been improved to reduce chance of minor as well as major accidents to the public on "self-service" cars. Results have been good and the accident rate has been reduced.

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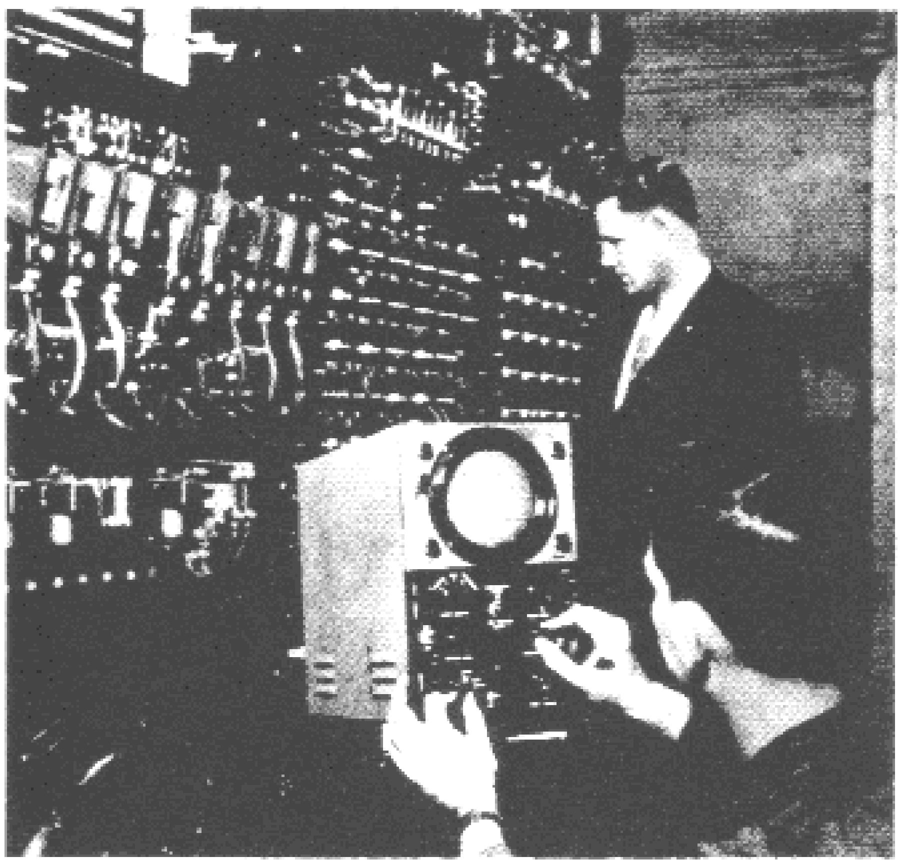
ADJUSTMENTS

CHAPTER 13
Section -a1

ADJUSTMENTS

General



Oscilloscopes Have Become Regular Tools For Adjusting Modern Elevators

1. During the last fifteen years changes in design and materials of elevator control have been quite radical in the field of high-speed equipment. The new approach has been reflected to some extent in the redesign of moderate and low-speed elevator components as well. Probably the most spectacular effect has been due to the introduction of modern "electronics" into the elevator industry.

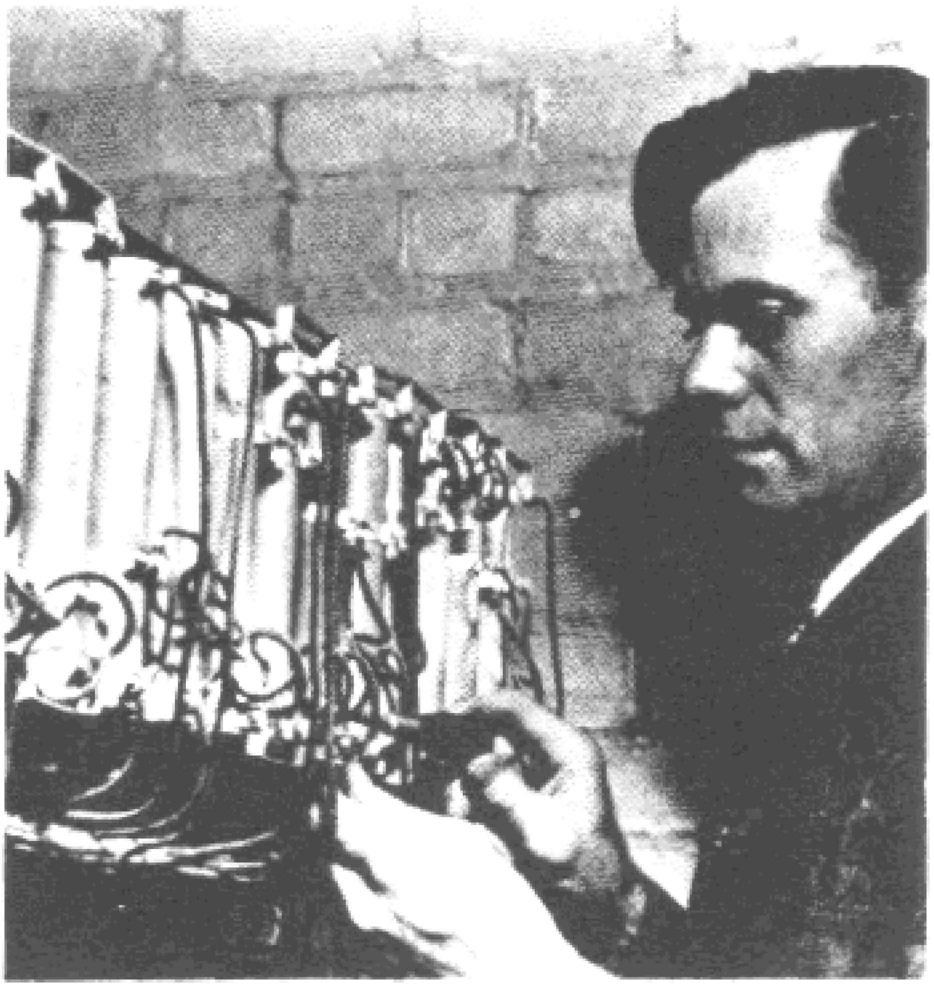
2. New applications of electronics to our work begin with the simple A.C. equipment where switch and relay "timing" is now performed through use of condensor circuits rather than the old fashioned, comparatively inaccurate mechanical "dash pots." Rectification of control and brake-magnet circuits is another example of application of electronics to A.C. equipment. Extension of the changed concept of control touches every type of elevator equipment, especially the highly refined dispatch and scheduling systems of the high speed, high rise equipment and involves all elevator manufacturing and contracting companies, from the smallest to the largest.

3. Routines previously developed to complete installation and adjust elevators have also been altered in order to adapt new ideas and techniques to our work. As time goes on the men who perform adjusting work are required to know much more electrical theory than previously.

4. The larger companies maintain field engineers, inspectors or similar personnel to make systematic inspections and adjustments on all new elevators. Where small installations are in remote sections of the country, exception may be made to the rule and a competent mechanic assigned to do the work. Field engineers then visit the jobs on routine trips through the area.

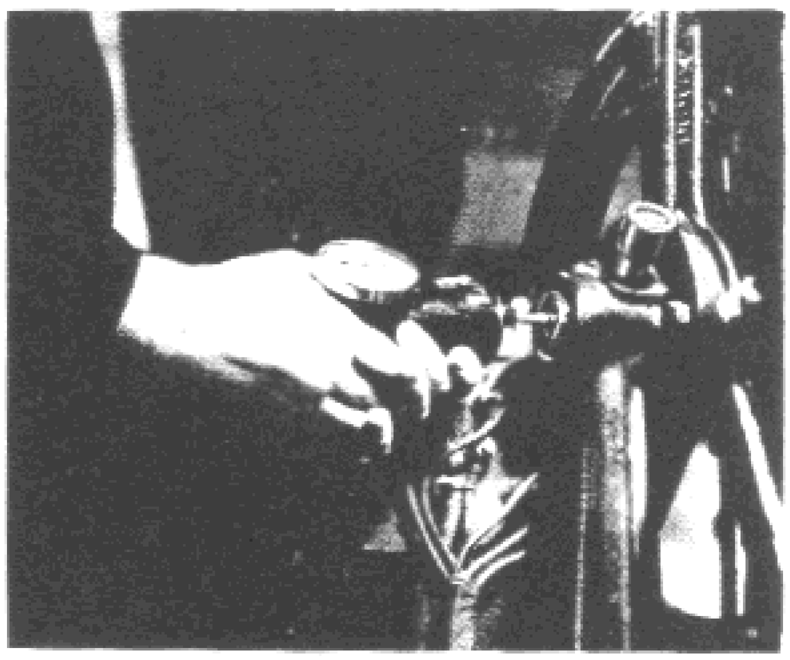
5. Some of the smaller companies use trained mechanics for this work and have production or other engineers make periodic field checks.

6. Regardless of how the matter is handled, it is desirable that all mechanics understand the rudiments of adjustment. If a man has a clear knowledge of the actions of the various parts of the elevator, he can install them more satisfactorily because he knows the function of each part.



Setting Values On Resistance Tubes Is a Basic Procedure in Adjustment

7. Some companies have established that the man who adjusts an elevator is also responsible for a final inspection of the equipment. When this routine exists, the adjustor carefully examines all components, from the machine room to the pit in order to assure himself that the job is properly installed and completed. Normally he checks equipment against the layout data or a sales abstract to be sure it corresponds to the material contracted for. A check list of faults is made and corrective action taken either by the job mechanic or the adjustor.



Elevator Speeds Can Be Checked By Tachometers Or Stop-Watches

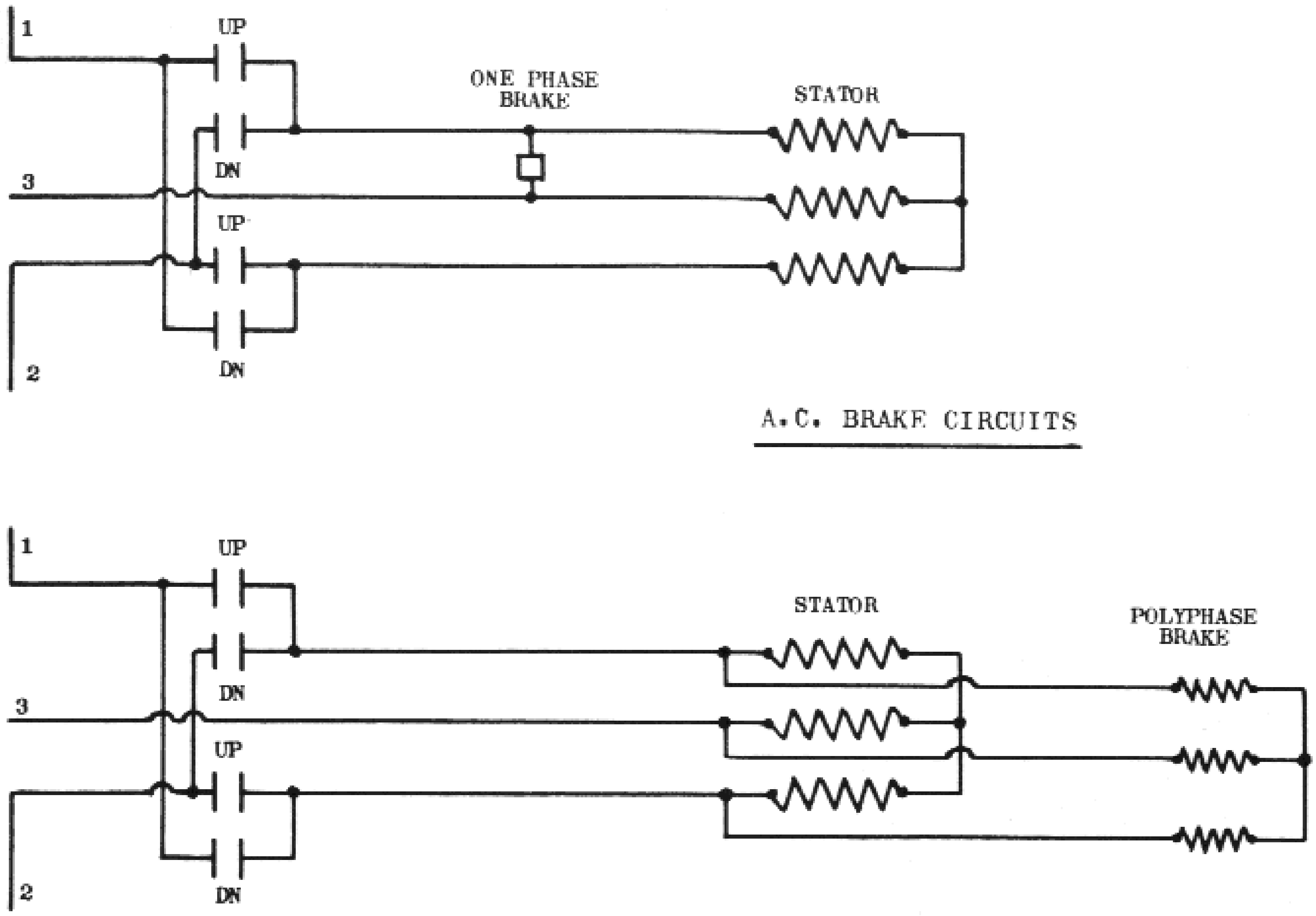
8. The commercial and technical advantages of using an adjustor as an inspector is very controversial. So, also, is the question of whether such a specialized man as the adjustor is required. However, this is a matter on which each company makes its own decision. The important point is that some one person must thoroughly check through a contract to be sure that it meets specifications and is properly installed.

9. This chapter is not written with the intention of providing information that will make skilled adjustors. Methods and equipment differ between companies to such an extent that each prepares its own adjusting data and spends considerable time and money training its own employees in that phase of elevator work. The suggestions made in this chapter can assist a new man to appreciate some of the rudiments of adjusting. The information applies to equipment of some companies but does not apply to all.

CHAPTER 13
Section -b1

ADJUSTMENTS

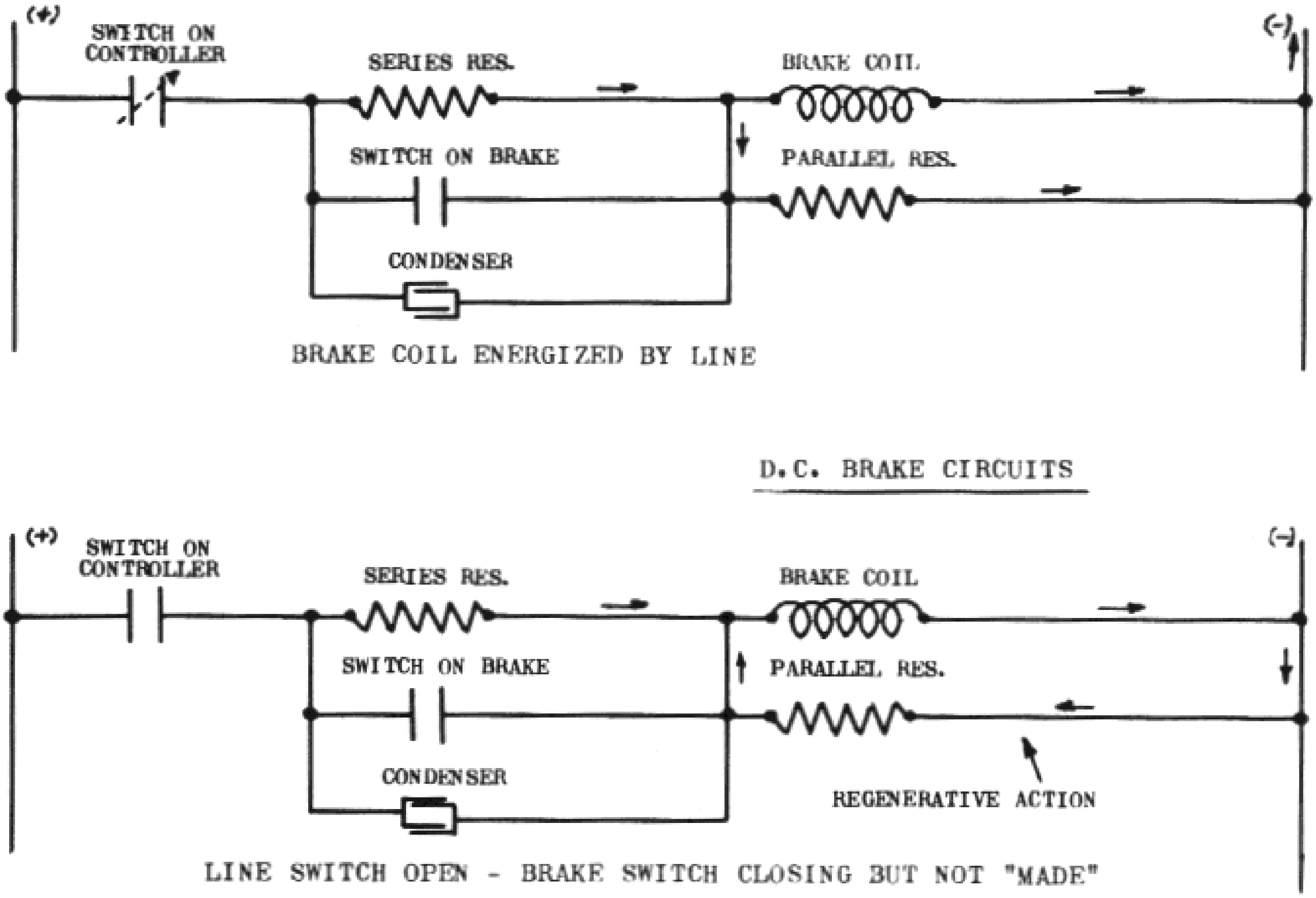
Brakes — General



Sketch #1

1. Elevator brakes may be divided into two general classes. These are: brakes for gearless and those for geared machines. The brakes of geared machines may be operated by A.C. (alternating current) or D.C. (direct current) power. Since all gearless machines to date have been D.C., they, of course, have brakes with the same characteristics. The pulleys of geared-machine brakes are mounted on the worm shaft or an extension of it, whereas those for gearless are directly on the drive-sheave shaft.

2. The subjects of sections -b2 and -b3, will be, ''Brakes, A.C.'' and ''Brakes, D.C.'' These may be interpreted as for geared and gearless machines respectively, as far as shoe clearances are concerned.



Sketch #2

3. Circuits for brakes with "A.C." operated coils are quite simple. In effect, the brake coils are connected across the line when the controller directional switches close. Sketch 1 illustrates typical circuits for A.C. brakes.

4. D.C. brake circuits may be a bit more complicated, but are not as a rule too complex. They have the advantage of being able to utilize regenerative braking. This is distinctly different from "dynamic," which uses the elevator motor to "pump back" into a resistance. Regenerative circuits are those set up in the parallel resistance circuits of the brake coil, after the main supply circuits have been disconnected. A study of the two D.C. circuit diagrams accompanying this article will help to clarify this (see sketch 2).

5. This "regenerative" action in the brake coil circuit permits a "slow" or "soft" brake application that is desirable, especially where dynamic braking can be used to slow the car speed to a minimum.

6. The brake contact is opened mechanically by the brake shoe arms. The function of the contact shown in these sketches is to short out the series resistance at the start of brake arm movement. This action permits a quick brake release when the elevator leaves the floor.

7. "D.C." brakes are frequently provided on elevators operated by A.C. motors. This is accomplished by connecting a copper oxide, selinium or similar rectifier in the brake-coil circuit. The supply side of the rectifier is fed by the A.C. supply, generally through a transformer. Half-wave and full-wave rectification are both used, design characteristics determine which is chosen. The same rectifier supplies power to switch and relay coils on the controller and other parts of the elevator equipment.

8. "Multi-voltage" elevators, whether geared or gearless, all use D.C. to operate the brake magnets.

9. It is suggested that mechanics study the straight wiring diagrams of their company's equipment, and work out the actions of the parts of the brake-coil circuits.

10. Mechanically, brakes must be sturdy in construction and as simple as possible in operation. The photos and sketches in this section (b) will serve to illustrate a number of brake types and arrangements.

CHAPTER 13
Section -b2

ADJUSTMENTS

Brakes – A.C.

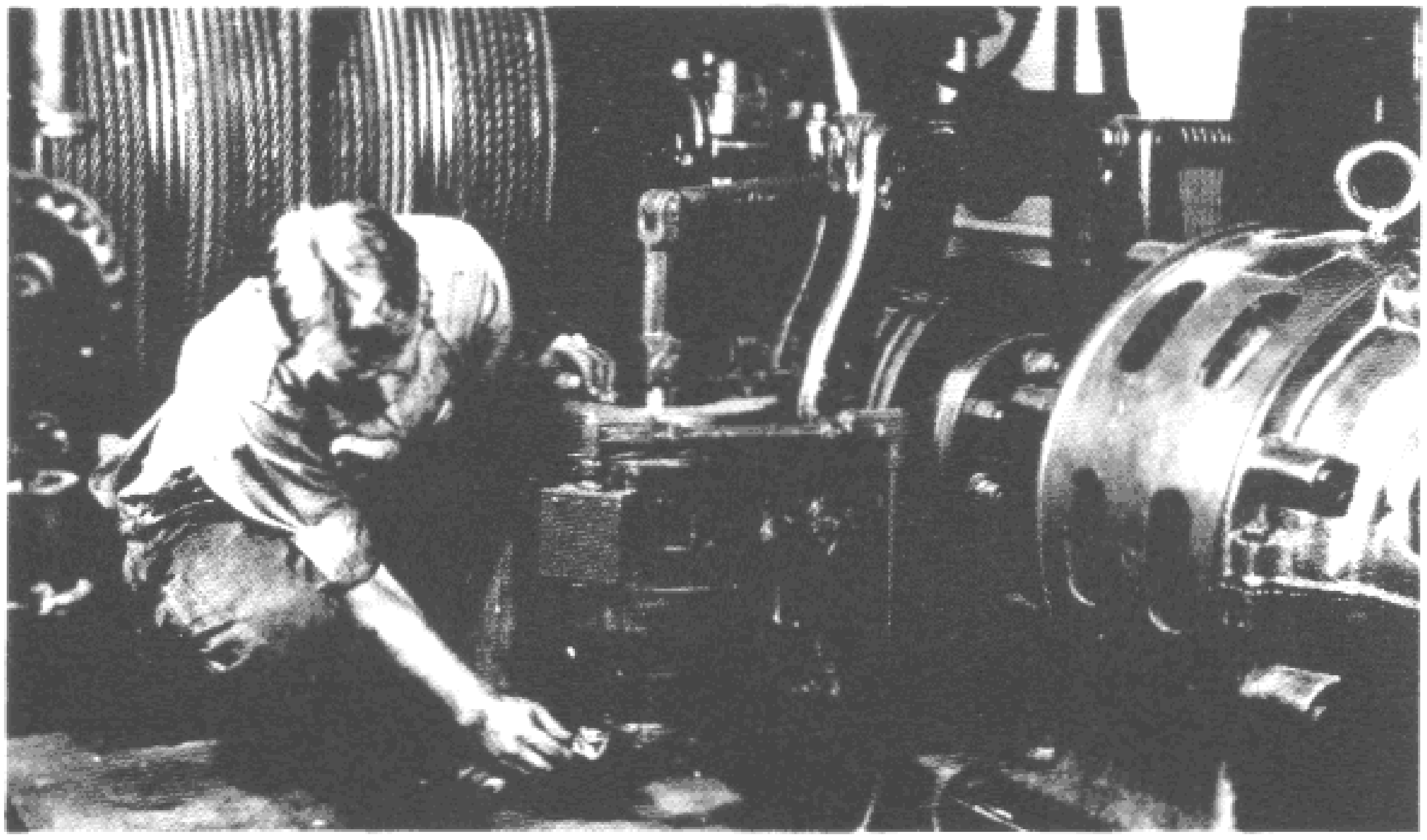
Suggested:

Materials –
- a. magnet oil
- b. lubricating oil
- c. graphite flakes
- d. emery cloth *0

Tools –
- a. hand tool kit
- b. extension-light cord
- c. test lamp
- d. test leads
- e. thickness gauges

1. The preceding section of this chapter noted that geared elevator machines may have brakes operated by either A.C. or D.C. power. However, since the mechanical actions of both types are similar, this article will mention A.C. types only. Information regarding the circuit action of D.C. brakes will be found in section -b3.

2. A.C. brakes are made for single phase and poly-phase operation. The single-phase coils are sometimes immersed in an "oil pot" and utilize a "shading" coil to obtain two phase characteristics. This is done to stop the brake from "chattering," which it would otherwise do on a single-phase circuit. An oil dashpot cushions the "lift" stroke.



Haughton Polyphase Torque Motor Brake

3. Poly-phase brake devices may be built in the form of a torque motor or in the modified form used by the Haughton Elevator Company for their "A.C. magnet operated brake." They may also use poly-phase coils wound around a common core.

4. The motor should be aligned to the machine before brake adjustments are made. The counterweight is "landed" before the arms and pins are removed for cleaning and lubrication.

5. All steel hinge and auxiliary pins in brake assemblies should be free of friction. It should be possible to slide or turn them by hand when they are not under pressure. It is recommended that such pins be cleaned lightly with *0 emery cloth, soaked in oil. Graphite flakes should be rubbed onto the pins with a bit of oily waste. This helps to prevent frozen or "sticking" brake pins.

6. The brake should be assembled with the spring tension equalized on each shoe. Most A.C. brakes have a single brake spring or spring rod, so this is automatically taken care of.

7. The brake coil should be energized by bridging (or jumping) the "brake" contacts on a controller switch. The clearances of the shoes can then be adjusted and equalized by means of the small adjusting screws. Shoe clearance generally range between .006" and .010". However, each company has its own specifications. These should be learned and the standard procedure followed.

8. If the shoes are equalized but the lift is too great, reduce the lift arm or plunger stroke. This will reduce the total lift, after which the "balance" of the shoes must be established again.

9. Tighten all lock nuts and be sure all cotter pins are in place, before leaving the brake. Run the car to be sure that the voltage does not drop sufficiently to affect brake lift, when the electrical load of the motor is "across the line."

10. Adjust brake resistances in accordance with company instructions.

11. After the brake is satisfactorily adjusted, replace any guards which were removed for access.

12. A rough check of car-to-counterweight overbalance can be made manually at this time with the brake released. Test weights are placed on the car platform until the effort to crank the car up will equal that used to crank the car down. The value of test weights in pounds should equal the per cent of contract load as specified for overbalance. Car and counterweight should be about level with each other for this test. Counterweight subweights can be added to get the desired balance. If the car is to be equipped with car balance weights, they should be installed before counterweight overbalance is checked for the final time.

CHAPTER 13
Section -b3

ADJUSTMENTS

Brakes – D.C.

Suggested:

Materials –
- a. lubricating oil
- b. graphite flakes
- c. emery cloth *00

Tools –
- a. hand tool kit
- b. extension-light cord
- c. test lamp
- d. test leads
- e. thickness gauges

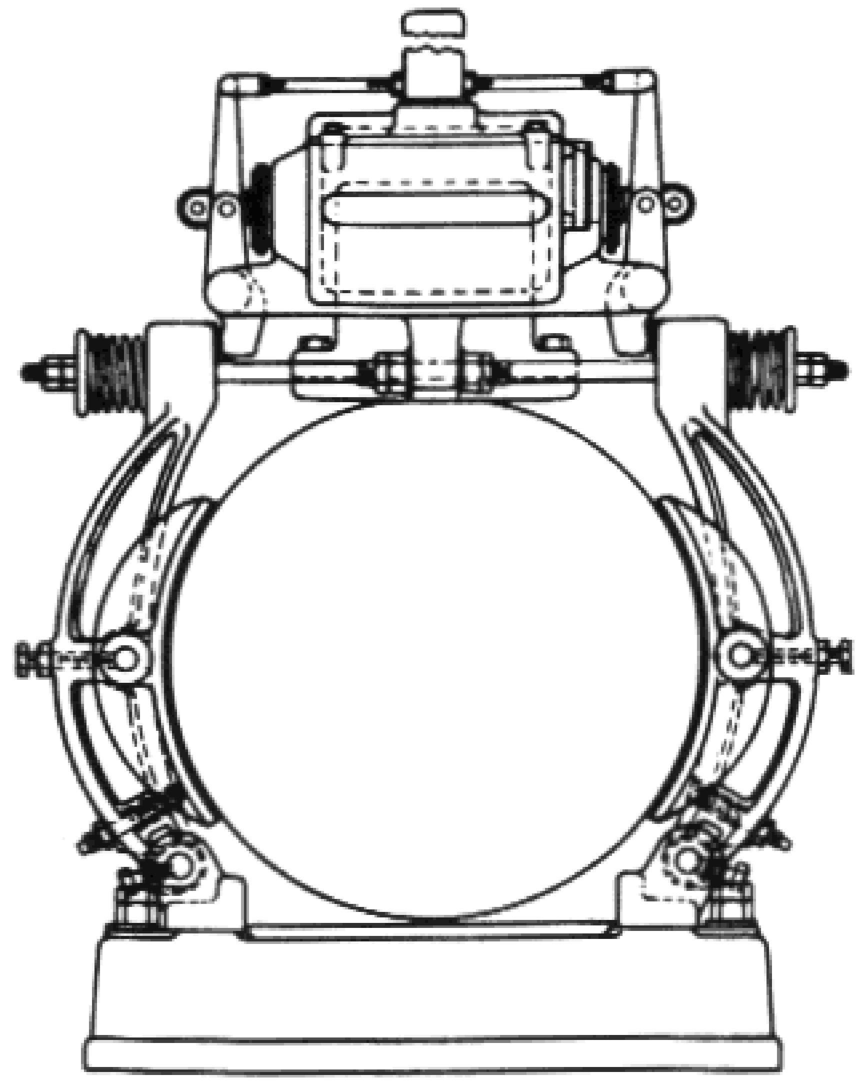
1. The arrangement of D.C. brakes varies slightly in appearance and types among the companies. For geared machines, the physical appearance and mechanical action is very similar to that of the A.C. equipment. On gearless installations, the brakes are proportionally larger because brake drums are necessarily installed on the drive shafts rather than the worm shafts and must have greater holding power.

2. If the brake pins and cores are to be removed for cleaning and lubrication, it is necessary to land the counterweight before disassembly is begun. Be sure that there is no excess weight in the car and that the counterweight is complete enough to overbalance the car and prevent a runaway condition.

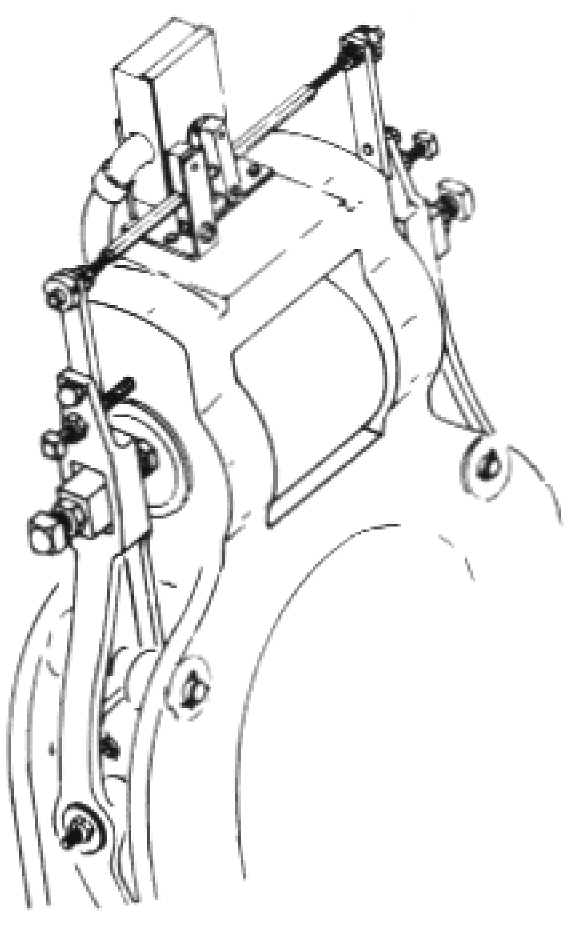
3. The hinge pins, like those of an A.C. job, should be cleaned and graphited also, if they are set in sleeve bushings. Only a light "dusting" of graphite flakes should be placed on the cores. If too much is used, it may "cake." This might then pile up between the core parts and reduce the brake lift. Some mechanics prefer to use vaseline or oil rather than graphite. It is best to check the company practice and follow it.

4. The brake is adjusted by first equalizing spring tension, then lifting it electrically and checking the shoe to pulley clearances. These clearances should range between .003" and .006" on gearless elevator brakes and should be the same on each shoe.

5. If the total clearances are incorrect, adjust the lift of the cores. The shoes can then be readjusted and balanced so that they lift evenly at top and bottom. Tighten all lock nuts and be sure all split pins are installed.



D.C. Magnet Brake Arrangement On Gearless Machine



Typical D.C. Brake Coil Used on Geared Machines

6. Brake operated switches, when used, should be adjusted so the contacts open at the last possible moment (near the end of the core stroke). This insures a strong "lift" because as the contacts open, a "cooling" resistance is inserted in series with the brake coil. This, naturally, weakens the coil strength and might affect the lift, if the contact opened too soon.

7. Regenerative and other brake resistance circuits should be adjusted in accordance with the instructions of the manufacturer.

8. There are several variations to the theory of applying brakes at the time a gearless machine car approaches a floor. The basic theory involves the positive and complete stopping of the elevator by "dynamic" braking effect on the armature, after which the machine brake is applied to hold the elevator in position. This is still the operation generally used for gearless brakes. Some companies have modified or changed this arrangement to

provide partial or ''soft'' brake operations during the leveling period or during releveling, if required. These variations are rather complex in approach and each is peculiar to its own design. Before attempting to adjust these types, the company's adjusting instructions should be obtained. The data is also needed for theory of operation of special brake circuit resistances.

9. Since gearless elevators run with rather close brake clearances and have large shoe areas, shoe drag caused by voltage fluctuation can affect elevator operation. It is wise to check brake clearances at intervals with elevators running under various load conditions, since brake adjustments are one of the first operations of adjusting. A practical check for ''drag'' is to feel the pulley at intervals during the adjusting periods to determine if it is heating up. Here again it is advisable to check carefully to be sure full lift is obtained when the machine runs full speed up with full load.

10. After the brake is adjusted, guards should be installed if the machine design includes this feature.

CHAPTER 13
Section -cl

ADJUSTMENTS

Controllers – A.C.

Suggested:

Materials –
- a. sundries

Tools –
- a. hand tool kit
- b. electric blower
- c. AC/DC voltmeter
  ammeter
  ohmmeter
- d. tachometer
- e. test weights
- f. extension light

1. There are comparatively few adjustments to be made on the controller of the average A.C. elevator. Essentially the type includes only single speed and two-speed controllers. The smaller sizes of single-speed units can start ''across the (power) line.'' This is very common application in Europe and some other overseas areas. However, most have an ''accelerating'' switch which is timed to cut out a starting resistance once the elevator machine moves. Both single and two-speed equipment may have leveling or ''inching'' features and all may include electric door operating equipment as part of the controller.

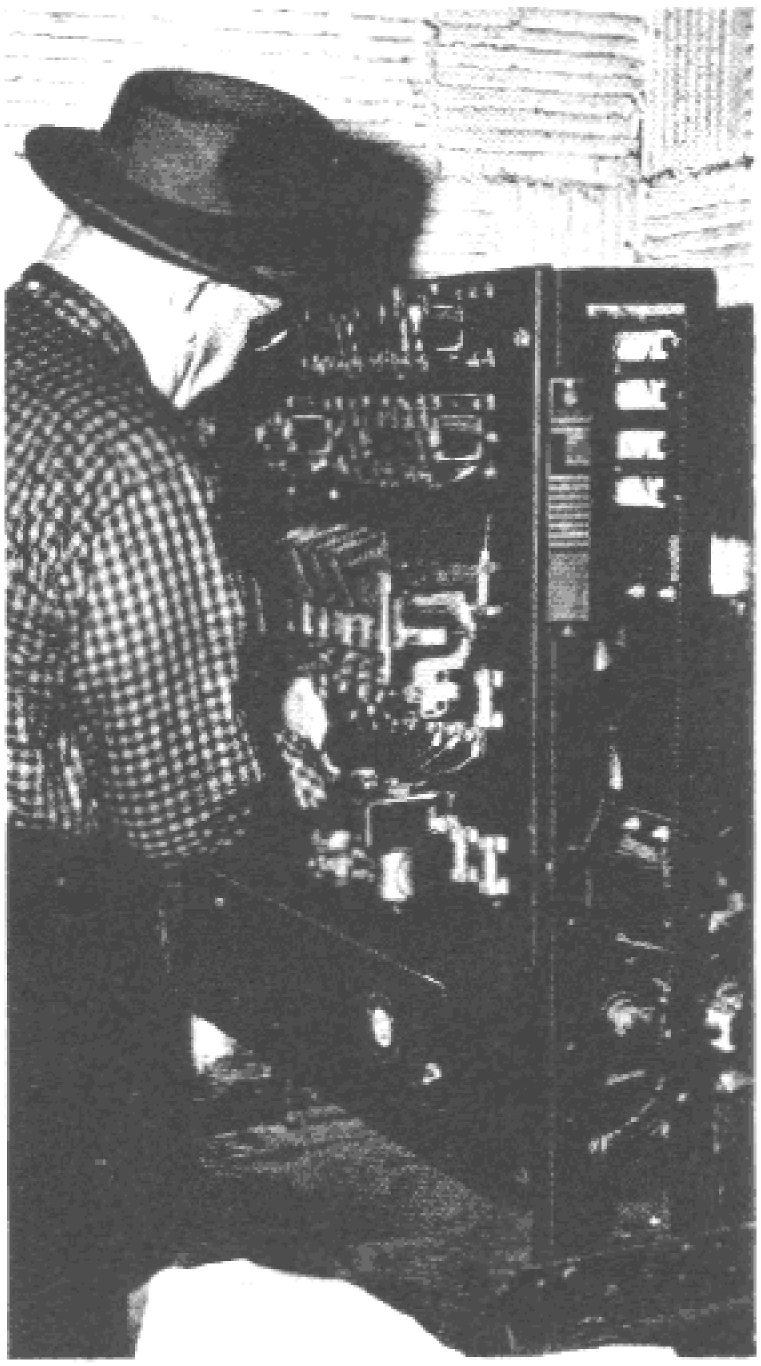
2. Before closing an elevator power supply switch for the first time, make a careful inspection of the controller. Examine all switches and relays to be sure that they are tight on the panel. See that the contacts, studs, braids and leads are all in place and secure. Check the contacts to be sure they "make" properly, and see that no mechanical friction exists. See that no resistance wires, condenser leads, or other equipment is broken. Test all fuses, overloads and reverse-phase relays.

3. Blow out all dust with the electric blower.

4. If the elevator is equipped with leveling, be sure the leveling switches in the hoistway or on the floor controller are temporarily cut out. Some controllers have "leveling" circuit fuses that can be removed for this purpose. (For leveling adjustments, see later sections of this chapter.) If an electric door or gate operator is included, take this device out of circuit temporarily, also.

5. Close the supply switch. See that the phase relay operates.

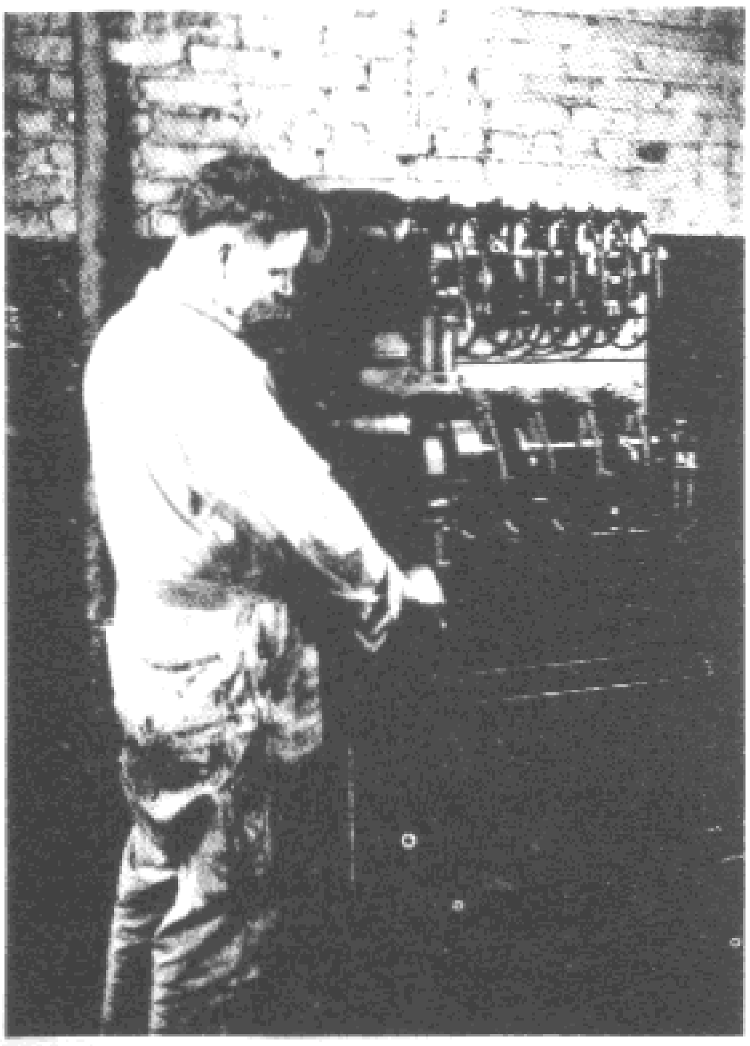
6. If it does not operate, check your wiring for proper phasing and make the necessary alterations.



Adjusting A.C. Controller

7. Test the voltage at the controller panel to be sure it is correct. If the controller is equipped with a rectifier for coil and brake circuits, check the output of the rectifier and its transformer. If the transformer output is low, the rectifier voltage will be, also. Transformers for this purpose are usually adjustable by means of "taps" so output can be established at the right voltage. (Note that selenium rectifiers from some electrical manufacturers require "reforming" before a load is applied. This involves removing one lead on the load side of the rectifier before the power is connected. The unit is then subjected to transformer current for about ten minutes, after which the main switch is opened, the load lead connected and the switch closed for a rectifier output check. If your equipment requires this action, your "super" should provide instructions.)

8. When these tests have been made and the equipment is in good order, make certain that the hoistway is clear of men and scaffolding. Then move the car a few inches in each direction by closing the line switch, one direction switch and the controller brake-switch for an instant, then the opposite direction switch with the others. The wiring is corrected if the test shows that the car moves in the wrong direction.



Mechanic Adjusting Electro-Mechanically Operated A.C. Switches

9. Adjust the brake to obtain proper shoe clearances and coil action (see section "b").

10. Try the elevator from the car operating panel. Run it a few feet in each direction, paying particular attention to car action when stopping. Be sure the car does not slide through the brake in either direction.

11. Have the helper run the car down. Connect the extension light on the car top. Get on the car with tools and set the top and bottom final limits (and floor stop switches, if used). One method of setting these limits is described in detail later in this chapter. Examine the safety device parts on top and bottom of car.

12. While on top of car, make a general check of the hoistway clearances, rope and traveling cable conditions, and set car shoe clearances.

13. Go to machine room and make a final check of the car to counterweight overbalance by checking up and down speeds with the tachometer. Add or remove sub-weights, if necessary, and complete the weight frame by securing the tie-down clamps or pipes. (The rough check of the overbalance was made after the brake was adjusted. If accurately done, the re-check at this point should merely serve as confirmation of the correctness of the overbalance.)

14. Check car speeds up and down for empty car, balanced car and full load conditions. Make other tests and checks, such as starting and running amperes and voltages in accordance with company routines and motor data plate.

15. Test the safety with full load in the car.

16. Adjust timing of controller switches and relays to conform to standard instructions.

17. Test all accessory parts, placing door operator into circuit and checking door direction, speeds and other variables.

18. Set leveling or inching switches and cams to obtain satisfactory results for these operations.

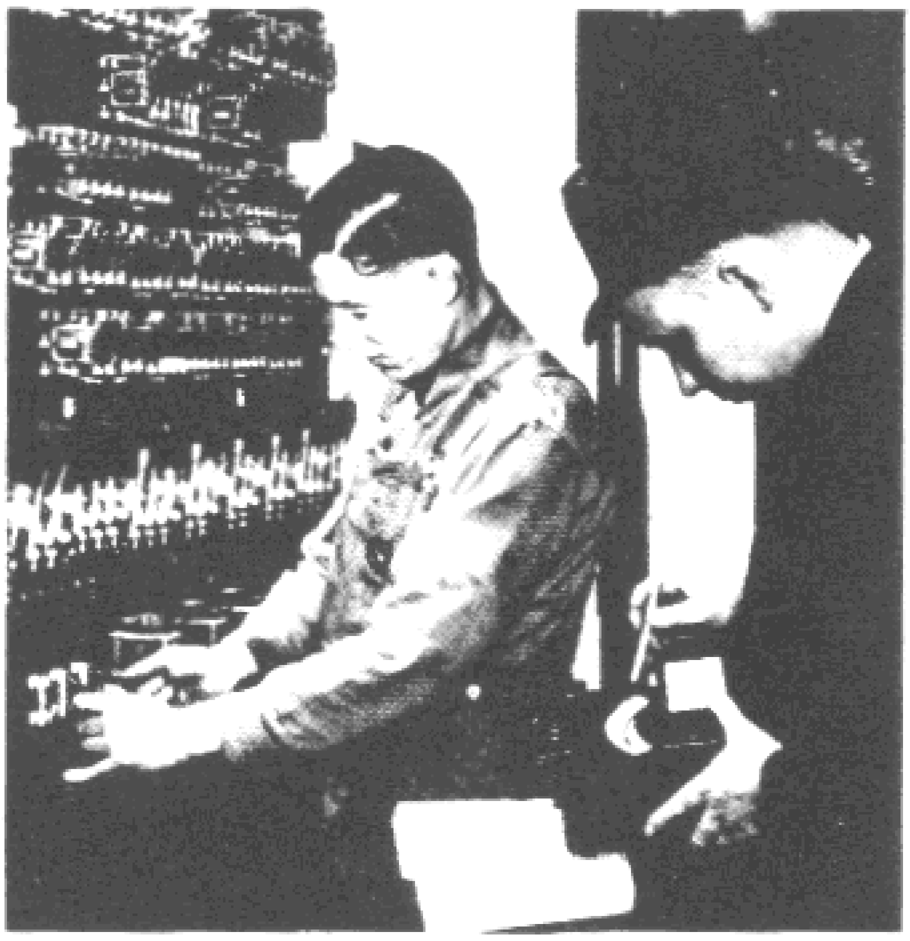
ADJUSTMENTS

Controllers – D.C.

Suggested:

Materials –
a. sundries

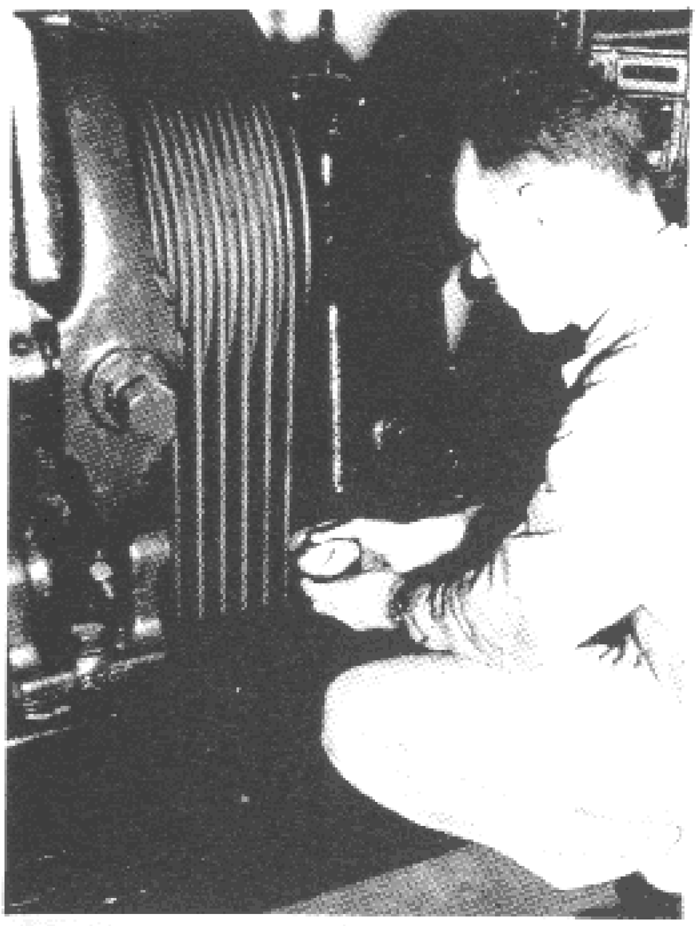
Tools –
a. hand tool kit
b. electric blower
c. meters (A.C. & D.C. voltmeter), D.C. ammeter, ohmmeter, tachometer
d. test weights
e. extension light



Testing Voltage of An Exciter Circuit

1. There are two general classes of direct current controllers used on elevator equipment at the present time. The older of these is a resistance control type that is connected directly to a D.C. supply line. It is also called "rheostat" control. Since direct current supply lines are gradually being replaced by alternating current lines, the rheostatic control equipment is seldom installed. However, it has come application, such as in factories or mills with privately maintained direct current power plants.

2. The type of direct current elevator control most widely used today includes several variations of multi-voltage equipment. It may be an adaptation of the Ward Leonard control or one of several others but in all, the prime power supply is generally A.C. This is utilized to drive a D.C. generator from which the basic elevator equipment draws its power. The generator unit may include an exciter as well as the A.C. driving motor and the generator. Other designs have separate exciters or even full-wave rectifiers which perform this function.



Car Speeds are Generally "Tached" at Hoist Ropes

3. Regardless of what the primary power supply is, or how complex the equipment may be, the approach to adjustment is parallel up to a certain point. The steps described in the preceding articles of this chapter must be followed so that mechanical functions can be checked carefully before a multi-voltage elevator is run "up to speed."

4. Although the multi-voltage controller is far more complex than the usual A.C. controller, the numerous switches, relays and other devices provide many refinements in elevator operation that could not otherwise be obtained. Switches can be accurately timed and they are reliable. Condensors, electronic tubes, potentiometers and resistances are all used by the different manufacturers for timing these operations.

5. After the preliminary stages of controller adjustments and inspection have been completed, many of the timed switches can be individually energized and set. It is convenient to make a check list of such switches, tabulating the switch names, the recommended timing and the actual timing for which each was set. This must be done in accordance with the manufacturer's data. Careful work should result in smooth starting and stopping of the elevator. The check list enables the adjustor to systematically determine that all switches are adjusted.

6. The car balance is checked with test weights and a tachometer or ammeter. The "balance" condition should exist with about 40% of the rated or "contract" load in the car.

7. The motor armature voltage is adjusted to correspond with the stamping on the motor data-plate. The adjustment is made on the armature resistance. It is done with the accelerating-switch contacts closed.

8. The "speed-per-step" of acceleration is checked with a tachometer and adjusted on its particular section of the armature resistance. It is advisable to tabulate these results also, for later reference.

9. The car speed is set with a balanced load in the car. It is obtainable by adjusting the motor field resistance, after armature voltages and speeds-per-step are adjusted.

10. Overspeed switches are adjusted with a full load in the car. Such switches may be on the controller, on the governor or in the hoistway.

11. High-speed equipment may have other refinements, such as load weighing that provides automatic by-pass of hall calls when the car load is near full capacity. Additional features might include warning lights for overloads, buzzers or taped announcements if doors are manually delayed by passengers or automatic transfers of schedule signals. Although these special operations may originate on the elevator car, a schedule panel or a floor controller, they all activate relays or circuits on the controller. It is obviously important to check out each function during the adjusting period.

12. Each company has its own data about adjustments of its equipment. This should be carefully studied before beginning this portion of the work. New men are given considerable "on the job" training before being permitted to adjust this type of equipment. The amount of time required for this training may extend to several years. Special aptitudes are needed to permit a man to develop into a first class adjustor for complex, high-speed equipment but it is one of the most interesting phases of elevator installation work.

CHAPTER 13
Section -c3

ADJUSTMENTS

Floor Controllers, Leveling Switches

Suggested:

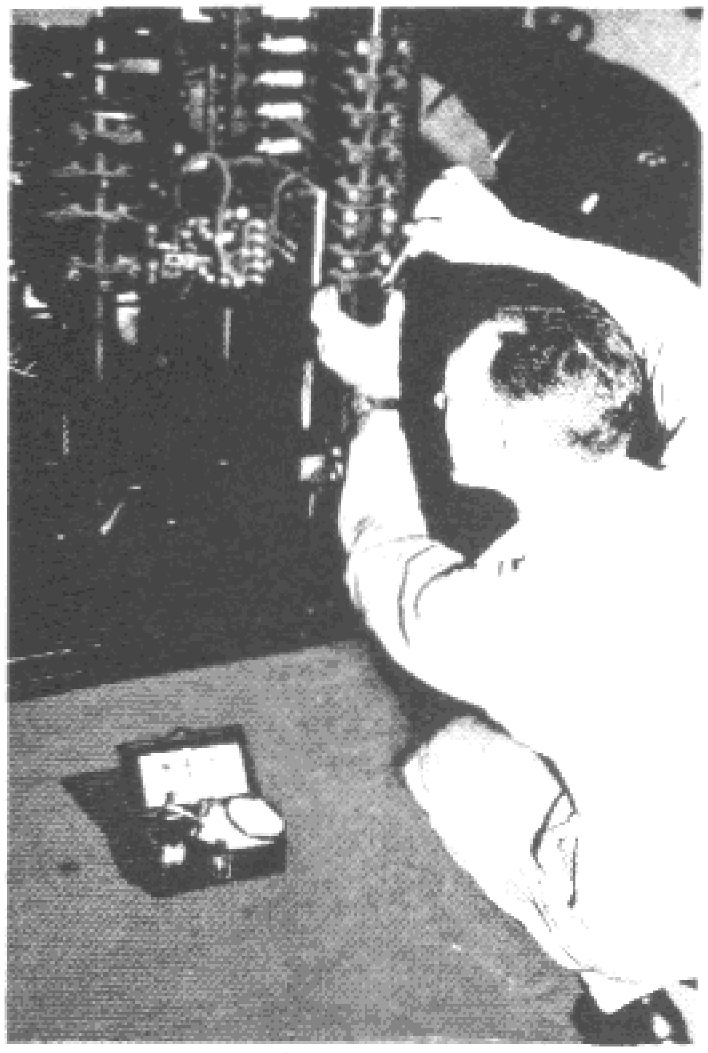
Materials –
- a. sundries
- b. cleaning compounds
- c. lubricants

Tools –
- a. hand tool kit
- b. gauges (as required)
- c. extension light

1. The terms "floor controller" and "selector" are more or less synonymous when applied to elevator work. The units perform numerous functions in relation to starting, slow down, leveling and stopping of cars. Signal system circuits are also routed through selector devices.

2. There are numerous forms of selectors used in Canada and the United States. European elevator manufacturers have also developed specific types, some of which are quite compact. Research on possible improvements and refinements continue, as is evidenced by comparison of the floor controllers of 1945 and those of 1961. Introduction of new materials and designs as well as better manufacturing techniques have made the units more compact and efficient.

3. Most floor controllers for multi-voltage elevators include arrangements to control car leveling. Some designed for slow-speed "A.C." units omit the leveling entirely or have separate mechanical or "inductor" leveling switches in the hoistway. A few companies use simple selectors for signal register and reset functions only.



Adjusting Floor Bar on Selector

4. Present day selectors are driven by steel tapes, steel wires, wire ropes or through inductor actuated circuits. The mechanical drives are probably the most common so this article will briefly outline a sequence for adjusting that type.

5. When the floor controllers are ready for adjustment, which is usually just after the car mechanical and the controller adjustments have been "roughed in," the entire unit should be carefully inspected, cleaned, lubricated and "freed-up" to elimnate friction. The selector should be plumb, particularly the tape-sheave face.

6. The drive shaft should be turned by hand to move the carriage enough to be certain that it moves in the proper direction and that there is no friction and that moving parts are clear of floor bars and cams.

7. The tape or other drive should be installed in accordance with the manufacturer's instructions. The broken-tape switch should be put into operation and tested.

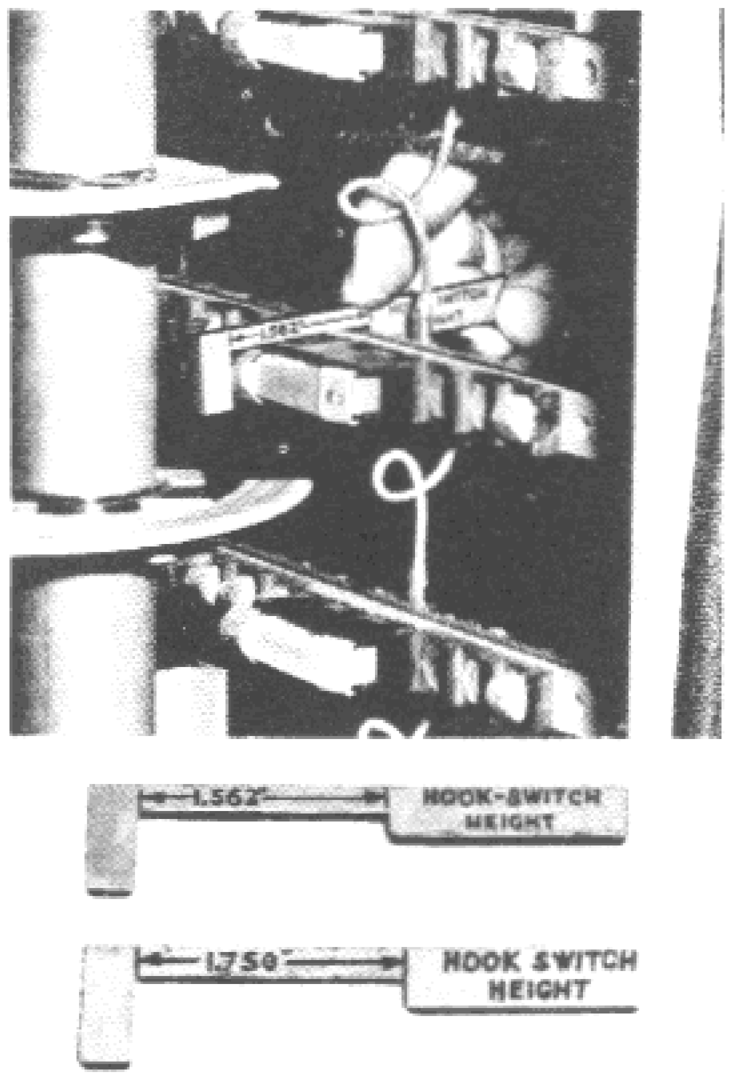
8. The leveling function shouldbe temporarily eliminated.

9. The elevator car is then set level with either the top or bottom terminal, and the floor-controller cams and contacts for that floor are adjusted to the traveling part, sometimes called the selector "crosshead."

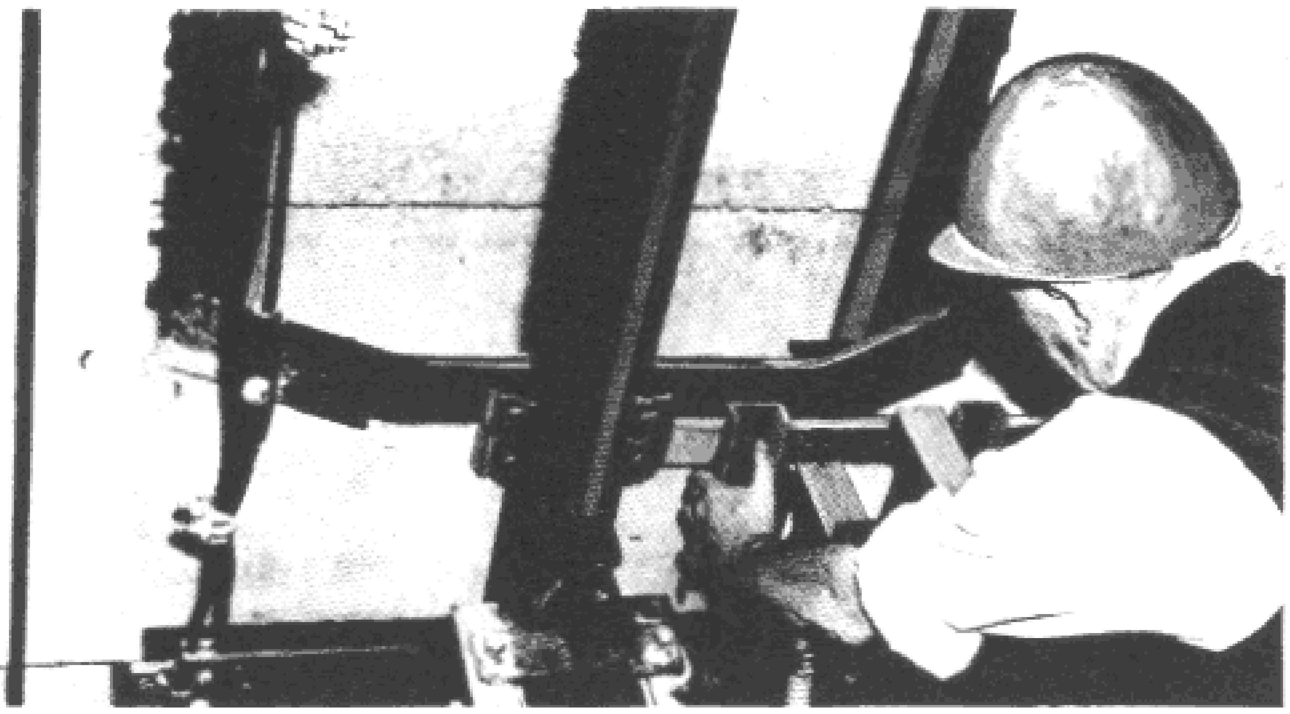
10. The car is then moved to the next landing and the same parts also adjusted to the cross-head index marks.

11. These adjustments are repeated at each landing, then the floor controller slow-down and stopping contacts are adjusted.

12. The leveling is then put into operation, if it is a part of the floor-controller assembly, and its contacts adjusted. Usually, leveling occurs in two or more steps on high-speed elevators. The car is placed a set number of inches above a landing and the down fast-speed



Floor-Bar Switches Are Set to "Gauge" Accuracy



Inductor Switches and Vanes Are Set from the Car Top

leveling contact is adjusted. The car is then moved closer to the floor (also a predetermined amount), and the down slow-speed leveling contact is adjusted. One such operation combined with the floor-controller adjustment, sets the leveling operation for all landings. Obtain tabulations of stopping distances of the unit you are adjusting from your "super."

13. Where hoistway leveling switches are used, the elevator is set at a terminal landing, the leveling switches set at pre-determined locations to correspond to those on the detailed drawings, and the "vane" in the hoistway set to the switches. The car is then moved level with each subsequent landing, and those vanes adjusted to the switches. After all "vanes" or cams are set to the switches, the car is run from floor to floor and the leveling accuracy is checked. If leveling error exists and is consistent, one or both switches can be moved to correct the error. If error is found at only one floor, the vane is altered to correct the fault.

14. After all floor controller and leveling work is completed, "final" or "touch up" adjustments are made on the elevator.

CHAPTER 13
Section -c4

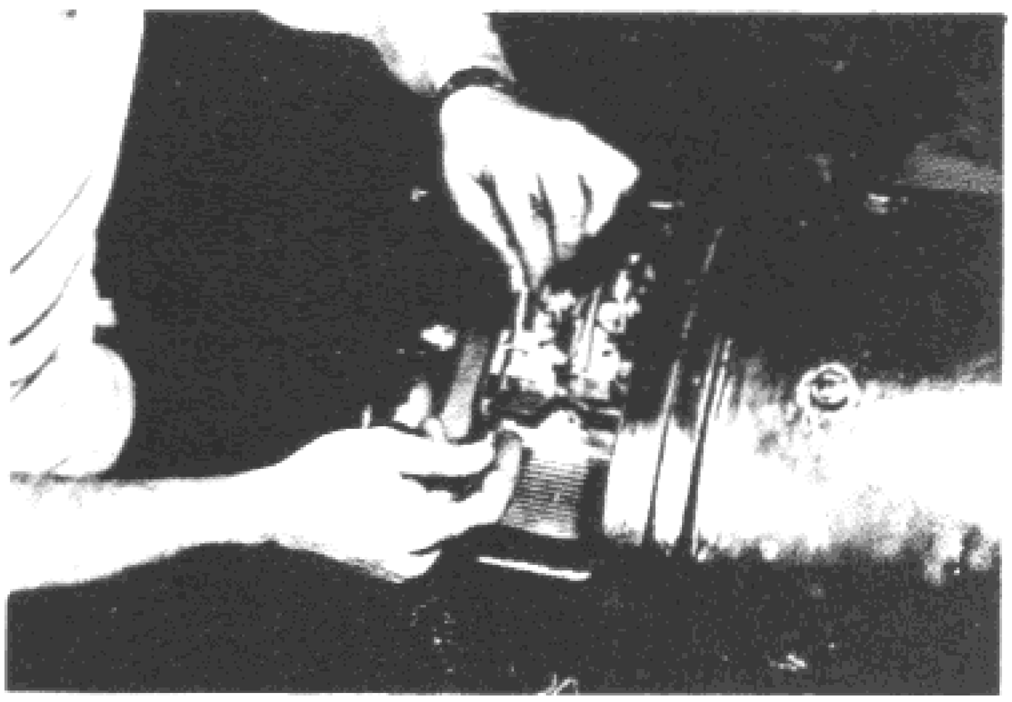
ADJUSTMENTS

Generators

Suggested:

Materials –
a. lubricants
b. sandpaper
c. sundries

Tools –
a. hand tool kit
b. tachometer
c. voltmeter, D.C.
d. test weights
e. electric blower



Generator Brushes Must Be Carefully Fitted

1. The use of motor generator sets on elevators permits elevator design engineers to transform line power of various characteristics to standardized elevator equipment requirements. Although it is possible to obtain "D.C.-D.C." motor generator sets, they are not commonly used today since most of the power supplied commercially is alternating current.

2. A "D.C.-D.C." set is used were the supply line is direct current. Aside from privately operated plants, there is practically no new direct current power being supplied today. Even in plants where D.C. is available A.C. motor generator sets are installed, if a choice can be made, since D.C. driving-motor speeds are affected by line loads. This, of course, affects elevator operation.

3. The "A.C.-D.C." motor generators are driven by squirrel cage A.C. motors at line voltage. The motors are generally (but not always) on the same shaft as the

D.C. generator. Field coils of the generator are directly excited by a separate exciter on larger M.G. sets. Low output sets may be self-excited.

4. Different elevator designs use exciters that may be small A.C.-D.C. generators or may be mounted on the shaft of main "M.G." set. Some types use dry-plate rectifiers as exciters. The exciters often supply power for the elevator motor fields, the machine brake coil, controller switches and other devices as well as the generator fields.

5. Generator and exciters should be inspected carefully before the main-line supply switch is closed. They should be cleaned with the electric blower, then examined to be sure no foreign matter is lodged between the rotating elements and the fields or starter. A "strong" light should be used to assist this inspection. The rotating element should be first turned by hand, before power is applied.

6. The quality, condition, and level of oil should be checked in sleeve bearing equipped sets. Oil rings or chains should move freely.

7. Anti-friction bearings are usually packed with lubricants at the factory, even where grease pressure fittings are supplied on the housings, Normally no grease should be pumped into these for the first few months of operation since excess lubrication can cause overheating and breakdown of bearings.

8. Motor generator sets are always run and test checked in the factory. There is comparatively little to be done on them in the field. They are usually compound wound.

9. The brush settings are checked for spacing and seating. Poor brush-seating can cause trouble in commutation, leveling, and many other phases of operation. Get detailed instruction about brush settings from your superintendent.

10. After the brushes are set, the generator neutral point is checked by lifting all brushes from the commutator, installing a pair of special "pointed" brushes in adjacent holders, and applying a low voltage to the fields. The current is fluctuated and the "deflection" noted on the milliammeter. The brush yoke is shifted slightly until a minimum needle deflection is obtained. The yoke bolts are then tightened, a final check made, and the regular brushes replaced.

11. After the neutral point is verified, the elevator is run in order to warm up the generator. (The overbalance of the counterweight is electrically checked about at this point, dependent on company routines.) Then the series field can be compounded.

12. The generator R.P.M. and empty-car speeds are checked and, if satisfactory, a full load is placed in the car, which is then run down to the center landing of the hoistway at high speed. As the car approaches the center landing, the down leveling-switches are held closed manually. This causes the car to continue to run down at leveling speed. This speed is "tached" and noted on a piece of paper. (These adjustments are all done in conjunction with controller, selector and other similar work.)

13. The car is now run to the bottom and then up to the center landing at high speed. As it approaches the floor, the up leveling-switches are held closed and that speed checked.

14. The down speed is divided into the up speed to obtain the percentage of compounding.

15. For example; let us assume that we obtained the following leveling speeds:

Down — 31 f.p.m. Up — 27 f.p.m.

$$\% \text{ of compounding} = \frac{\text{up leveling speed}}{\text{down leveling speed}}$$

$$= \frac{27}{31} \text{ or } .87 \text{ therefore;}$$

$$\text{compounding} = 87\ (+)\ \%$$

16. The percent of compounding required is different for most types of generators, and for the "combination" of elevator motor and generator used together. Ascertain what figure to use for the installation you are adjusting.

17. The value of compounding is adjusted by some type of shunt or by series-field taps.

18. (Special Note:) M.G. sets driven by D.C. motors are equipped with overspeed governors. These are tested for "tripping point" by "taching" the shaft R.P.M. while weakening the driving motor field until the governor switch opens. This should be done with considerable caution after first opening the contact by hand to be sure it is operative. Before testing, determine the designed tripping point of the governor. Do not exceed this speed by more than five (5) per cent without approval of the "super." Reset the governor, if necessary, to obtain proper tripping point but re-seal the governor so its setting cannot be changed.

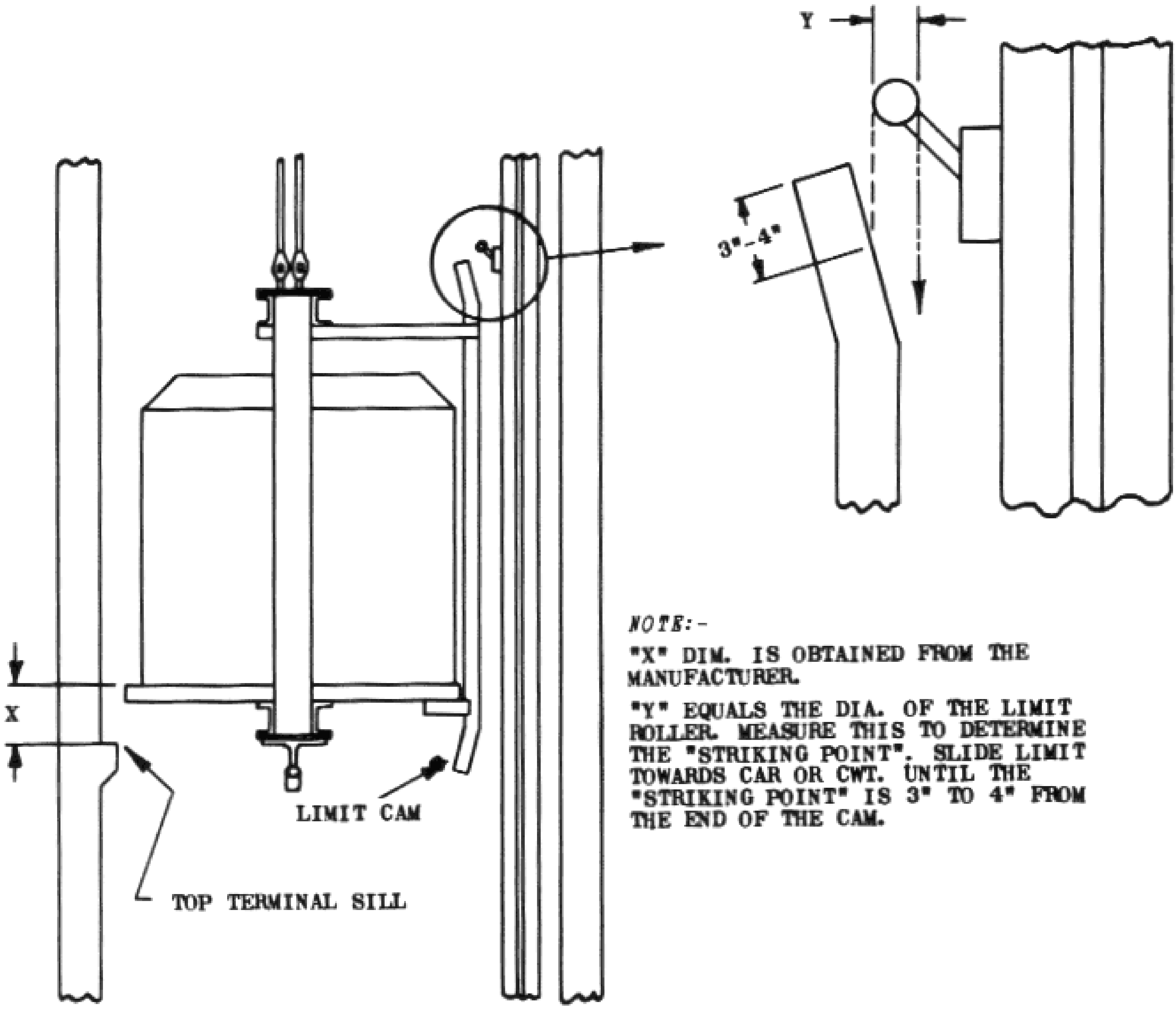
ADJUSTMENTS

Final Limits

Suggested:

Materials –
- a. sundries

Tools –
- a. hand tool kit
- b. small plumb bob
- c. extension light



Sketch #1

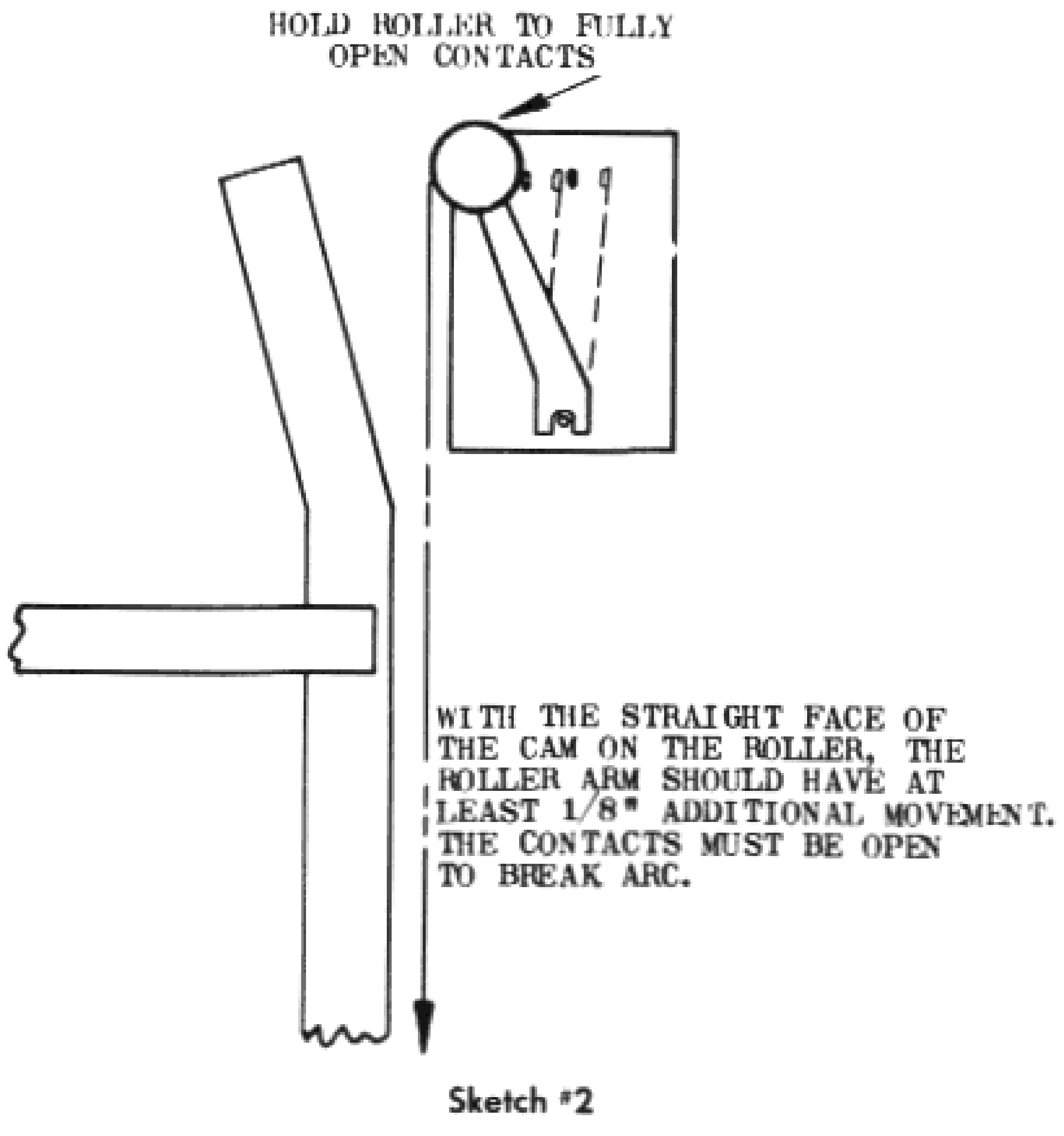
1. "Terminal Stopping Device, Final" is the official code terminology for the switch most field men call the "final limit." It is mandatory to use these switches on all power elevators in code territories. They are used in addition to normal terminal stopping switches, such as "direction limits," or "slow-down" switches.

2. The function of a final limit is to cut off power to the controller switches and the machine brake when the elevator has passed a pre-determined distance beyond either terminal landing. It is required to be set to operate as close to (but beyond the level of) the terminal landing as practical. On elevators equipped with spring buffers, the switch must function before the car (or counterweight) strikes the buffer. Code Rule 209.3 describes the switch and its function in detail.

3. Usually the final limits are mounted in the hoistway and the cam is installed on the car. Drum machine elevators also require a "stop-motion" switch on the machine. This is another kind of "Terminal Stopping Device, Final" but cannot take the place of the hoistway final-limits.

4. The first step in adjusting final limits is to inspect the limit cam. It must be plumb on the car, be in the correct vertical and horizontal position, and be securely fastened to the car.

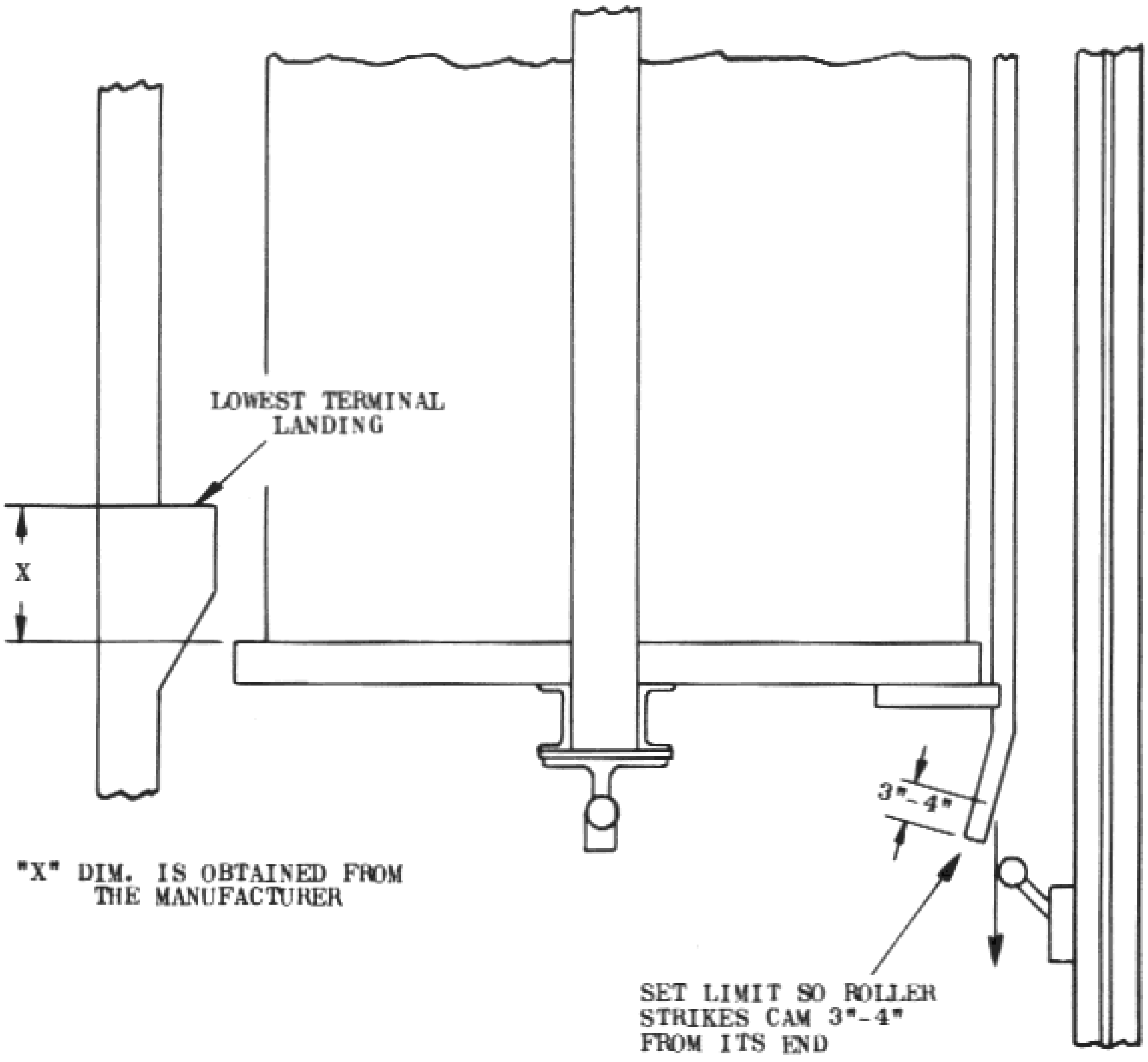
5. After the cam has been checked and set, block out the leveling circuits on the controller (if used). Raise the car above the top terminal landing. Stop the car the distance above the top landing sill at which limit operation should occur. (Obtain the measurements from your company.)



Sketch #2

6. Work from the car top. Connect the extension light to the car-top outlet. Adjust the top limit and bracket by hand until the roller is clear of the cam by several inches. Move the switch in a front-to-back direction until a plumb bob dropped from the roller shows that the roller will strike the face of the cam a few inches from the end. Refer to sketch 1.

7. Secure the limit tightly to its bracket, then slide the bracket down until the limit contacts are opened 1/8''. Tighten the bracket bolts.



Sketch #3

8. Next, open the limit contacts fully by hand. Drop a plumb from the roller to be sure that when the straight or vertical face of the cam is on the roller there is still at least 1/8'' of movement in the limit roller arm (sketch 2). Limit roller arms or rollers can be broken by the cams, when they are improperly aligned.

9. Run the car at a slow speed and open the limit switch by hand. It should stop the car in both directions.

10. Move the car down a few floors. Run it up at slow speed until the final limit-switch is set and the car stops. This should be at about the distance above the floor for which the limit was set. If so, through bolt the limit bracket to the rail with a 1/4'' round-head bolt. Otherwise readjust the limit to obtain the distance wanted and then through bolt the bracket to the rail.

11. When field telephones are available on the job, it is often easier to have the helper ''inch'' the car up from the controller until the ''potential'' or ''line'' switch controlled by the limit switch drops out. (The rail or wall is marked to indicate car crosshead position, when the car is level with the terminal landing. This makes it easy to determine the position where the switch functions. The telephones facilitate giving instructions to the helper.)

12. After the top limit-switch is properly set, go to the lower terminal. Place the car at the proper number of inches below the sill.

13. Working from the pit, adjust the bottom limit to strike the cam a few inches up from the end. Sketch *3 illustrates that in setting a lower limit, the plumb line is dropped from the cam face to the limit roller, instead of from the roller to the cam.

14. Move the limit until the contact opens about 1/8''.

15. Check clearance between cam and roller with limit contacts fully opened.

16. Test the operation of the switch by hand as you did for the top final-limit.

17. Make a slow-speed test of the lower limit. If the car stops at about the right position, through bolt the limit bracket to the guide rail. If not, readjust it and then through bolt the bracket and guide. In most installations the mechanic can safely stand in the pit to perform this test.

CHAPTER 13
Section -d2

ADJUSTMENTS

Stopping Limits

Suggested:

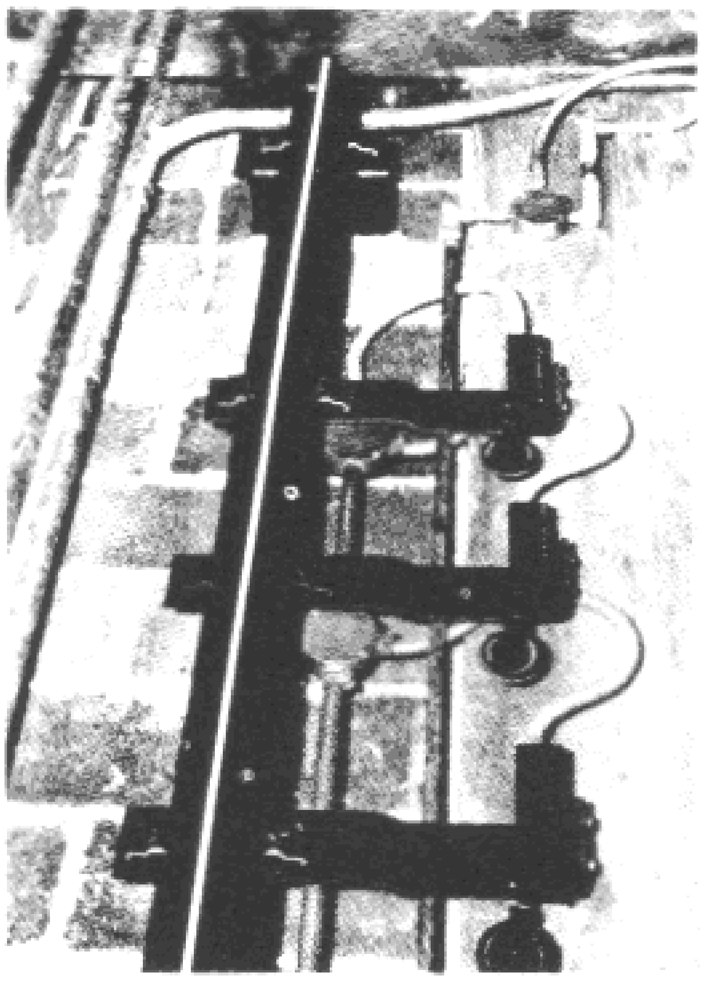
Materials –
a. sundries

Tools –
a. hand tool kit
b. extension light

1. Stopping or "slow-down" limits are used at the terminal landings of certain types of elevators. They are used to automatically slow-down and stop the car, even if the attendant should fail to do so. Generally, stopping limits are used on 2 speed A.C. cars and as "stopping switches" on multi-voltage elevators.

2. Stopping limits are similar to final limits in construction and installation. Very often they are operated from the same cam. The last one in line generally opens the circuit for a "direction" switch on the controller.

3. There can be any number of these limits set in a vertical row, depending on the number of "steps" of elevator speed to be cut off. As a rule, two or three are used at each terminal. Use of more than this is unusual and is generally considered uneconomical so a stopping switch would be used instead.


A Group of Three "Stopping" Limits

4. On elevators with leveling, the last or "stop" limit is set to open when the car is a few inches from reaching the terminal landing. This can be and generally is a regular floor stop switch.

5. On elevators without leveling, this last limit is set to stop the car an inch or two beyond each terminal. This permits a slight variation in stopping distances with the changes in load conditions in the car.

6. The stop limit is set to obtain, either one of these two conditions, as outlined in paragraphs 4 and 5, and the other limits installed at predetermined distances from it as specified by the manufacturer.

7. Measurements are taken from center to center of the rollers.

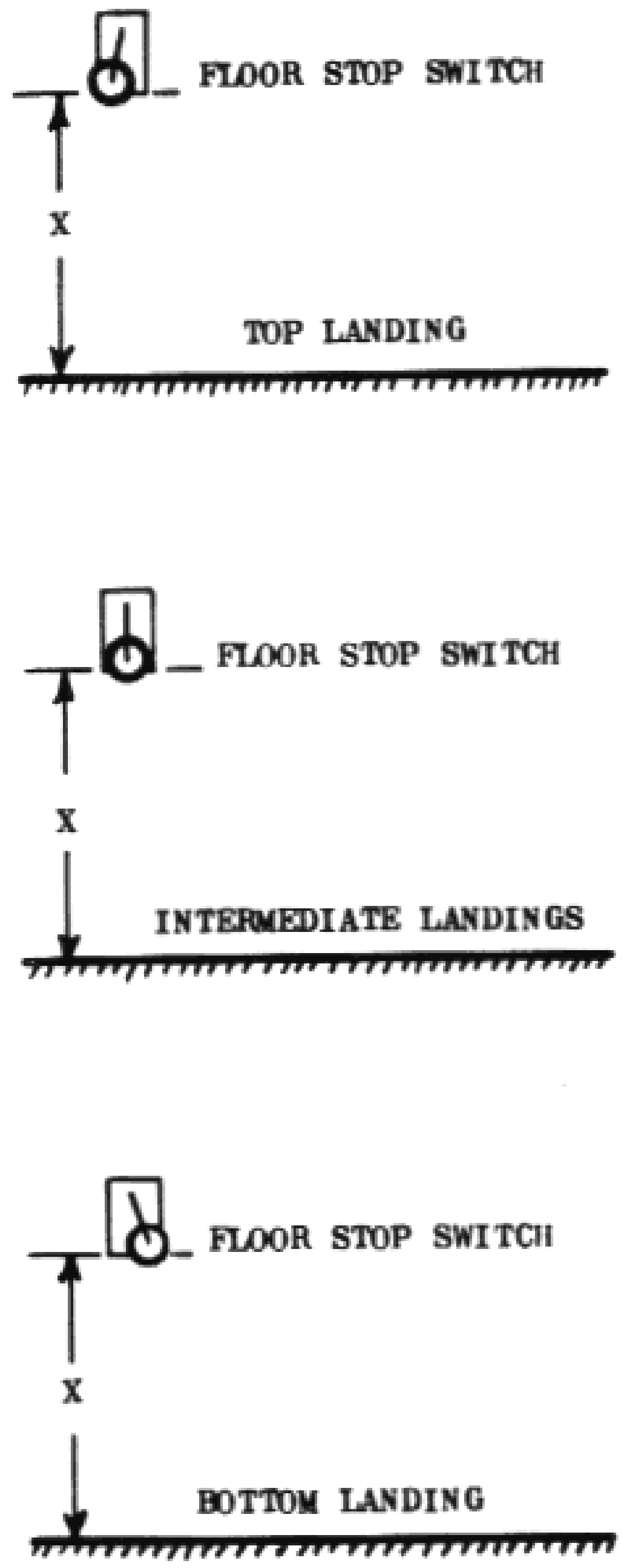
ADJUSTMENTS

Intermediate (Floor Stop) Limits

Suggested:

Materials –
a. sundries

Tools –
a. hand tool kit
b. long straightedge
c. level



SWITCHES VIEWED FROM INSIDE OF CAR

Sketch #1

1. Final and stopping limits are arranged to have two contact positions, closed and open. As a rule they are held in the closed position by springs until a cam forces them open.

2. In contrast to this, intermediate or floor-stop limits, which are used on types of self-service elevators, have three contact positions. These are: "up," "down," and "open" circuits. When an elevator is first operated, say from the bottom floor, all the intermediate-stop limits must be in the "up" circuit position or the car will not run.

3. A special cam designed to transfer the position of each limit roller from "up" to "down" as the elevator moves past them must be used with certain designs of these limits. Other manufacturers use two (2) switch boxes and eliminate that particular special cam.

4. The elevator brake should be adjusted before intermediate-stop limits are set.

5. Intermediate-stop limits are supported on brackets that are, most generally, clipped to a main guide-rail. The cam for them is sometimes separate from the final-limit cam and is set out from the carframe on steel brackets.

6. The elevator companies supply drawings or charts detailing the positions of the limits in relation to the landing sill lines. It is, therefore, a simple matter to extend the straightedge out from the sill to the guide rail, level it, mark the rail back with soapstone, and install the limit with its roller center the proper distance above the "floor" mark on the rail.

7. The correct distance between the roller center and the rail center must be established also. The clearances between the roller and the cam brackets on the car must be as specified.

8. The limit boxes should be plumb.

9. After all limits are adjusted in this manner, test the car on "floor-to-floor" stops. All of those in the down direction should be uniform. All of those in the up direction should also be uniform.

10. If all stops in one direction are uniform, but not level with the floor, adjust the cam.

11. If individual stops are irregular, adjust the limits for those floors.

12. If all stops are uniformly poor for both directions, the machine brake may require readjusting.

CHAPTER 13
Section -d4

ADJUSTMENTS

Stopping Switches

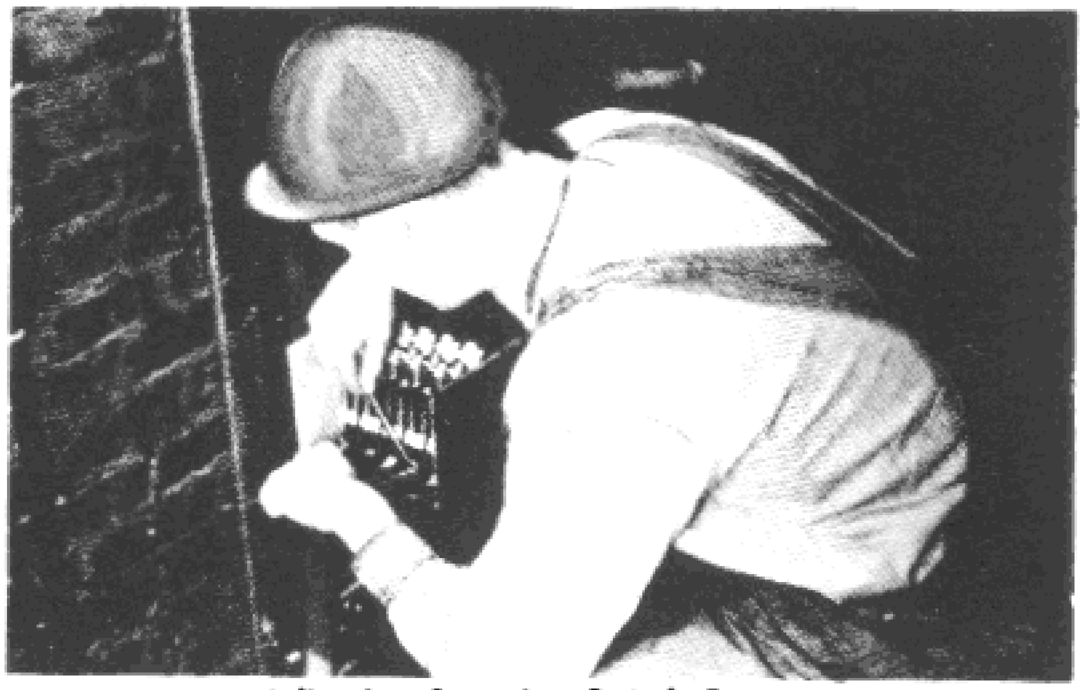
Suggested:

Materials –	Tools –
a. sundries	a. hand tool kit
	b. extension light

1. Most elevators of moderate and all those of high speeds are equipped with "stopping switches." These switches are mounted on the car, as a rule, although in some instances they may be in other locations. They are equipped with two (2) sets of contacts, one (1) for each direction of travel. These contacts are opened or closed by the action of an arm which is moved by cams located at the terminals, if the switch is on the car.

2. The purpose of the switch is to provide a smooth, safe and automatic slow-down in case the normal slow-down should fail at the terminals.

3. The switch is set on a support which is bolted to the carframe.



Adjusting Stopping-Switch Contacts

4. The cams are fixed to the rails by steel brackets. Once set, at least two (2) brackets of each should be through bolted to the rail backs, after they are positioned. Detailed drawings are supplied for the work of installing the cams.

5. In the event that the elevator compresses the buffer, the stopping-switch roller should still be on the cam. If this condition does not exist, shift the cam or extend the length of it, but bring the matter to the attention of your superintendent. See sketch 1, for details.

6. When the cams are installed properly, take the car to the lower terminal. Get on the car top and have the helper level the car with the terminal sill.

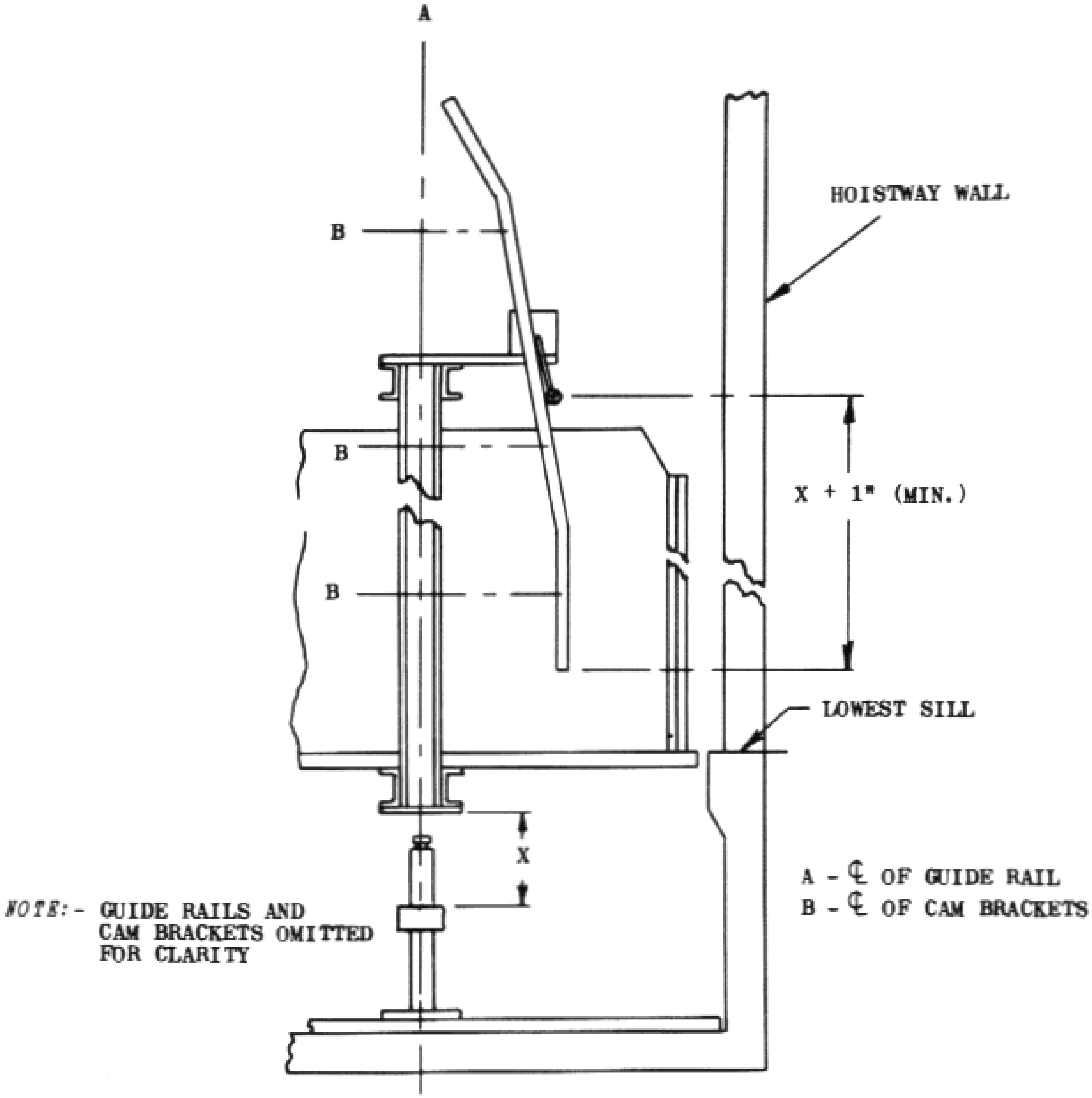
7. Mark the rail at the car shoe, as per sketch 2.

8. Contact "settings" are given by the manufacturer. They vary considerably with car speeds. In effect, they parallel those used for "stopping limits" but, being for higher-speed elevators, are spaced at greater distances.

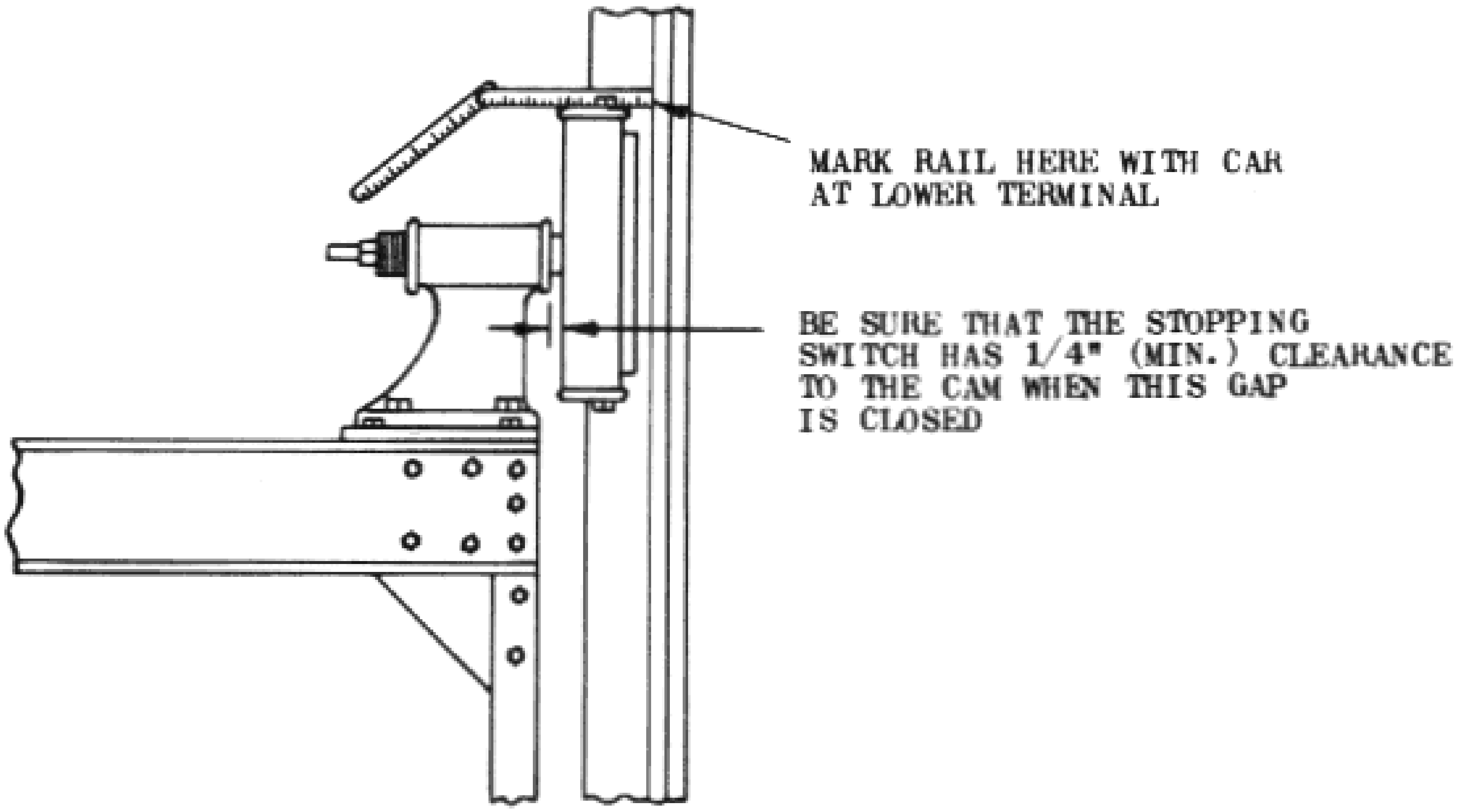
9. It is only necessary to mark the guide-rail back with soapstone at the positions where you want the contacts to open, then move the car up so that the shoe top is level with these marks and set each contact, in turn.

10. The car is then taken to the top terminal and the "up" contacts set in the same manner.

11. The switch is then carefully hand tested with the car running to be sure that the switch operates in the proper directions. The car is then run onto the cams to test the smoothness of the stop. If necessary, contact adjusting screws can be turned slightly to "smooth out" the stop. (Be certain to make the floor-controller stops in-operative, when testing the stopping switch.) Most designs provide that the normal stops at terminals are made by the selector. The "stopping-switch" contacts would, therefore, be effective only in an emergency. Because of this, selector stopping-distance settings are a few inches greater than those for stopping-switch contacts.


A
B
B
B
HOISTWAY WALL
X + 1" (MIN.)
LOWEST SILL
X
NOTE:- GUIDE RAILS AND
CAM BRACKETS OMITTED
FOR CLARITY
A - ℄ OF GUIDE RAIL
B - ℄ OF CAM BRACKETS

Sketch #1



Sketch #2

CHAPTER 13
Section -e1

ADJUSTMENTS

Safety Governors

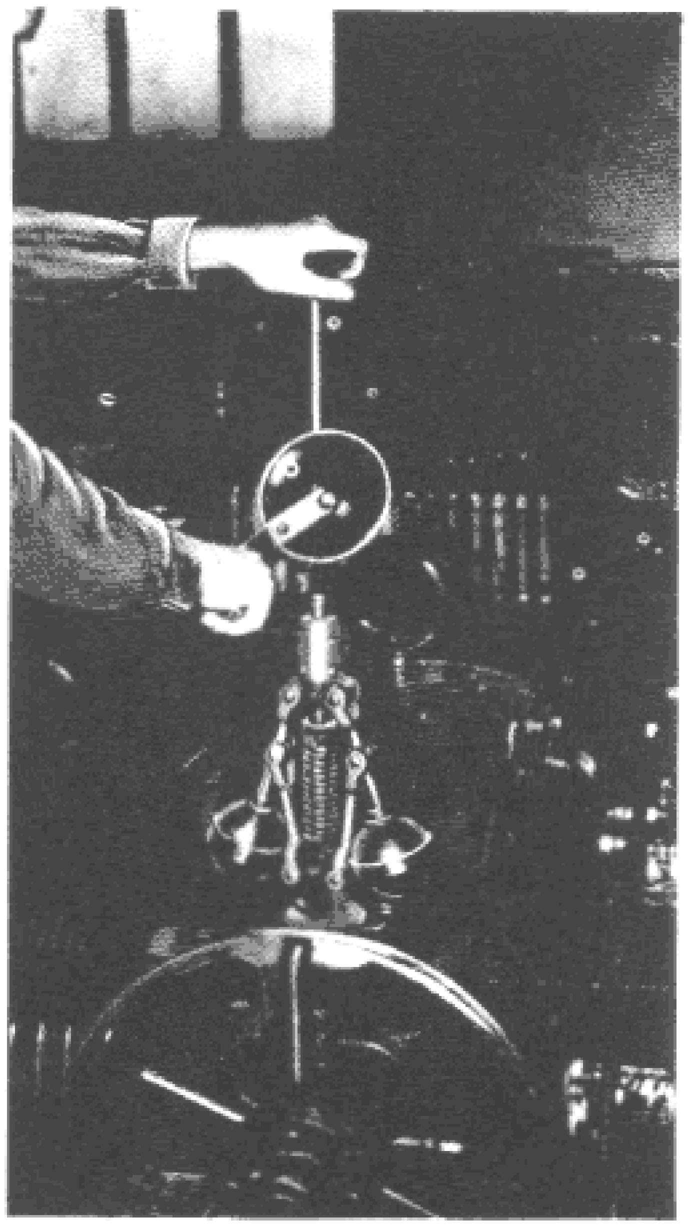
Suggested:

Materials –
- a. cleaning sundries
- b. lubrication
- c. seals for governor

Tools –
- a. tachometer
- b. hand tool kit

1. All safety governors are factory tested for general operation, after assembly is complete. Each is also tested to assure that the so-called "tripping point" of the governor is set according to the code requirement for its contact. (The "tripping point" is the speed at which the governor will actuate the safety operation.) After this is set, the factory applies a seal to the adjusting mechanism. The tripping point cannot be changed without destroying the seal. This is a code requirement.

2. The code also states that all bearing and rubbing surfaces shall be kept free of paint and a hand test made after painting to assure that all parts operate freely as intended. Since many factory procedures make painting the last operation, it is necessary for the field men to examine the governor before making a safety test. It is sometimes necessary to free up the unit. (Rust and dirt can also affect the governor before it is put into operation.)



Field Testing the Tripping Point of a Governor for a High-Speed Elevator

3. A simple field test for ascertaining the tripping point of one low-speed type of governor follows:

a. Open the main line switch.

b. Clean and lubricate the governor.

c. Clean and lubricate the rope tightener in the pit. (Release the "hold down" clamps, if the assembly includes these.)

d. Place the car at the top landing with a helper on the car top.

e. Have helper remove governor rope shackles from the safety arm.

f. Connect the two ends of the rope by tieing the upper and lower shackles together.

g. Hang a weight of 2 to 3 lbs. on the shackle. (A pair of adjustable wrenches or something similar serves satisfactorily for this purpose.)

h. When this is done, the mechanic should go to the machine room and prepare his tachometer to read the rope speed. He then instructs the helper to allow the governor rope to run freely down the hoistway. The weight will cause the rope to accelerate to tripping speed. Readings can be made quite accurately in this manner.

i. We suggest that you take about three readings and determine the average overspeed tripping point.

j. If necessary, remove the cotter pin from the governor centrifugal weight spring and adjust the spring nut to obtain correct tripping point.

k. If it is necessary to adjust the governor to obtain proper tripping point, you should note this on the Field Test & Data Report under "remarks." Reseal the adjusting mechanism.

4. This basic method would not be as practical for large governors as for low-speed types. Each company follows specific routines that suit their equipment.

CONTENTS

CHAPTER 14

CHAPTER 14
Section -a1

HYDRAULIC ELEVATORS

General

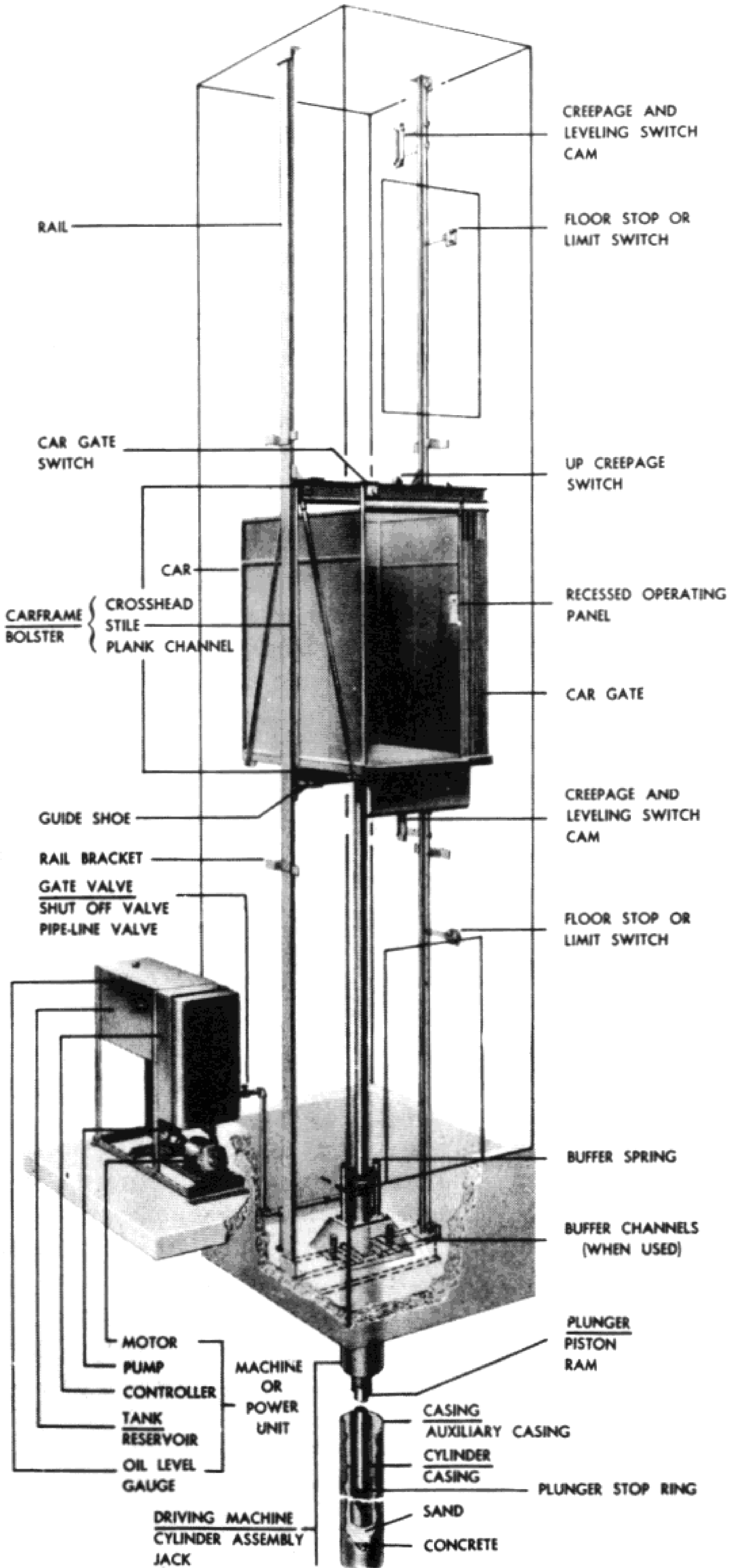
1. The brief history of elevators in chapter 1, of this book, outlined a few facts about "plunger" or "hydraulic" elevators. They indicated that although the volume of "plunger" elevators being installed at present is not too large in dollar volume as related to overall elevator and escalator sales, there is a definite and continuing interest in the type. The actual number of hydraulic units installed in 1959 was impressive, being over 1600 elevators or about 23% of all elevators reported to N.E.M.I. as installed. Because of this, we will review some information about what the components of a modern hydraulic elevator are and describe some installation procedures that are commonly followed.

2. Terminology used in reference to hydraulic elevators varies considerably. For example, some companies call their product "oil-hydraulic" elevators. Others use the name "plunger-electric." The cylinder and piston assembly is termed "the jack" by Rotary Lift and some others. Because of this difference in phrasing, the present article makes use of basic names of the hydraulic elevator and its components as described in section 300, of the Safety Code.

3. Sketch #1 illustrates the cutaway parts of a modern hydraulic elevator. Several versions of common names of the major components have been included on the sketch. In each case the first given is the one used in the code, where such names are available. The other titles are names used by several companies which manufacture or sell hydraulic elevators.

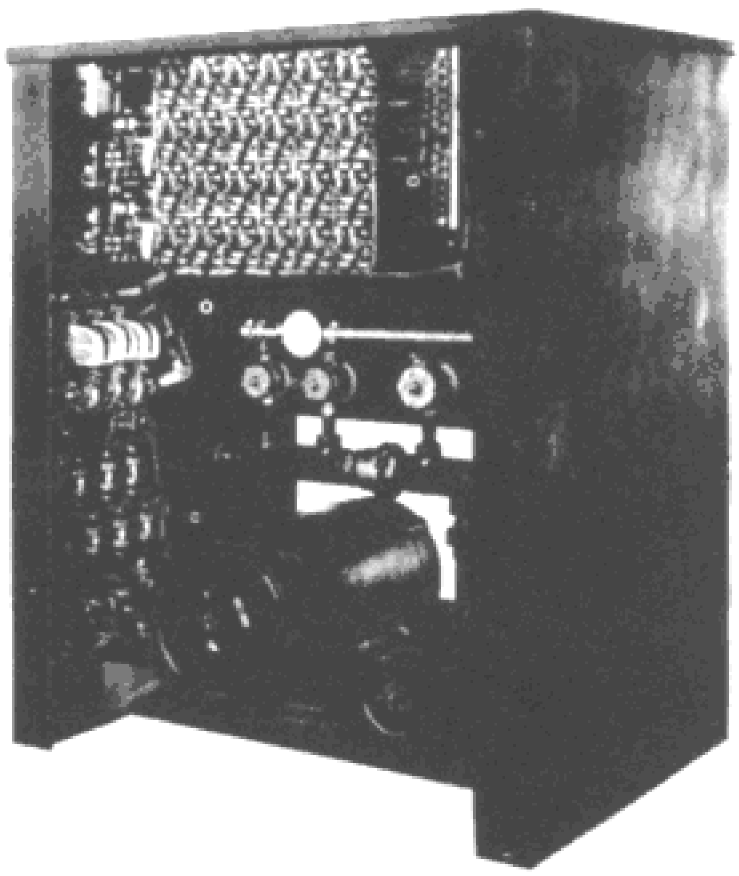
4. The activating fluid used in modern units is usually oil rather than water.

5. The present day "hydraulic" installation includes many of the features of the conventional electric units. The elevator car travels on guide rails which are essentially the base lines on which the elevator is installed. The cylinder (or jack) assembly is placed in a planned position whose location is related to the guide-rail center lines. The cylinder may be supported on a steel channel frame arranged in a manner similar to conventional buffer channels, or may be supported on a concrete block. Company design determines which method is used. Where the ground or "soil" condition is not solid, an outer, earth retaining (or auxiliary) casing is generally installed first and the cylinder is placed in a plumb position inside this casing. The plunger is installed in the cylinder. It is provided with a heavy, steel plate or "platen" on its top. The carframe member corresponding to a traction elevator car's "safety plank" is secured to this plate. The car stiles and crosshead are assembled on the plank channels and the platform, cab and gates are secured in the frame. No overspeed safety is required. Counterweights are not used on regular installations.



Hydraulic Elevator Components

Sketch #1



Montgomery Power Unit or "Machine"

6. A single line of piping is led from an outlet near the top of the cylinder to the machine room. The storage tank for the fluid is located in the machine room. It may be a tank located at any convenient position but in present practice is generally a part of an assembly which includes a pump, pump motor, controller and valves. The piping connects the cylinder to the tank through the pump and valves.

7. Conventional elevator wiring is used. The control system could be any of the ordinary traction elevator controls, such as double button, car switch, push button or collective operation but push button and collective are the most common. Limit and floor-stop switches are used, as are special features such as ''anti-creep'' switches, automatic leveling and releveling devices.

8. The car enclosures may be service, freight or passenger types. Doors would correspond to those normally supplied for the intended usage. Electric door-operators are often supplied.

9. In the code areas all conventional electrical safety devices are required. These include door and gate contacts, emergency stop switches, emergency exit contacts, alarm bells and access switches, as well as others.

10. Upward movement of the plunger electric elevator is accomplished when an ''up'' hall or car button is pressed, or a switch moved to an ''up'' operating position. This action energizes a controller switch which, in turn, starts the pump motor through conventional circuitry. The pump motor assembly forces fluid from the storage tank to the cylinder. By-pass and check valves are included in the pipe line system. Passenger and some other elevators usually have muffler devices in the line. As the fluid is forced into the cylinder it displaces the piston and the car moves up. When the elevator arrives at the selected floor, a floor stop switch, selector contact or "car-switch" contact is opened and the car levels with or stops approximately at the floor. Many modern units are equipped with leveling systems that bring the car accurately to floor level in either direction of travel.

11. Downward motion is obtained by electrically opening a pipe line main valve through means of controller switches. Opening the valve permits the fluid to flow from the cylinder to the storage tank. The weight of the piston and car assembly, plus its load, create sufficient pressure to ensure this flow. Obviously, the pressure will vary according to the load being carried by the elevator, therefore, the down speed will also vary somewhat according to car load.

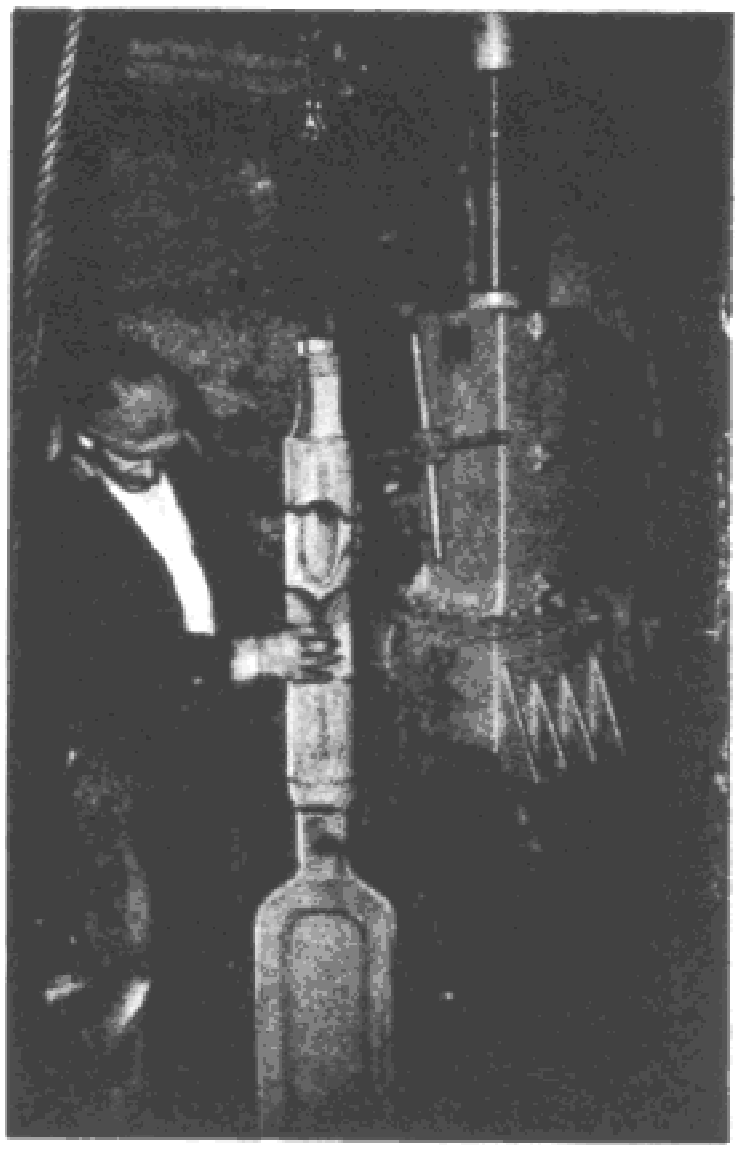
12. Speed in up direction varies somewhat too, but is rated at full load.

13. The revival of popularity of the hydraulic elevator is due to a great extent to certain characteristics. These include the facts that less hoistway overhead is required than for overhead traction or drum elevators and that the building structures need not be strengthened to support overhead loads. Disadvantages include those mentioned in chapter 1, such as speed variations that might be objectionable in some applications.

14. There are numerous arrangements of hydraulic elevators. Some heavy duty elevators have two or more plungers. Multiple pumps are used on many installations.

15. Most of the plunger electric elevators being installed today are quite limited in rise. Sixty-five feet is a commonly accepted maximum for normal hydraulic units.

16. More detailed information on the components and their installations will follow in the other sections of this chapter.



"Drilling" the Hole

CHAPTER 14
Section -a2

HYDRAULIC ELEVATORS

Preparatory Work

1. The approach to the work of installing a hydraulic elevator parallels that for traction elevators. The mechanic should study the erection data and drawings supplied by the company and relate them to job conditions. Storage and handling space must be arranged. Power for working lights, tools and testing is obtained with the help of the building contractor's "super." Availability of space and supports for unloading, material, rigging and hoisting are generally checked earlier by the elevator "super" but conditions must be rechecked by the mechanic on arrival at the jobsite.

2. On the jobsite, the mechanic checks the material packing lists or shipping papers against the delivery. Any apparent damage and all shortages, overages or wrong material are immediately reported to the elevator super or the office. Replacements are ordered if need for this is indicated.

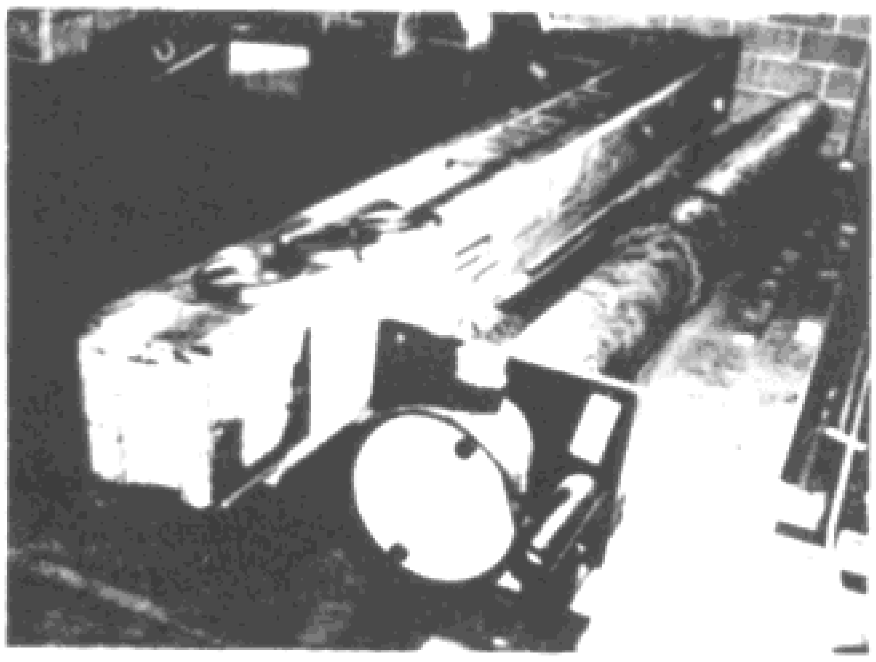
CONTRACT DATA		
Code Combination		
Duty Load	20,000	
Static Load		
Speed F.P.M.-F.L.U.	30	
Plunger	12-1/2"	
Cylinder	16"	
Machine Size,-Type	17A	
Pump No.	A313C-250	
Valve Size	2-1/2"	
Motor,-Frame No.	GE	
R.P.M.	3600	
Horse Power	60	
Fluid	Oil	
Fluid Pressure Lbs. per Sq. Inch	365	
Controller	30H1BL	
No. Stops & Openings	5-5	
Carframe	6946C	
Platform - Type	10[illegible]HS-7T	
Car Rails	OA	
To & From Piping	3"	
Tank Capacity	367 Gals	

CURRENT CHARACTERISTICS

Power A.C. ________ Volts ________ Phase
Supply D.C. ________ Wires ________ Cycles
Confirmed ________________
Lighting A.C. D.C. ________
Supply ________ Volts
Confirmed ________________

ESTIMATED WEIGHTS	1-Opng.	2-Opng.
Car Enclosure	3720	3210
Door Including Support		
Gate Including Support	735	1470
Car Door Hangers		
Platform Maple Flooring	9935	9935
Threshold-Toe Guard	145	290
Car Operating Box	25	25
Annunc. or Indicator		
Limit Sw. Cam & Support	55	55
~~Door Zone &~~ Leveling Sw.	15	15
Wiring & Conduits	140	160
Traveling Cable	20	20
Door or Gate Operator and Support - Type ( )		
~~Gate~~ Ret. Cam Device	45	90
Side Braces	700	700
Car Frame	3385	3385
Total Car Weight	18920	19355
Platten & Plunger Bottom	250	250
Plunger - Size 12-1/2"	2445	2445
Coupling	90	90
Total Car Incl. Plunger	21705	22140
Duty Load	20000	20000
Gross Load	41705	42140
Static Load Extra		
Gross With Static Load		

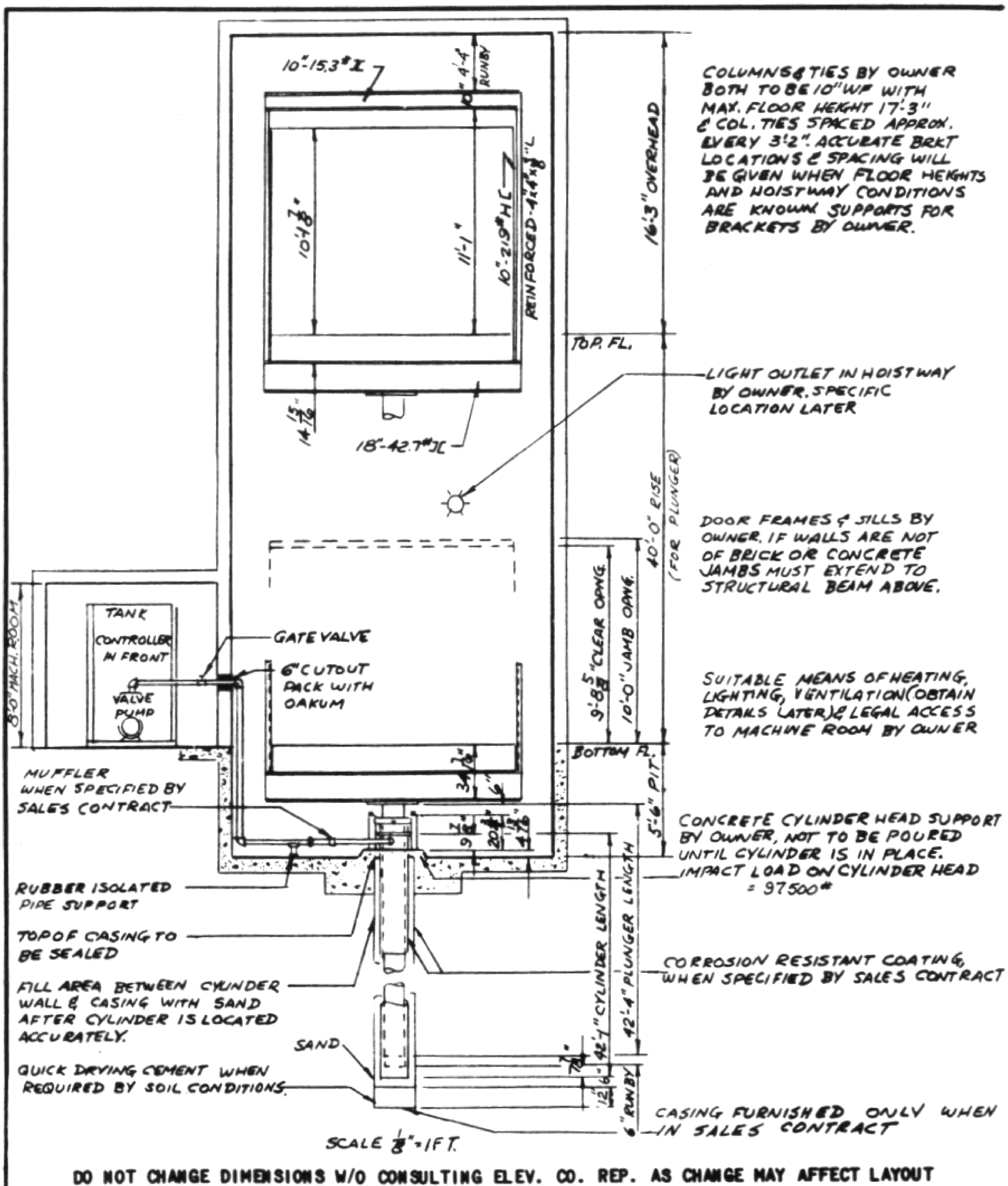
Contract and Weight Data Tabulations are Part of the Layout Sheet



This Photo Shows the Cylinder and Boxed Piston as Received on the Site—The Packing-Gland Rings Have Been Laid Out in Sequence.

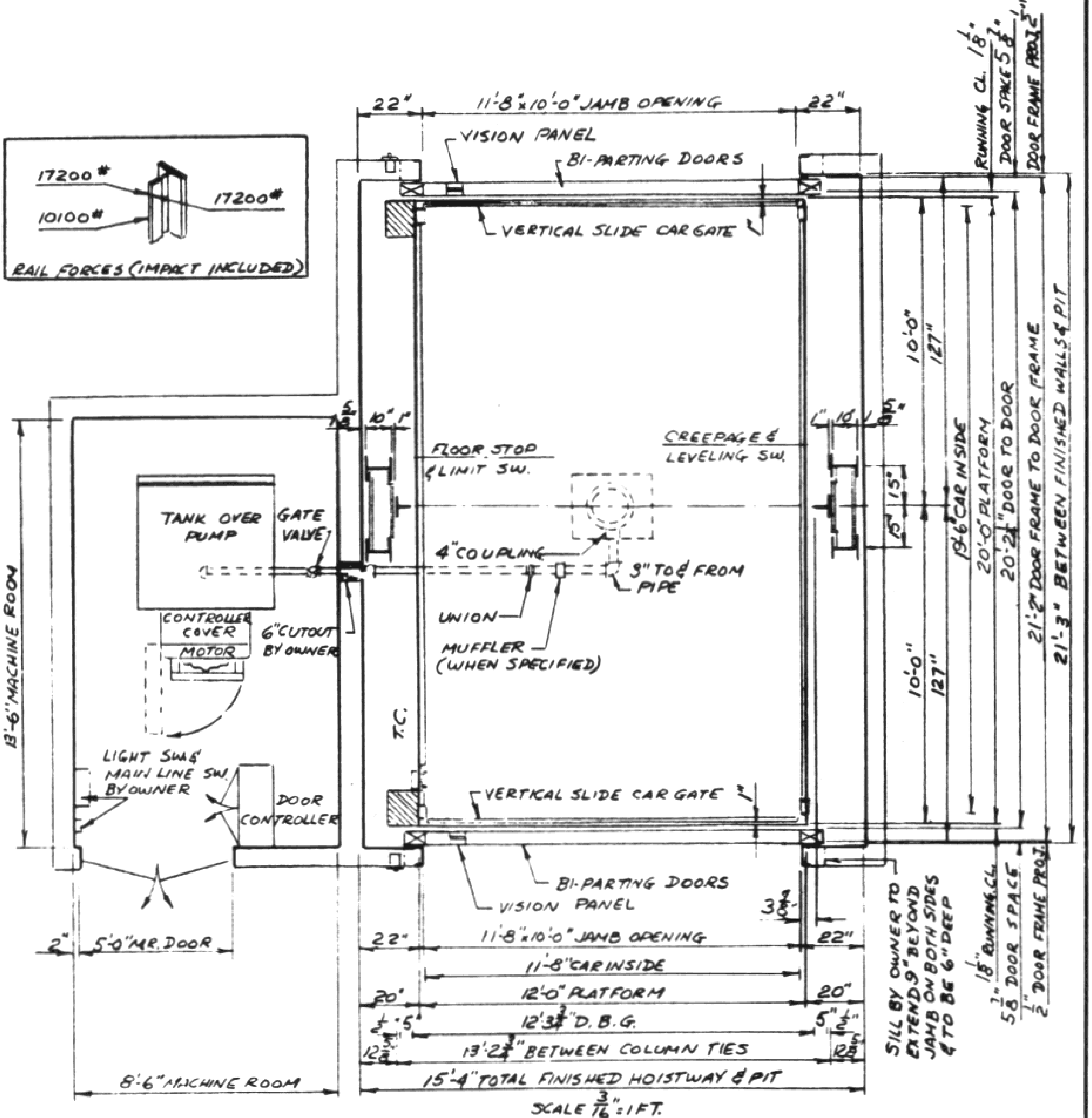
3. Most material for hydraulic equipment is shipped to the jobsite in a conventional manner. However, the cylinder and plunger are crated or boxed and may be shipped in various ways. Low rise units frequently include shipments of assembled cylinders and plungers. Higher rise installations necessitate a break-up of the cylinders and plungers into several pieces. Large diameter plungers may be heavy enough to require that the cylinder and plunger be shipped separately to some jobs even though they are comparatively short.

4. It is very important to handle plungers carefully, whether they are shipped in the cylinder or separately. Damage



DO NOT CHANGE DIMENSIONS W/O CONSULTING ELEV. CO. REP. AS CHANGE MAY AFFECT LAYOUT

REACTIONS GIVEN INCLUDE ALLOWANCE FOR IMPACT. DIMENSIONS SHOWN FOR PIT & OVERHEAD HEIGHT COMPLY WITH A. S. A. CODE; THE SPAN OF ANY SUPPORTING BEAM SHOULD NOT EXCEED 10 TIMES ITS DEPTH. HOISTWAY JAMB CONSTRUCTION AS PER CONTRACT.		
LAYOUT APPROVED:- J. JONES	HOISTWAY GUARANTEED:- F. SMITH	
RECOMMENDED STRESS	BUILDING:- OFFICE & WAREHOUSE CENTER	
	LOCATION:- 313 CITY	
STEEL 16,000# PER SQ. IN.	OWNER:- J. DOE	DATE:- 00-00-0
GENERAL CONTRACTOR:- KAT CONST. CO.	ARCHITECT-ENGINEER:- J. JONES CO.	



Layout Drawing for Typical Hydraulic Elevator

PLUNGER ELECTRIC FREIGHT
20,000 LBS. AT 30 F.P.M.
PUSH BUTTON CONTROL

to the finely finished surface of the plunger could create a permanent leak in the assembly.

5. Many elevator contracts have variables from the accepted ''norm.'' The erection data given to the mechanic, either in writing or orally through the superintendent, should be clear in providing information about any variable. It is the responsibility of the mechanic to see that these variables are handled in accordance with instructions.

6. One of the most important variables encountered in connection with hydraulic equipment is the arrangement for ''digging the hole.'' The work is sometimes done by the mechanic who installs the elevator equipment but is frequently performed by a sub-contractor who specializes in ''well digging.'' The work may be in a sub-contract under the general elevator contract or may be a part of some other such as the building construction contract. Whether or not it is a part of the elevator contract, the elevator mechanic and super should determine that the ''hole'' is properly located, plumb and of correct diameter and depth.

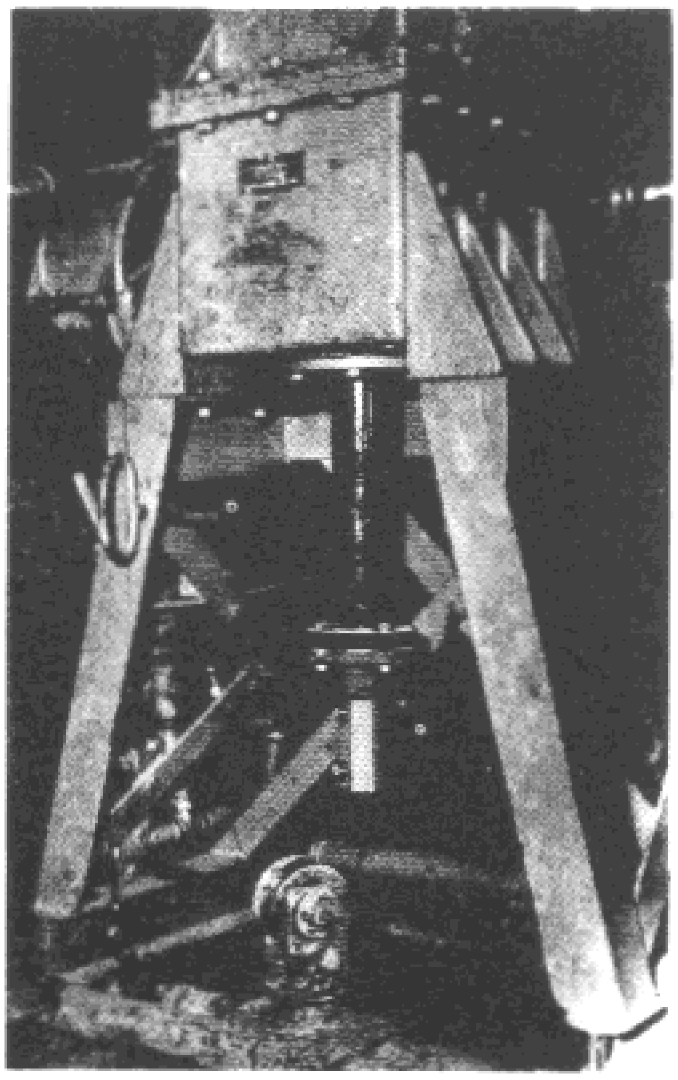
7. Hole digging tools vary from hand shovels or augers to elaborate well digging machines. Soil conditions and geographical location determine what tools are used. As a matter of interest it is noted that some sub-contractors in remote areas of a low standard of industrial development dig holes for a casing by making a pit about two yards square, with hand shovels. These are shored up at considerable cost but the net to the building contractor is less than the cost of shipping a machine to the site.

8. The sequence of installation of components will obviously be different on some jobs because of field conditions. Consider an average installation with a basement machine room as an example. In most instances the machine room equipment consists of one relatively bulky assembly that includes the controller, fluid storage tank, pump and pump motor as well as supplementary items such as piping, directional, operating and gate valves. Since this equipment is subject to damage and might block off space required for a passageway used by other trades, it is often best to place the assembly in approximately its permanent position before proceeding with the hoistway work.

9. On other contracts with similar equipment the contractor may be held up on completing hoistway and adjacent corridor walls until after the rails and cylinder assembly are hoisted and set. This type of job would require that the hoistway work be done first.

10. However, we can consider that a satisfactory general sequence would be as follows:

- **a.** Check materials.
- **b.** Check hoistway and machine room against layout and data.
- **c.** Arrange for concrete base for controller assembly (or power unit), if required.



This Tool is Used to Sink Holes in Rock

d. Install guide rails.

e. Drill for auxiliary casing or cylinder hole (if this is part of the elevator contract).

f. Rig for handling casing, cylinder and plunger.

g. Install cylinder assembly.

h. Set controller assembly (or power unit) in permanent position.

i. Run the pipe line from cylinder to power unit.

j. Install car platform.

k. Install door frames, panels and operator.

l. Install wiring.

m. Install car enclosure (on some elevators, the door operator must be installed after the "cab" is in place).

n. Inspect work, adjust the equipment and test it in accordance with code and company regulations.

o. Obtain note of acceptance from the owner's representative.

p. Return tools and unused materials to the company.

CHAPTER 14
Section -bl

HYDRAULIC ELEVATORS

Guide Rails

Suggested:

Materials –
- a. rails, brackets, sundries
- b. wood for guide-rail template
- c. wall anchors and bolts

Tools –
- a. hand tools
- b. electric hammer
- c. electric welder

1. Guide rails for plunger electric elevators are the same as those used for electric elevators. The same weights, lengths, fishplates, brackets, fastenings and bolts apply. However, since there usually is no counterweight, it follows that only one set of rails is used. Conventional brackets are secured to the building structure by welding or bolting to steel and by anchoring to concrete by inserts, anchor shells or similar devices.

2. Since the cylinder is normally located midway between the car guide-rails it is not possible to install a conventional buffer channel. The rail bottoms are sometimes left suspended or secured to angle clips which are anchored to the concrete pit floor. No overspeed safety device is supplied on the car, therefore, if the rails are to be lubricated, the rail bottoms can be held a few inches above the pit floor when drip pans are required.

3. However, some companies use an alternate arrangement of pit work. The method followed is to provide a pair of channels set on edge on the pit floor. They extend from rail back to rail back. These channels are placed "back to back" so they span the "jack" or cylinder, clearing it by about 1/4" at each side. By means of supports they serve to tie together the rail bottoms and the jack. Angle brackets welded to the cylinder also span the channels and act as supports for the cylinder.

4. When "buffer" or pit channels are used, the buffer springs are normally mounted on the pit channels midway between the cylinder and each guide rail. These buffer stands may be bolted in place at any convenient time, but it is recommended that their installation be delayed until after the carframe is assembled and the platform installed. This routine provides more clear working space in the pit during car assembly.

5. When ready to install the rails, the mechanic places a straight, "chalk lined" plank across the top of the hoistway in the approximate position of the rail center line. Plumb lines are dropped from the plank the same as for rails on a traction elevator.

6. The plank is adjusted to provide the best possible rail position. A second plank is set in the pit and the lines are secured to it.

7. Brackets are installed to the lines and the rails are then installed, aligned and filed.

8. The guide-rail center lines are used to locate the position of the cylinder. The guide rails can be used as guides on which to run a "pile" driver for sinking a casing for the cylinder.

CHAPTER 14
Section -b2

HYDRAULIC ELEVATORS

Installing Outer Casings, Cylinders and Plungers

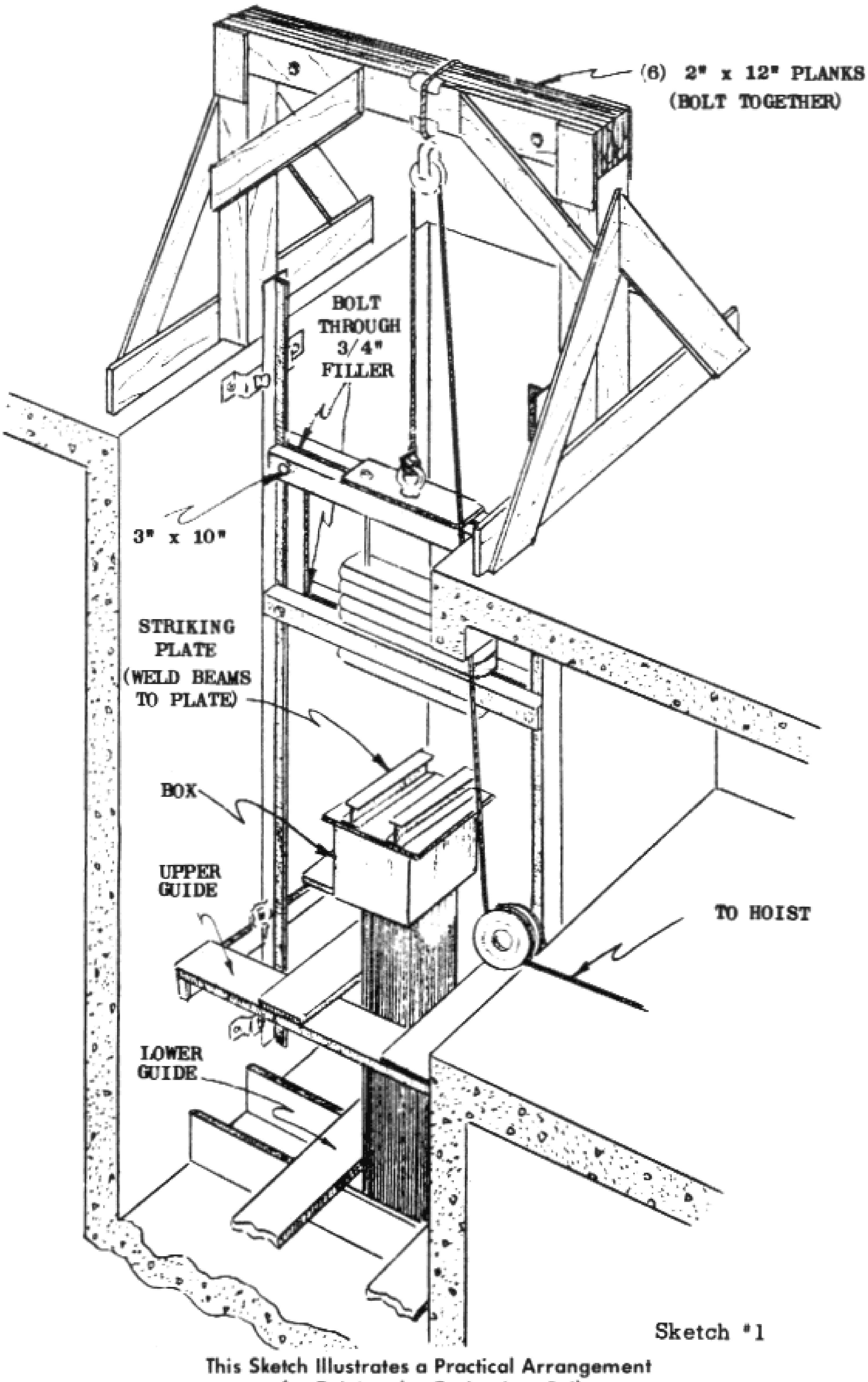
Suggested:

Materials—
- a. pipe for casing
- b. cylinder and plunger
- c. couplings
- d. concrete mix
- e. timbers and planks
- f. hoisting beam

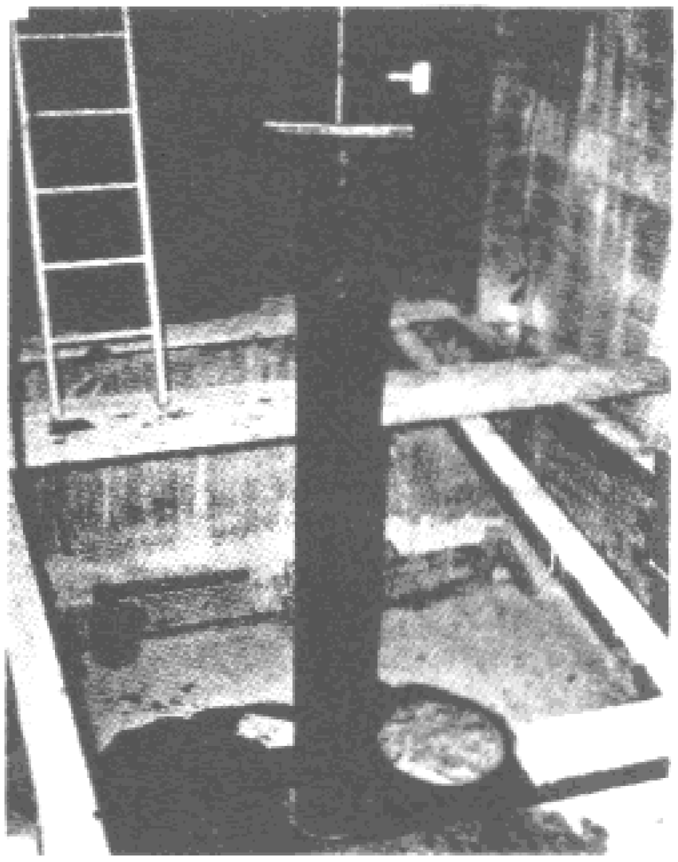
Tools—
- a. hand tool kit
- b. electric arc welder
- c. strap wrenches
- d. chain tongs or wrenches
- e. special plumb bob
- f. pile driver and tackle
- g. wood clamps

1. The field assembly of the cylinder and plunger is simple in concept but requires careful work to obtain satisfactory operation of the elevator. Basically the problem is to set the cylinder plumb and to the correct depth in a prepared hole, then lower the plunger into it. This is quite simple in a short rise job where an oversize hole is provided in firm earth or rock. It may be difficult where the soil is loose or where water is present. In such cases, it is customary to use a "casing" which is nothing more than a heavy-wall commercial pipe, open at both ends. In the United States and Canada the casing is usually driven into the ground, when used. Generally, it is from four to eight inches greater in diameter than the cylinder which will go into it.

2. The mechanic rigs a chain hoist or puller in the overhead, centered between the guide rails. The position determined for the casing is scribed onto the pit floor in the form of a cross, with its center at the planned center of the casing. (If the pit floor is concreted in advance, a hole is left at the correct position and slightly larger than the casing.)



This Sketch Illustrates a Practical Arrangement for Driving the Casing into Soil



Lowering Cylinder into the "Hole"

3. A guide frame for the casing is prepared in general conformance with sketch #1. It is laid out near the top of the rise; say at the top landing, so it can be quickly installed. The guide will hold the top of the casing in its correct position between the guide rails. It will be fixed to the casing and slide on the guides.

4. The casing is rigged to the chain hoist with a rolling hitch and suspended so the bottom is a few inches clear of the pit. The bottom is guided to the premarked position and the chain hoist lowered until the casing just rests on its mark.

5. The guide jack is then assembled at the top of the casing. This will hold the casing in its proper location. The chain hoist is then released and the rigging removed.

6. Following this the pile driver is rigged in place and the casing driven down. Sketch #1 illustrates a simple but practical pile driver.

7. In most soils the casing will penetrate the earth in a plumb position since the top guide will control direction. However, if large stones or gravel are likely to be encountered it may be advisable to install a guide at the bottom of the casing. This guide should be secured to the rails and let the casing slide through it. The outside of the casing can be greased, since the hole in the guide should have limited clearance.

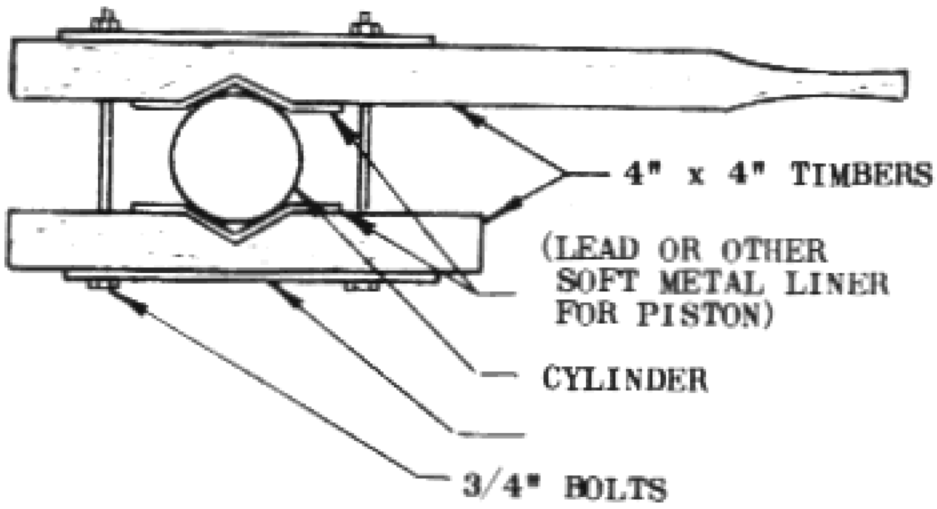
8. While the casing is being driven down, a considerable amount of friction develops on its walls. When the rise is much over ten feet or the soil is especially resistant, this may cause the pile driver to "mushroom" the top of the casing. To prevent this, it is general practice to clean the earth out of the casing at intervals while it is being driven. An "orange peel" bucket and 90° well digger's shovels are used for this purpose. The earth is excavated a slight distance below the casing at each operation. Once the casing is down to its correct depth, the remaining dirt is removed from inside it with the orange-peel bucket or long handle 90° well digger's shovels.

9. The draftsman or ordering clerk specifies the size of the casing in accordance with job layout conditions. Generally, it is driven down so its top is about level with the ground. The length of the casing is about a foot more than the cylinder from pit level down.

10. When all dirt is removed, the depth of the hole is checked against the layout. If it is correct, a fill of "High Early" or waterproof concrete is dropped in. The concrete should be about 6" thick. The mixture is 1:2 cement and sand. It forms a plug that reduces the chance of water or soft soil entering the casing. Once the concrete

has dried, a six inch layer of clean sand is poured into the casing. This will form a base on which to rest the cylinder and will still permit the cylinder to be shifted for plumbing.

11. Where a cylinder is to be placed directly into solid soil and the rise is low, the hole can be drilled with an auger, a rotary well digger, clam shell or any commercial well digging machine.



A Wood Clamp is Used to Hold the Cylinder Section in the Hole

Sketch #2

12. Some areas have considerable rock formations and these present the greatest difficulty in providing a hole for a plunger cylinder. The holes are generally cut by experienced men who use commercial percussion type rock drilling equipment or rotary drill rigs. Where the strata is reasonably uniform and level an experienced driller can estimate time and cost with a reasonable degree of accuracy. However, irregular formations in sub-soil or a slanted strata can throw job schedule estimates completely off on a plunger installation.

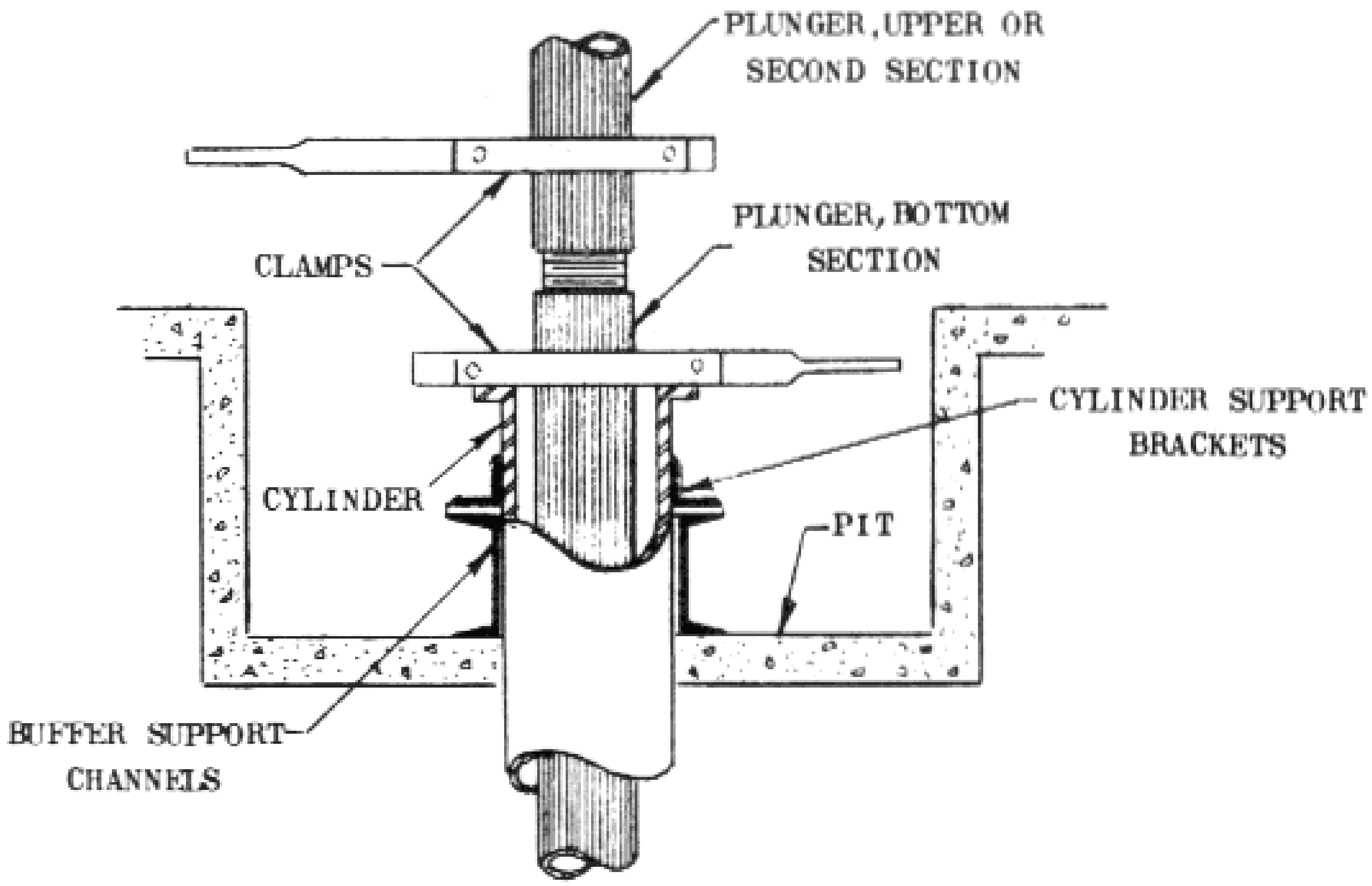
13. The cylinder is of commercial pipe, heavy walled and in some cases high pressure. The bottom is "headed" or capped and this cap is welded to avoid leaks. The top is flanged to receive a short section or "head" (usually a casting) that contains a connection for the pipe line from the machine or power unit. It also contains the base of the packing gland (or "stuffing box" in the old terminology). The cylinder head is also provided with a bleeder valve, an oil drip ring, and oil collecting device. The outside of the cylinder is usually protected with a rust inhibitor like bituminous paint or a wrapping of a protective synthetic. Long plunger cylinders are supplied in sections. These are screw coupled, flange bolted or joined in some conventional manner and it is most important that the joints be made up tight. Most companies use a thread compound to seal screw joints. Most companies also weld the coupling after assembly. It is standard practice to check cylinder sections for straightness after assembly. Once a cylinder is installed and in service, the cost of repairing a leak or overcoming a crooked joint (i.e., out of plumb or dog-leg condition) is extremely high.

14. Once the casing (or hole) is prepared the cylinder is set inside it and plumbed. On low-rise jobs or on jobs where the cylinder (and plunger, later) can be assembled on blocking on the floor and hauled into the hoistway, the cylinder is handled in one piece.

15. Where the rise is too long to make use of one-piece cylinders practical or where space conditions are such that the full length cylinder cannot be hauled into the hoistway, the sections are manufactured, shipped and handled separately.

16. Since the method of handling single section assemblies varies considerably from that used for multi-section types, they will be described separately.

17. When single section "jacks" or assembled cylinders and plungers are shipped to the job, they include the cylinder, a plunger, a packing gland with its packing c gasket. A guide assembly is supplied by some companies.



Wooden Clamps Used as Wrenches

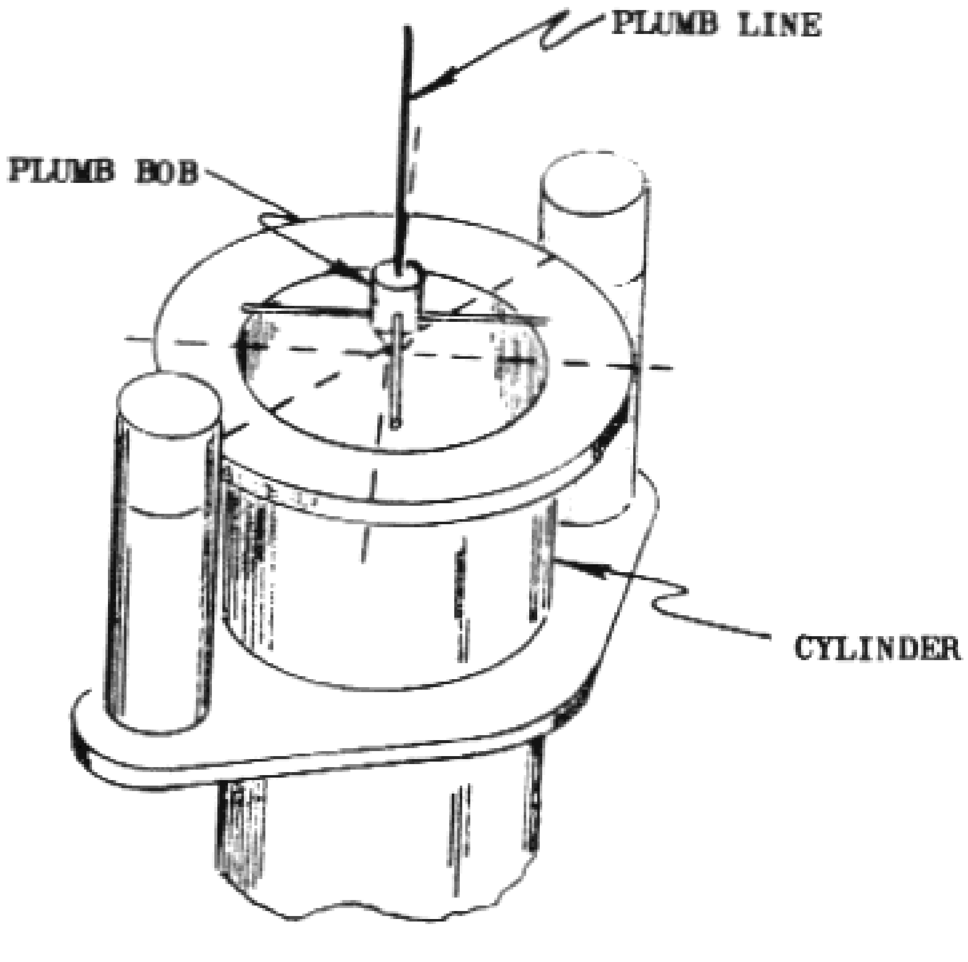
Sketch #3

18. The binding straps or wires should be removed and the plunger should be pulled out to its full length. Care should be used to keep the plunger clear of water, dirt or grit. The unit should be inspected for damage and the length of the exposed plunger should be measured. It is then compared to the rise dimension on the layout and the hoistway distance from bottom landing to top landing. The plunger length should be about 10" to 20" longer than the floor-to-floor measurement. If the plunger measures less than the travel, the cylinder length should be checked. This dimension should be about 6" greater than the completely exposed plunger.

19. Some companies place wooden slats inside the cylinders and around the plungers when they ship long pistons inside their cylinders. The slats prevent damage to the pistons and stiffen them during shipment. If the plunger appears too short and the cylinder is the proper length, the cause may be the slats or ''shims.'' The wood must be removed, of course, and this is done by dismantling the packing gland base and extending the plunger far enough to unfasten the slats and take them out.

20. The plunger is then replaced in the cylinder, the gland reset and the assembly slung to a chain hoist or rope fall and lifted for entry into the casing or hole.

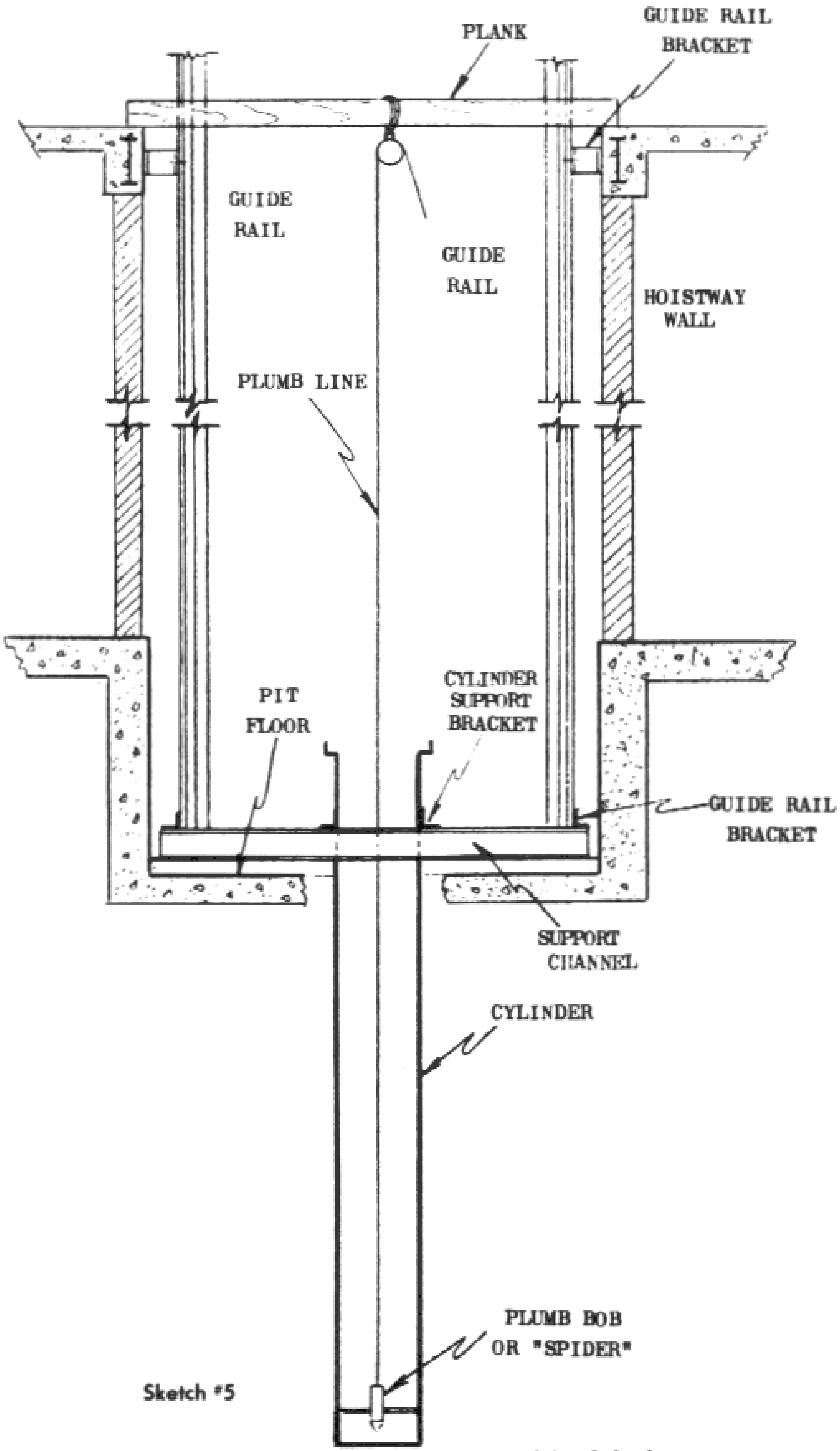
21. The procedure for setting the assembly in place and plumbing it is similar for that used for multi-section cylinders and pistons so will be described after reviewing the method of handling the latter type.



The Plumb Bob Line Support is Adjusted Until the Bob is Centered in the Cylinder Top

Sketch #4

22. When conditions referred to in paragraph 15 exist, the mechanic will receive two or more cylinder and plunger sections. The cylinders are capped to prevent entry of dirt and the threads are protected. The plungers are protected during shipment by boxes or crates and are generally wrapped with corrosion resistant paper. They should be stored in dry areas until they are to be installed. Packing, packing glands and gaskets are separately boxed for protection.



Sketch #5

The Plumb Bob Is Slowly Lowered and the Cylinder Bottom is Adjusted to a Plumb Position

23. The plunger sections should be measured and the total length checked against the rise and the layout. Allowance must be made for the length of each joint when calculating the total lengths of plunger and cylinder. The ''excess'' lengths of each should be about the same as for the assembled ''one-piece'' cylinder and plunger.

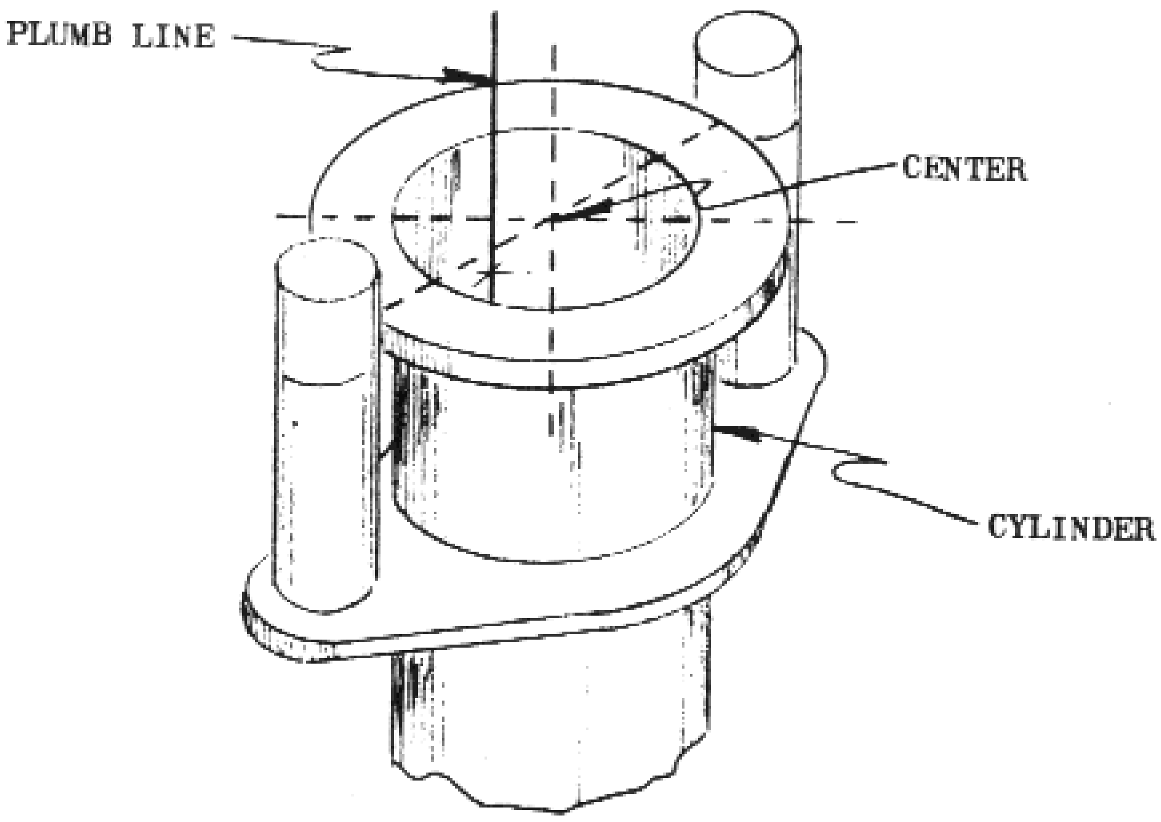
24. The casing or cylinder sections should be examined to be sure they are clean.

25. A wood timber clamp is prepared to hold the lower sections in the cylinder while the upper sections are screwed into them. This can be made of two pieces of timber about two-thirds as long as the hoistway is wide. Thickness will depend on the load to be held. They are laid facing each other and are shaped to fit roughly around the cylinder. Long bolts or threaded rods pass through the timbers, each side of the cylinder location, and will serve to clamp the timbers to the cylinder. See Sketch #3.

26. The bottom section of the cylinder is slung and hoisted by the chain fall. It is lowered through the timber clamp into the casing. The clamp is then secured to the cylinder section so that the coupling is about 6'' above the clamp.

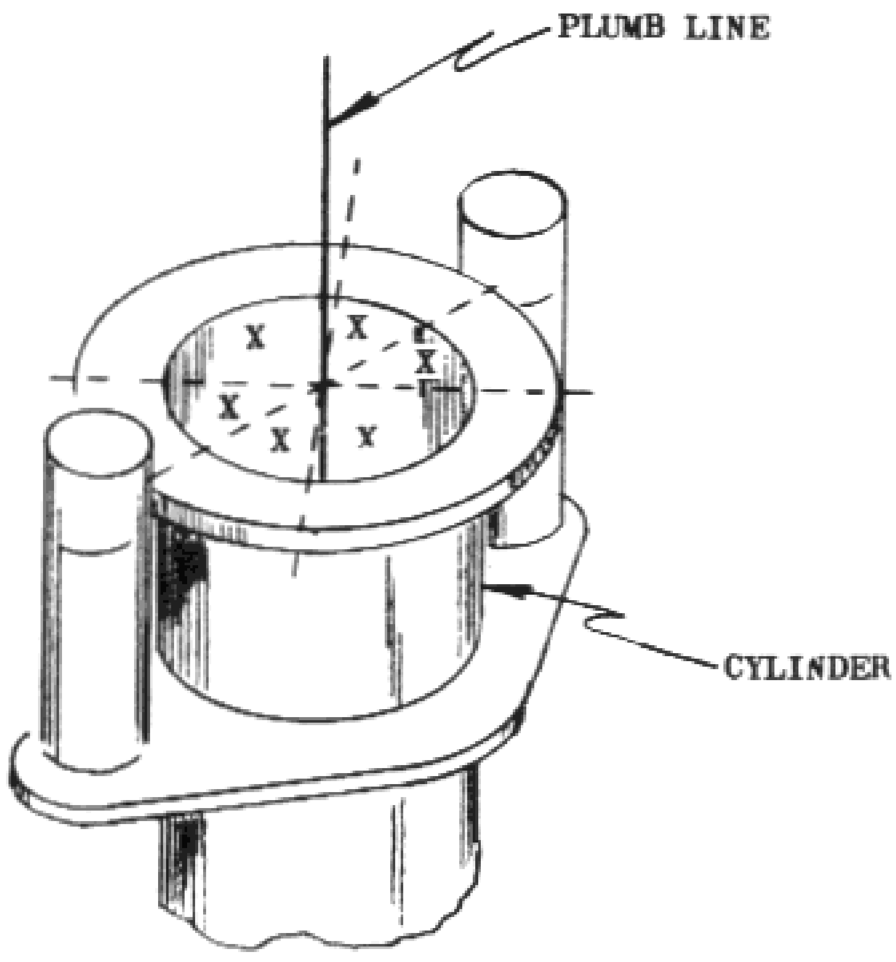
27. The swivel hook of the chain hoist is lubricated well and the second section of the cylinder hoisted on it. When this section is hanging free above the bottom section, the thread sealing compound is applied to the threaded part of the male end. Applying compound only to the male thread reduces the chance of the sealant working into the oil line where it might cause trouble.

28. These two sections are carefully screwed together, using the timber clamp and chain ''tongs'' or wrenches to tighten the two parts. Care must be used to assure that threads are not crossed. Sketch #3 shows a schematic arrangement of the operation.



THIS CONDITION PROVES THE CYLINDER IS OUT OF PLUMB

Sketch #6



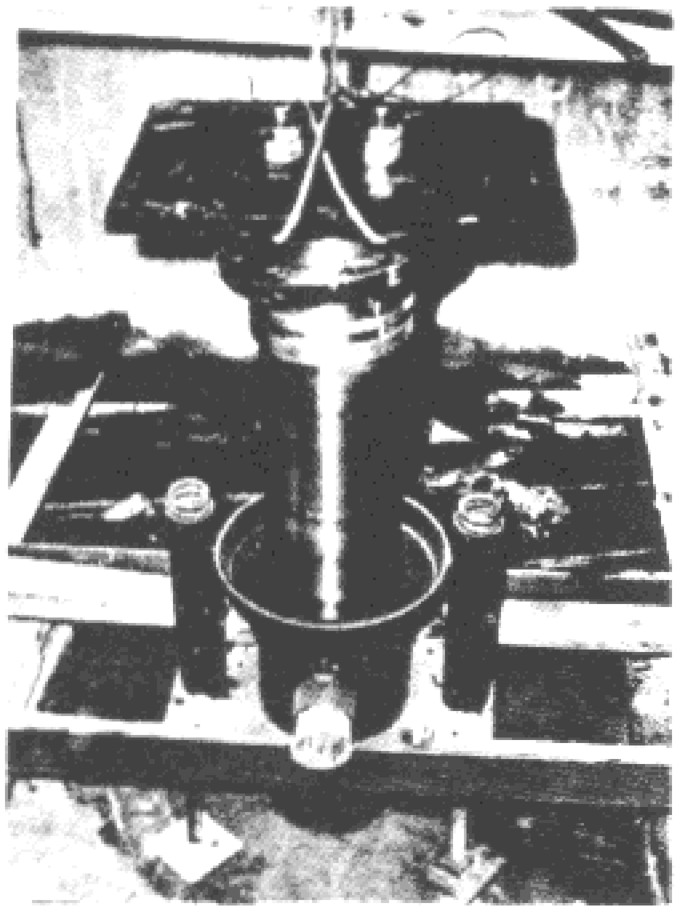
The Cylinder is Located Properly When Dimensions "X" Are Equal

Sketch #7

29. When the joint is tight, it can be welded. Tack welds should be made at opposite points on the circumference, then a seam weld made completely around the joint. The timber clamp is then released and the assembled parts are lowered. If a third (or more) cylinder section is to be added, the work is done in the same manner as for the second. The Rotary Lift Company routine requires mechanics to plumb the outside of the assembled casing (cylinder) on installations with cylinders of two or more sections. This straightness check is made by plumbing the outside of the cylinder-casing, after each joint is screwed together and welded. The object is to assure that possible cross threading or distortion due to heat of welding has not caused a ''dog-leg'' in the assembly. Such a condition could cause serious plunger scoring or wear, of course. Some companies do not use threaded joints but provide pressure joints by flanges or similar devices. All types of cylinders should be checked for straightness before being lowered into the outer casing or ''hole.''

30. When all cylinder sections are assembled, the steel angle cylinder brackets or the lower wood clamp is used to support the cylinder at the height above the pit floor that is shown on the layout or detail drawing. (As shown in the ''cutaway'' sketch at the beginning of this chapter and further described in section -b1, paragraph 3, some companies support the cylinder by steel angle brackets across the ''buffer channels.'' Other companies rest the cylinder head on a conrete pier. When steel angles are supplied, the wood clamp need not be used to temporarily support the cylinder in place, of course.) Shims or blocking can be used under the timber ends to obtain the correct height and some sand can be added in the hole, if needed to support the weight. (Shims are also used under the brackets or timbers to help plumb the cylinder.)

31. There is always some space between the inner wall of the cylinder and the plunger. This will permit some very minor out of plumb conditions to exist without serious difficulty. Company practices determine allowable amounts but we recommend holding any such condition to 1/8''. Such conditions should be brought to the "supers" attention. However, there is no question but that the cylinder should be as nearly plumb as is possible.



The Piston (or Plunger) Being Lowered into the Cylinder—
Note the "Packing Rings" on Piston

32. The methods of checking the plumb of cylinders also depend on job conditions. One satisfactory method is to make a "plumb bob" of wood in an "X" shape. The diameter should be about 1/4'' less than the inside diameter of the cylinder. The "bob," or "spider" as it is termed by Rotary, is suspended from a piano wire and weighted so it hangs level. This bob is then lowered into the cylinder from a board secured across the rails as far as possible above the cylinder head. The wire is adjusted so it is fixed exactly in the center of the cylinder. An accurate method of locating the wire is to hang the plumb bob or "spider" so it is a fraction of an inch above the cylinder top. When the bob is in this position (and assuming the cylinder top is located exactly to layout measurements between the guide rails), the "bob" wire anchor point can be shifted until the "bob" itself is exactly centered above the cylinder. Sketch #4 illustrates this procedure.

33. The plumb bob is then slowly lowered into the cylinder. An extension light is also lowered into the cylinder and the cylinder bottom shifted until the plumb bob is centered. A slight amount of shifting can be done by shimming under the ends of the timber clamps that are steadying the cylinder assembly, or under the cylinder support brackets when these are supplied. The clamp timbers can also be used to twist the cylinder to "walk" it in the sand. Prys between the casing and cylinder will assist. The top of the cylinder must be held to its layout location. The correct plumb position has been obtained when the plumb wire hangs exactly centered in the top of the cylinder and the bob is centered in the bottom.

34. Sketches #4 thru #7 will help to understand the method described.

35. When the cylinder is definitely set and rechecked for position between rails, the space between the cylinder and casing is filled to about 4'' from the top with clean sand. The sand should be poured in from several points around the cylinder and should be tamped frequently to be sure no air pockets exist. A concrete cap is grouted in this 4'' space. As previously noted, on some designs a block of concrete is poured in the shape of a truncated pyramid to support and finish off the top of the cylinder assembly. The height of this is established by layout conditions. Other

designs support the cylinder assembly on the "buffer channel" by means of the angle brackets, which were previously described also.

36. The buffer assembly itself may be secured to this concrete block or may be on the steel buffer channels that tie the cylinder assembly and rails together, as described in 14-b1. The "air bleeder valve" is located at the top of the cylinder and must be set so it is easily accessible.

37. The plunger should be carefully handled because of its highly finished surface. As noted in earlier paragraphs the plunger is designed to be only a few inches longer than the car travel. (Because of this it is very important that the mechanic checks the floor heights to be sure that the building contractor has constructed them exactly according to the plan.) The hollow plunger, like the cylinder, is plugged and welded tight at the bottom. Short plungers are in one length. Those for higher rises are screw coupled, or joined by other methods. The safety code requires that a "stop ring" be securely affixed near the bottom of each plunger assembly. This ring will permit only a few inches overtravel in the up direction before stopping the car movement. A "platen" or plate is fastened to the top of the plunger by means of two or more heavy bolts. The function of the platen is to secure the plunger to the carframe. The platen can be factory drilled for the plunger bolts but field drilled for the bolts to the carframe or the reverse condition can be true. Either method permits some adjustment in the field. The platen is shipped separately from the plunger.

38. Installation practices for the plunger follow those for the cylinder. The same rigging is used. Single section plungers or those which can be assembled on the floor and handled in one piece are carefully lifted, then lowered into the cylinder.

39. Plungers which have to be installed in sections are lowered consecutively beginning with the bottom section which is then clamped, after which the next piece is swung to it on a swivel, then coupled.

40. There is one very important difference in procedure. Clamps used on plungers must be lined with babbitt, leather or some similar material to avoid damaging the finish. Furthermore, they cannot be clamped so tightly that the hollow piston is distorted or bent out of shape. This is very important! The maximum precautions must be used in this operation.

41. The male threads of sections of hollow plungers should be coated with a pipe sealing compound. Excess compound should be wiped off the outside of the plunger before hardening in order to avoid damaging the packing. Some companies install an "O" ring (or compression sealing ring) on the threads of the plunger in addition to the sealing compound. Most companies finish the assembled plungers in their factories. Before disassembling the finished plungers, the factory makes index marks on the surfaces at each side of each joint. These marks may be scribe marks or very fine center punch marks. When assembling the plungers in the field, the mechanic tightens each section until the index marks match up. (They may pass each other slightly but this is not serious.) All joints must be smooth, i.e., no "step" should exist between sections.

42. The plunger should be lubricated in accordance with company practices before it is placed in the cylinder. This may include partially filling the cylinder with oil.

43. Once the plunger is entirely installed it should be lowered to be sure it cannot bottom in the cylinder. It can be left in this position temporarily. (The code prohibits use of plungers that can bottom in the cylinders.)

44. The Rotary Lift Company suggests the following method for installing packing in the packing glands. After the plungers are lowered into the cylinders, the "jack" gasket (plunger-to-cylinder gasket) is removed from its packing case, dipped into oil and laid in the groove of the cylinder flange. The piston guide assembly is placed over the plunger and slid down, and the holes in the guide assembly aligned with the studs on the cylinder flange. The guide is then lowered to its permanent position. Care must be used to avoid damaging the gasket. The flange bolt nuts should be installed next and tightened evenly. Rotary Lift Company installs alternate layers of woven cotton and hollow core packing which is field cut about 1/4" full, with both ends square. The cotton packing is pushed into place first, while the ends are kept "butted up." A section of hollow core packing is then cut and installed in the same manner but the joints should be staggered. The process is repeated until the specified number of rings are in place.

45. The packing gland is then installed and tightened snugly. The correct adjustment will permit a film of oil to remain on the cylinder but will not create an oil leak.

46. This routine should be generally acceptable to most companies, but the packing material will vary according to the manufacturer's specifications.

47. A readjustment of the packing gland is generally required after the elevator has been run. Naturally this readjustment is also necessary at intervals during servicing of the elevator.

48. This phase of the work can be considered complete and the next begun.

CHAPTER 14
Section -b3

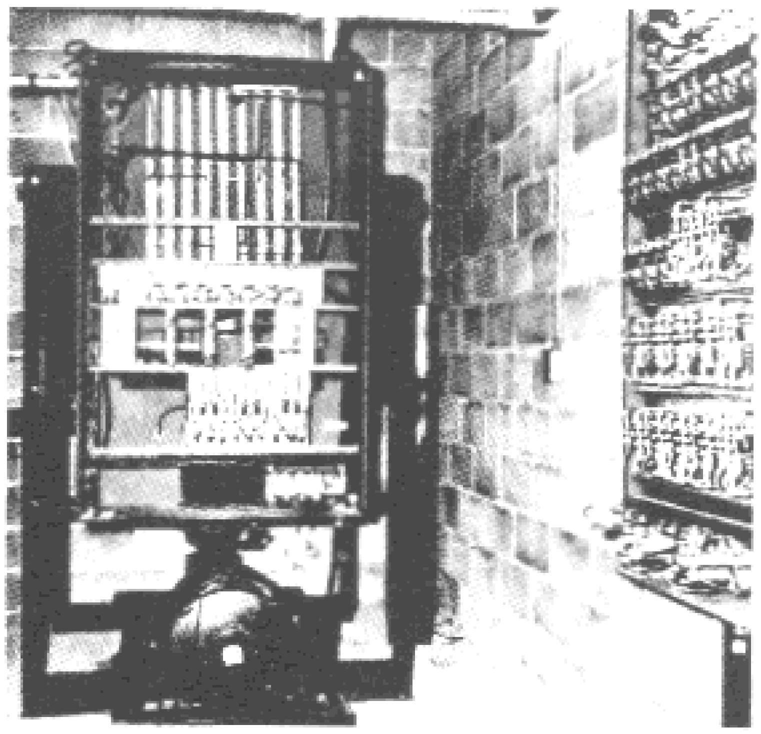
HYDRAULIC ELEVATORS

Installing Machine-Room Equipment and Piping

Suggested:

Materials –
- a. self-drilling concrete anchors
- b. bolts and washers
- c. shim or packing material

Tools –
- a. hand tool kit
- b. electric hammer
- c. chuck for anchors
- d. pipe and conduit tools



Plunger Electric Power Unit

1. Plunger elevator machine-rooms are often adjacent to the hoistway and about at the level of the lowest landing. Some installations have "machine" located at a remote point from the hoistway.

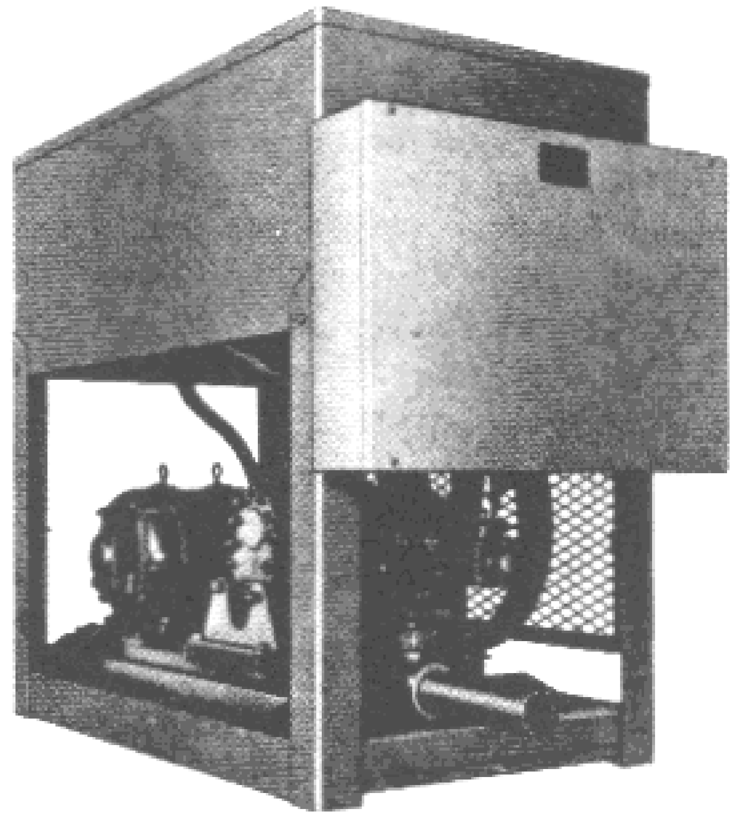
2. When they are in remote locations, the equipment is placed from lines laid out on floors from the building walls. Alignment of piping and of conduit for wiring can be made quite easily as long as the layout arrangement is followed.

3. When the machine room is immediately adjacent to the hoistway, an axis line is extended from the guide-rail center lines to form a base line for locating the controller-pump assembly. This line can be a chalk-line mark or can be roughly scribed on the floor. (The terms controller-pump assembly, power unit and machine are used synonymously in reference to machine-room equipment.

4. The position of the machine is marked out from the axis and a wall of the machine room. The assembly is then placed in its approximate position and temporarily left there while rail work is completed and the plunger assembly is installed.

5. Once the plunger is in the piping is run, working from the cylinder end. Lengths of pipe are supplied as specified from the layout. Muffler devices, elbows, couplings, unions and gate valves are assembled in their respective positions and led to the machine room where they are connected to controller-tank-machine unit. This unit has been left unfastened so it can be shifted slightly to facilitate alignment of the piping. The last pipe union is made only hand tight.

6. Once the pipe is assembled the position of the machine legs is scribed on the concrete floor or machine base for those units designed to be so fastened. The unit is then shifted a few inches and anchor shells are driven into the concrete. The machine is then moved back to its permanent position and the pipe union made up tight. The anchor bolts are installed and tightened in the machine (or controller) supports. Shims are installed to get a plumb, level condition. As indicated in the first sentence of this paragraph, some designs are not secured to the floor or base.



Conventional "Machine Room" of Modern Hydraulic Elevator

7. All male pipe threads are coated with sealing compound before assembling. The threads must be clean and sharp. The connections must be made up tight. Pipe supports should be installed in accordance with the layout and be secured. Some supports are sound isolated.

8. The piping on most small installations is exposed in the pit and runs up a side wall to a hole in the machine room wall. The hole is generally packed with a sound absorbent material such as oakum, after the pipe is installed. Some contracts have the piping concealed in a trench, especially if the machine room is in a remote location. Layouts and other drawings detail the method to be followed.

9. Large machines are often set to a layout position and secured before piping is run. This may require "setting" a pipe. The method is common on multiple pump jobs.

10. Multiple pumps are sometimes mounted in a frame or on the wall separated from the controller and tank. They lead to a manifold and then to the line.

11. Check valves, leveling or by-pass valves and other equipment with specialized functions are a part of the machine assembly as a rule. They are checked and tested at the time of adjustment, as is the motor-pump assembly.

12. Wiring and other machine room work is installed in accordance with normal standards for traction elevators.

CHAPTER 14
Section -b4

HYDRAULIC ELEVATORS

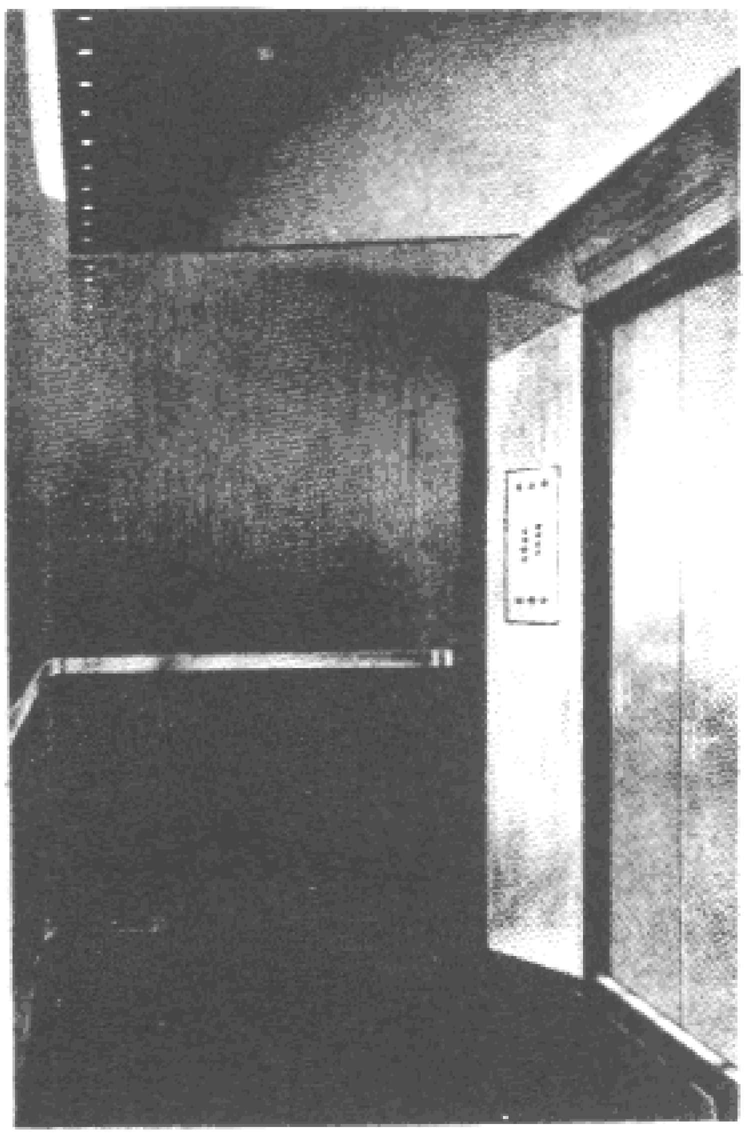
Car Enclosures, Hoistway Doors and Wiring

Suggested:

Materials –
- a. car enclosure and accessories
- b. masonry anchors
- c. wiring sundries

Tools –
- a. hand tool kit
- b. chain puller
- c. slings
- d. electric hammer
- e. wiring tools
- f. door templates

1. Elevator cars on plunger installations are very similar to those of electric traction machine units. Probably the most noticeable differences are the omission of the overspeed safety and the fact that the car is supported on its lower frame member instead of being suspended from the cross-head. Because of this the bottom member (or "safety plank") may seem relatively heavy while the stiles and crosshead can be lighter in proportion. Passenger car enclosures are sometimes sound isolated. Freight cars are not, usually.



Hydraulic Passenger Elevator Car

2. The chain hoist used to install the cylinder and plunger is also used for car assembly. The "safety plank" is installed first. It is lowered onto the platen, leveled and bolted tight. Shims can be used to get the level condition. The stiles are bolted in place and squared. The crosshead is installed. Car shoes are bolted onto the frame, then squared and tightened. The platform is installed, aligned, leveled and then fastened permanently.

3. Job conditions determine whether the enclosure is assembled at this point or door work and wiring is performed, using the platform as a working stage. It can be done either way and the work follows the description given in chapter 8.

4. Door work is also conventional and follows the general pattern outlined in chapter 11, of this book. Bi-parting doors are generally supplied with plunger-electric freight elevators and sliding doors are used with passenger or service elevators. Some private residence or small apartment plunger electric units are supplied with swing hoistway doors. Car gates on freight installations are vertical lift but may have two panels because of overhead conditions. Passenger cars use sliding doors or collapsing gates.

5. Wiring is installed to conform to the National Electric Code and the Safety Code. The information given in chapter 10 generally applies to these plunger electric units. Moisture proof and/or explosion-proof wiring can be supplied when required.

Adjusting Plunger Electric Valve

CHAPTER 14
Section -c1

HYDRAULIC ELEVATORS

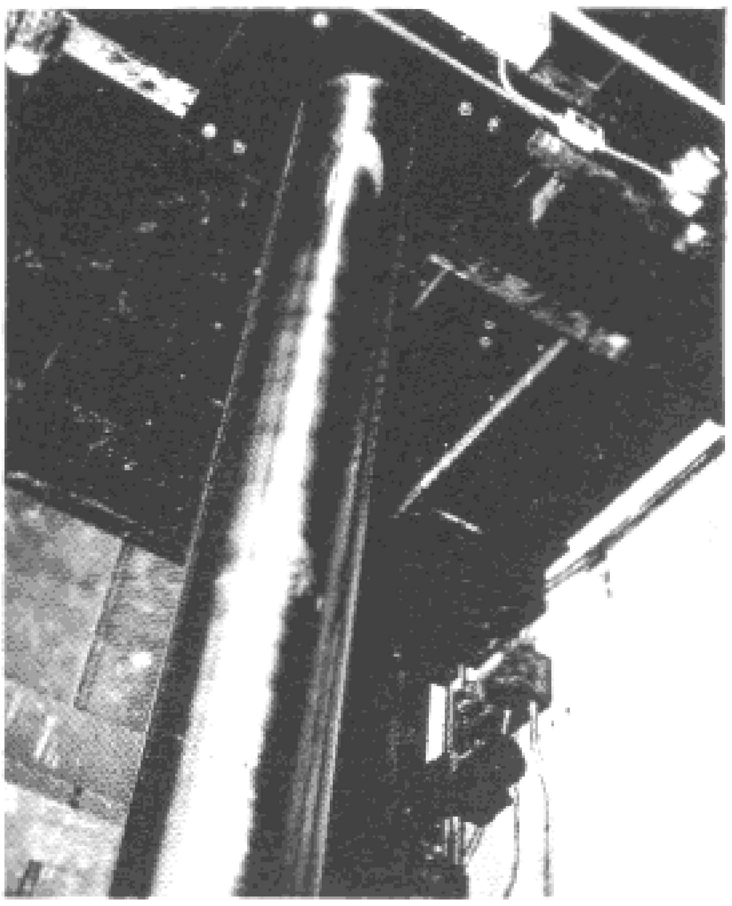
Inspection and Test

Suggested:

Materials –	Tools –
none	a. hand tool kit
	b. appropriate meters
	c. test weights

1. After a plunger electric elevator is installed, it is customary to review the work done or to "make an inspection" of it. This would normally be done by a careful mechanic regardless of whether or not a company inspector was assigned to follow him up.

2. The inspection is usually made in sections. Motor room equipment is examined. Fluid is poured into the storage tank to the proper level as indicated on the gauge, if this was not previously done. Fuses and wiring connections are examined. Voltage is confirmed with a meter. Pipe and hose connections are checked for leaks. Proper



The "Platen" (Plate) Connects the Piston and Car Together

lubrication of motors, pumps and other rotating equipment is assured. Overloads are set. Signal devices tested.

3. Once the machine room equipment is found satisfactory, a similar inspection is made of car, doors, rails and pit work. Lubrication is applied where required. Normal cleanliness is established.

4. The piping and cylinder gland are checked for leaks. The buffer compression is checked to be sure the car will rest on them before the platen strikes the cylinder packing gland.

5. The empty car is moved up a short distance at a time by operating the controller switches by hand. One man watches the clearances around the car while this is being done. When the car is at the top, the overhead conditions are examined.

6. Limit and other hoistway switches are set mechanically to the car cams then tested electrically. Door, gate and emergency contacts are tested. Then the car is operated from the car operating panel.

7. Full load tests are made with test weights in the car. Leveling and "creep" switch adjustments are finalized.

8. The pump assemblies of the different elevator companies may be manufactured by those companies or a commercial pump manufacturer. Special features are included in each particular design and adjusting instructions are given as required.

9. Controller switches are generally timed by condensors or potentiometer circuits, though dashpots have been used. Set switches to company standards.

10. Check car speeds under empty and full load conditions.

11. Recheck the oil level in the tank gauge. This must be done with the car in the same position as when the original check was made. Loss of oil may indicate serious leaks in piping, plunger or cylinder packing. Consult with your "super" if any significant oil loss occurs.

CONTENTS

CHAPTER 15

CHAPTER 15
Section -a1

ESCALATORS

General

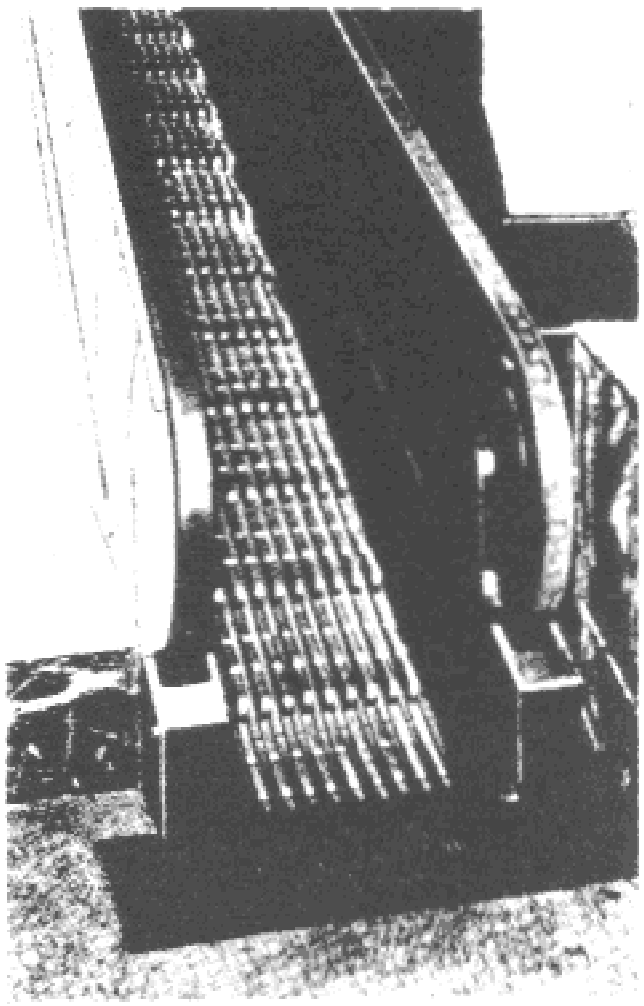
1. Although knowledge of the principle of moving material on an inclined plane goes back to primitive times, the idea of moving the plane to transport material was conceived at a comparatively recent date. In this historical respect the "moving stairway" or "escalator" differs from the elevator, the basic principle of which was devised several thousand years ago.

2. The word, "escalator" is a corruption of several Latin words: "e" (out of or from) and "scala" (staircase or flight of steps). An Otis Elevator Company advertising brochure dated 1912 translates the word "escalator" as "means of traversing from." Probably the translation is as valid as any, even if not necessarily literal. The name "escalator" was apparently coined by a Charles D. Seeberger about 1900. He registered the word as a trade mark and eventually the Otis Elevator Company obtained title to it. This registration was cancelled by the U.S. Patent Office in April, 1950, on the grounds that the word had become the generic name for moving stairways and had lost its power to indicate the origin of such goods as being of a single manufacturer.

The First Escalator Made.
Paris Exposition 1900

3. The first reference to escalators that we found was mention of a U.S. patent granted to Nathan Ames for "Revolving Stairs" in 1859. The patent covered flat steps with cleats and was arranged for separate sets of stairs for each direction of travel. Chains or ropes were specified as optional types of drives. A single stationary handrail was described in the patent as a part of the invention.

4. Strangely, no use appears to have been made of this patent and presumably it expired. The next escalator patent activity was evidenced in January of 1891, when a Mr. Jesse W. Reno received a patent on an "inclined elevator." This type consisted of a single link chain drive to which wood platforms were fastened. The platforms or "cleats" traveled essentially in parallel alignment with the chain, which was set at approximately 25 degrees from horizontal. This stair also utilized a stationary handrail, but it did add "comb plates" at the landings.



A Cleat Type Escalator Based on The "Reno" Design

5. Beginning with the Reno invention, the 1890 era became an active decade in the escalator field. Just a few months after the Reno patent was granted, a George H. Wheeler also obtained a patent on a moving stair. This device was an improvement over the Reno in that it provided flat steps and a moving handrail. Passengers stepped on and off the escalator from the side, rather than the ends. Charles D. Seeberger purchased this patent.

6. Another inventor, Mr. James H. Dodge received a patent on a moving stairway in 1897. Wheeler obtained another patent in the same year. This one was for flat cleat steps, comb plates and other improvements. As a result of these the 1897 Wheeler patent is generally conceded to the the basic one from which the modern escalator has evolved. Mr. Seeberger acquired a half interest in this Wheeler patent and eventually obtained full control. He sold these rights to the Otis Elevator Company, which developed and built its first moving stairway in 1898. During this same year improved Reno stairs were installed in Siegel Cooper's Nineteenth Street Store (New York) and the Manhattan Railroad Company's Third Avenue and Fifty-Ninth Street "Elevated" Stations.

7. The first "step" escalator was shown in the Paris Exposition in 1900. Reportedly a fee was charged to passengers who rode this escalator at the exhibit. After being shown in Paris the unit was returned to the United States and installed in Gimbel Brothers Philadelphia Store. This escalator gave service to Gimbels until 1939.

8. During 1900 another escalator was installed by Seeberger in a New York Store named "Simpson Crawford" and a third in the New York Elevated Railroad Station at 6th Avenue and 23rd Street. In 1902 the same man installed five escalators in R. H. Macy, New York. Four of these were in operation until about 1950.

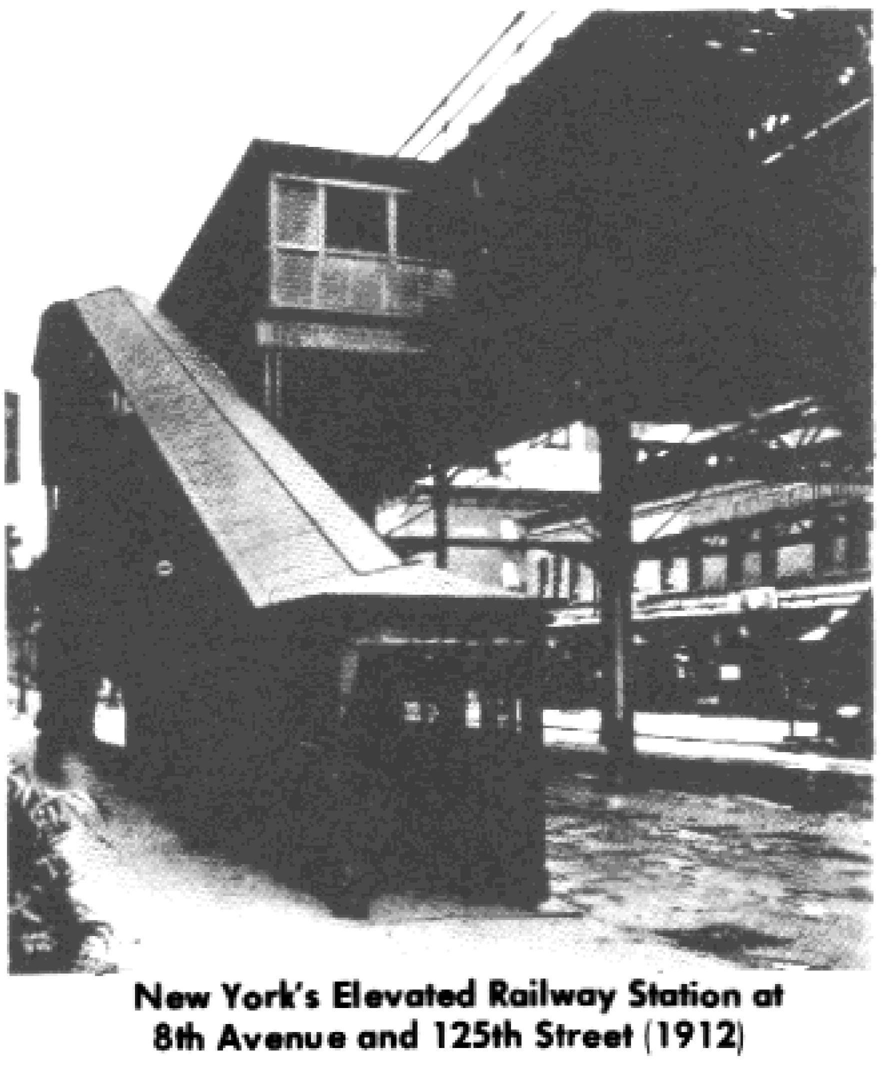
9. In the period from 1890 to 1911 Seeberger and Reno appear to have been the most active individuals in escalator development and Otis Elevator was the one Corporation involved. By 1911 Reno had sold out to Otis completely, and that Company had also acquired the Seeberger, Wheeler and Dodge patents.

10. Despite the disadvantages of the Reno type they were installed as late as 1922 and operated until 1937 in the United States. The writer has ridden on a Reno within the past few years in a Toronto Department Store.

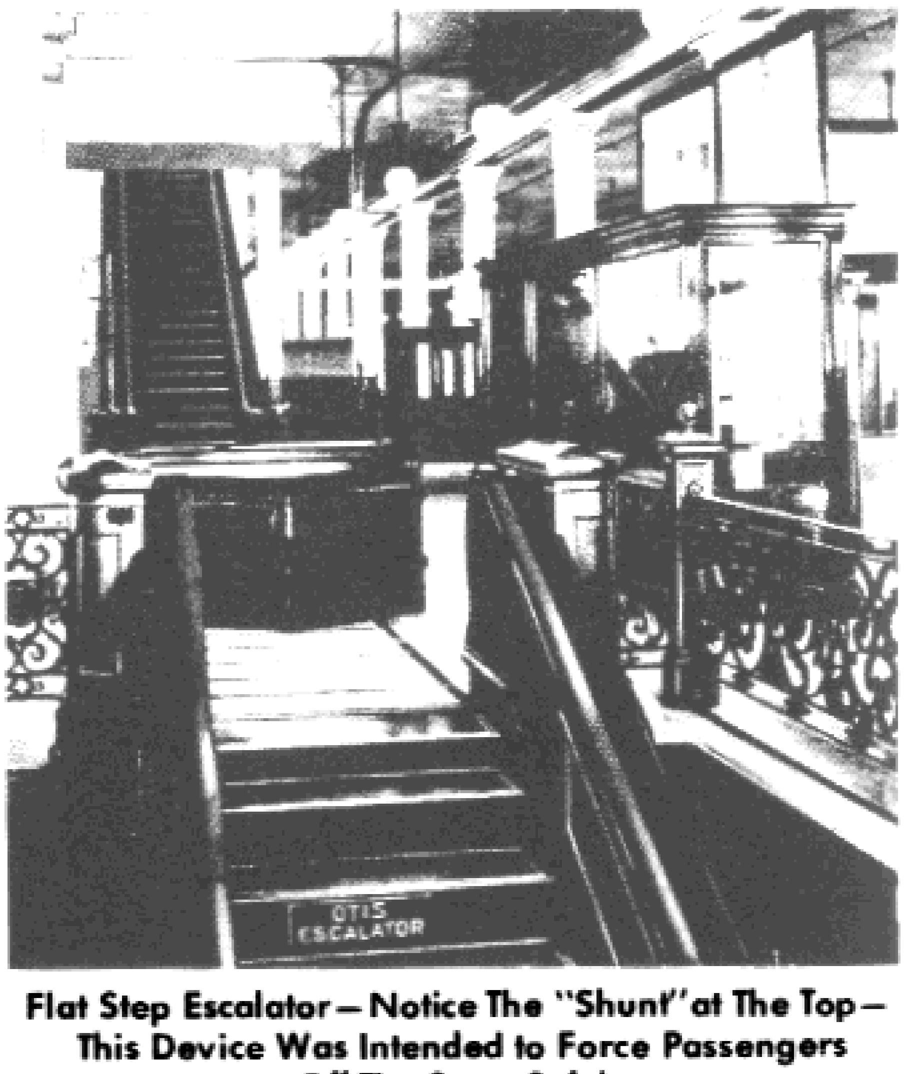
11. The evolution of the "escalator" was rather slow and sales volume quite small for some years. The Westinghouse Electric Corporation's Elevator Division entered

Fashionable Ladies on a Fashionable Conveyance—
Siegel Cooper and Company's Store,
Chicago, Illinois (1912)

Escalators "Made" News in The "Illustrated London News," Earl's Court Railroad Station, 1912



New York's Elevated Railway Station at
8th Avenue and 125th Street (1912)



Flat Step Escalator—Notice The "Shunt" at The Top—
This Device Was Intended to Force Passengers
Off The Steps Safely

Escalators in Wood's Worsted Mills at Lawrence, Mass. (about 1912)

the field in the 1930 period with Philadelphia's "Penn" Station installation. Rockefeller Center, New York, was one of their early major contracts, also. Motorstair developed their unit and first marketed it about 1946. The Haughton Elevator Company built escalators just before World War II and installed several in the Buick Motor Company's Flint Plants in 1946. They dropped the line but re-entered the escalator business in 1949. The Montgomery Elevator Company manufactures escalators in their plant in Moline, Illinois, under licenses granted by an old line escalator manufacturer in Europe.

12. Early equipment was slow and crude but gradual improvements were added as experience was gained. Most obvious was the provision of practical, straight access to expedite traffic flow. Steps, balustrading and paneling all reflected the advances in technical knowledge and improvements in quality of materials. Advanced designs of track systems, driving equipment, safety devices and other concealed parts of escalators paced that of the decorative and conveyor parts. Today's units are well designed, efficient transportation mediums in which close manufacturing tolerances and good engineering practices combine to provide safe and efficient moving stairways at greatly increased speeds.

13. Present day escalators are installed in steel truss assemblies that are generally suspended on two main bearing beams in accurately constructed wellways.

14. Although many people think of escalators as a means of transportation used mainly in department stores, this is far from accurate. Almost from the time of their earliest development, escalators have been used to transport factory and office employees as well as in special purpose structures, such as "elevated" railroads and subways. Our code restricts escalator speeds to 125 feet per minute. London uses escalators that travel at speeds up to 180 feet per minute in subway (or "underground") stations.

15. This rather belies the impression of the stolid, deliberate English.

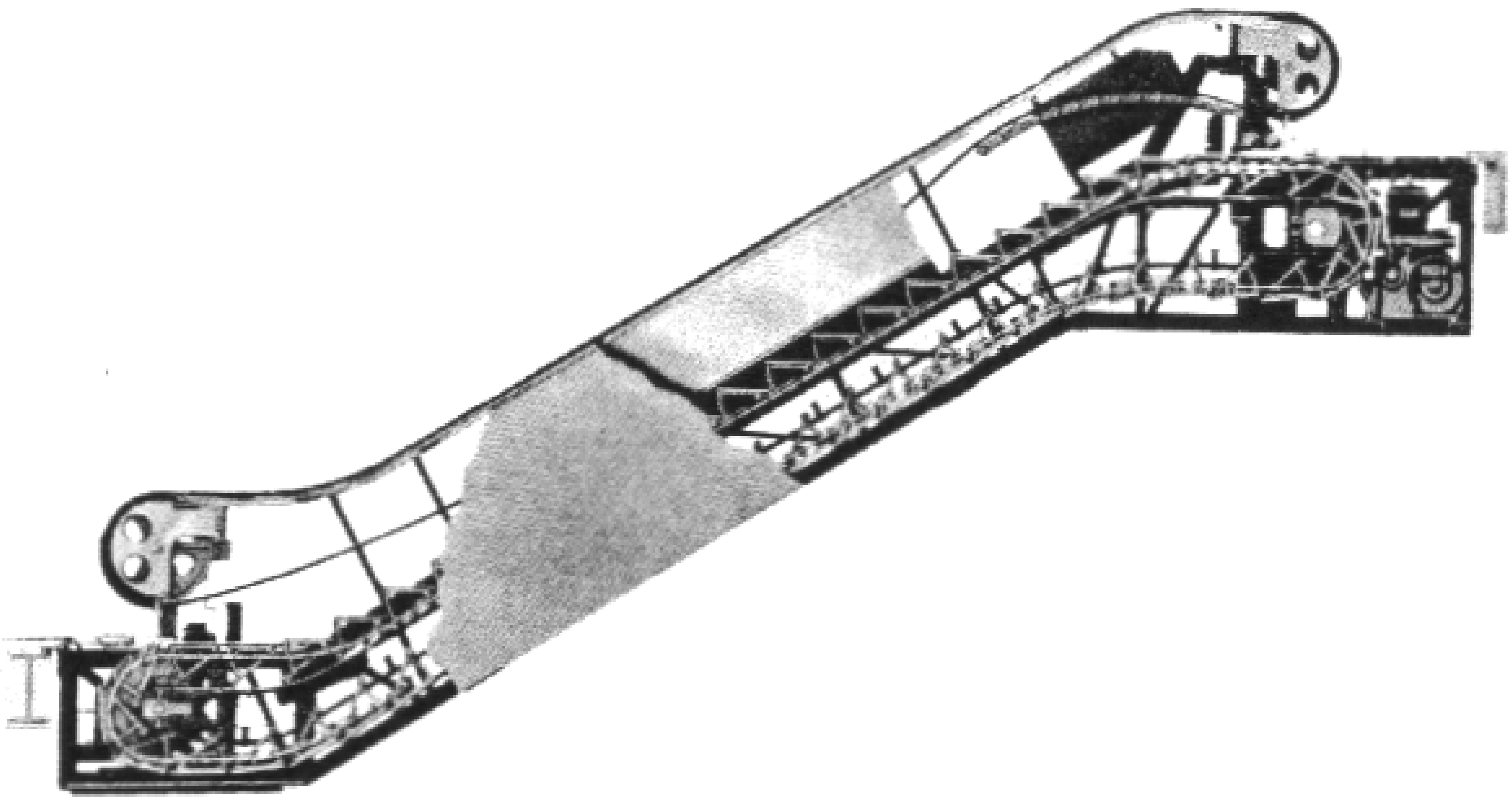
16. It is probably well known that practically all of the large aircraft carriers in our Navy are equipped with escalators for flight deck service. Possibly the fact that a number of English, Dutch and American passenger liners are also served by passenger and "kitchen" escalators is not common knowledge.

17. There are a number of foreign firms which are now installing escalators. These companies are manufacturing in Europe, Japan, South America and Australia.

CHAPTER 15
Section -b1

ESCALATORS

Escalator Equipment



Cutaway View of Modern Escalator

1. Modern escalators are comparatively simple assemblies of parts built to close manufacturing tolerances. The foundation on or in which the escalator is built, is called a "truss." Conventionally the truss is a crate like structure built of riveted, bolted or welded steel members. This unit is supplied by the escalator manufacturer and is suspended from top and bottom bearing points that are part of the building structure. These bearings are usually steel beams in U.S.A. and Canada but are often reinforced concrete beams, particularly on overseas and Latin American installations. Where the supports are concrete, a steel bearing plate is set and leveled on each of the beams. The plates are installed by others. They should be secured to the supports. Long rise escalators may require intermediate supports in addition to those at top and bottom. These are also installed by others.

2. The truss itself has flat (horizontal) sections at top and bottom with an incline section connecting them. A drip pan is fastened in the bottom of the truss. The machine, controller and main drive mechanism are usually contained in the top section, while the upper handrail newel is mounted on it. A step chain tension carriage may be placed on rails in the lower flat truss section and the lower newel is bolted on top of it.

3. The machine drives the escalator either directly, by gears, by chains or by a combination of these. The controller is arranged for either one or two-speed operation. It may be "A.C." or "D.C.". Speeds are commonly 90 feet per minute or 120 feet per minute.

4. A double track system extends through all of the truss sections and provides guide rails for the wheels of the step train. The steps are joined to each other by a pair of heavy roller chains similar to bicycle chains in appearance. These chains pass over the main drive and the tension device sprockets and cause the steps to move in the direction dictated by the controller. There are several means of attaching chains according to company design. Steps recede into the truss ends to form flat platforms for convenience of passengers embarking on and leaving the escalator. This is accomplished by track design. The step treads are cleated in line with the direction of travel (i.e., along the length) of the escalator. They merge with comb plates that fit into the slots of the cleats at the top and bottom landings of the escalator.

5. The A.S.M.E. Code limits the angle of incline of an escalator to 30 degrees from horizontal. In Europe many 35 degree incline escalators are installed in order to conserve floor space.

6. Balustrades are provided at each side of an escalator to protect passengers. The support brackets for these are secured to the truss, usually by bolting. Balustrade panel material can be wood, metal, a laminate, "tempered" glass or a plastic. Generally it is ornamental and sometimes it includes low panels at step level named "skirt guards" or "skirt panels." The balustrade main panels are set on top of the skirt guards. The horizontal top sections are called, "decking" and are surmounted by the handrails.

7. The handrails are shaped to accommodate the normal hand grip. They are usually formed of layers of canvas fabric vulcanized together and have an outer surface of rubber. This may be natural or a specific synthetic material. Some have steel tape liners vulcanized in the fabric layers to eliminate stretch of the rail. This type is usually made in the form of an endless belt and is vulcanized together at the factory.

8. Many handrails are supplied in single lengths and must be "spliced" in the field. This is usually accomplished by vulcanizing the two ends in a special portable furnace or oven.

9. Handrails are generally driven from the main drive-shaft by means of sprockets and chains or by belts. They travel on concealed "guides" at approximately the same speed as the steps. The code requires that they extend (i.e., "travel") at least 12" beyond the line of the comb plate engagements with the step cleats.

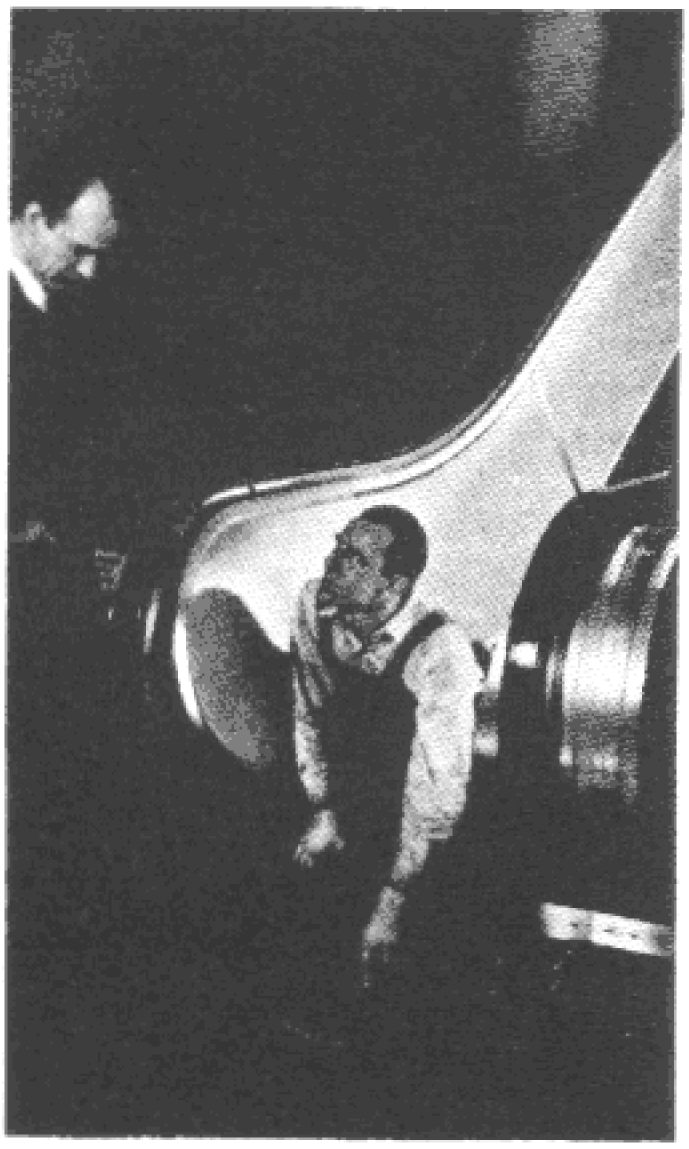
10. Escalators are equipped with various code dictated safety devices such as starting switches within sight of the escalator, emergency stop buttons at top and bottom landings, broken step-chain devices. broken drive-chain devices (for escalators with chains connecting the main drive and the machine) speed governors, and overspeed pawl brakes. Specific lighting minimums are also required by the code. The lighting

may be a part of the escalator installation in a form of a "strip" lighting in balustrades, it may include "comb lights" or may be entirely separate from the escalator.

11. Section 800 of the code relates to escalators.

12. The arrangements of groups of escalators within a building depend to a great extent on building layout and the intended function of the escalators. Several of the more common types of installations are shown in the illustrations in this chapter.

13. The routines used when installing escalators are very important. Handling and storage of material requires considerable study. Alignment of units with relation to each other and to the building structure is just as critical as similar work for banks of elevators. However, since many escalators are installed in existing, occupied buildings, it is sometimes necessary to work from column surface lines. Conventional column centers can generally be obtained in new frame structures. In all cases, the starting lines should be obtained from the owner's representative and should also be shown on the final layout.

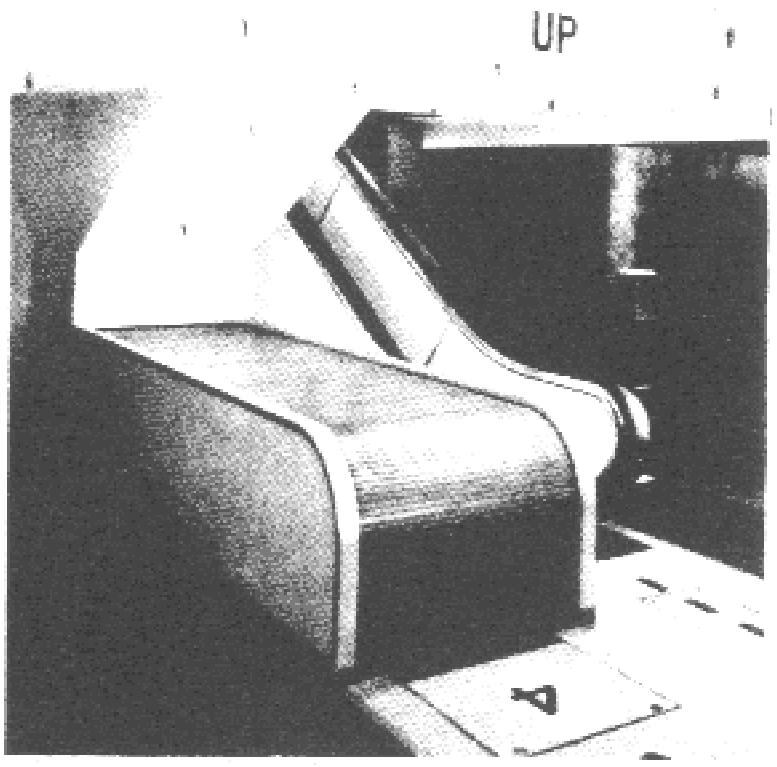


Floor Plates Provide Access to Pit Equipment

14. The machine room is contained in the upper truss section, as noted in paragraph 2. Access to this area is obtained through a movable section of the floor plates or platforms that extend from near the comb plates outward to the building floor line. Similar access is generally provided through floor plates to the step chain tension device in the lower truss section. Many installations include side doors on the external surfaces of the incline. These provide access to the step and chain areas for adjustment, maintenance and repair.

15. The open wellways of escalators can become flues or chimneys in the event of fire inside a building. Because of this, "roll-up" or "shutter type" fire doors are sometimes provided by others to reduce the possibility of a fire traveling through the wellway. These doors operate from a rolled up position at the top landing of an escalator. They move in tracks set above the top guard rails in a manner similar to the cover of an old fashioned roll-top desk or a roll-up garage door. Operation of the doors can be thermically triggered and fully automatic or manual. Code requirements may specify the kind of operation to be provided.

16. Sprinkler systems are often installed over or near escalators and may be installed inside the truss. All of these protective devices are installed by appropriate trades and not by elevator men.



This Photograph Illustrates an Escalator Fire Door in Closed Position

17. The following routine is suggested as a practical sequence for installing escalators.

Truss, assembly and alignment
Upper drive (install but do not align)
Lower tension carriage; install and align
Set machine into machine room but do not align
Upper newels
Lower newels
Balustrade brackets
Sub-deck assembly (if used) or decking
Mouldings, as required by design
Handrail tension device
Handrail guide
Time out for plastering
Align upper drive
Align machine
Controller, conduit and wiring
Track brackets
Curved and straight tracks and track extensions
Skirt panel brackets
Lubricators
Handrail drive chain
Step chains
Broken step-chain switch
All but twelve (12) steps (or per company standard procedure)
Floor plates, comb plates, access door
Step-chain roller guides, upper landing
Step-chain guards, upper landing
Decking (if not installed earlier)
Handrails
Skirt panels and kick plates
Handrail brushes
Wedge guards
Adjustment of escalator
Balance of steps
Interior panels and mouldings

CHAPTER 15
Section -cl

ESCALATORS

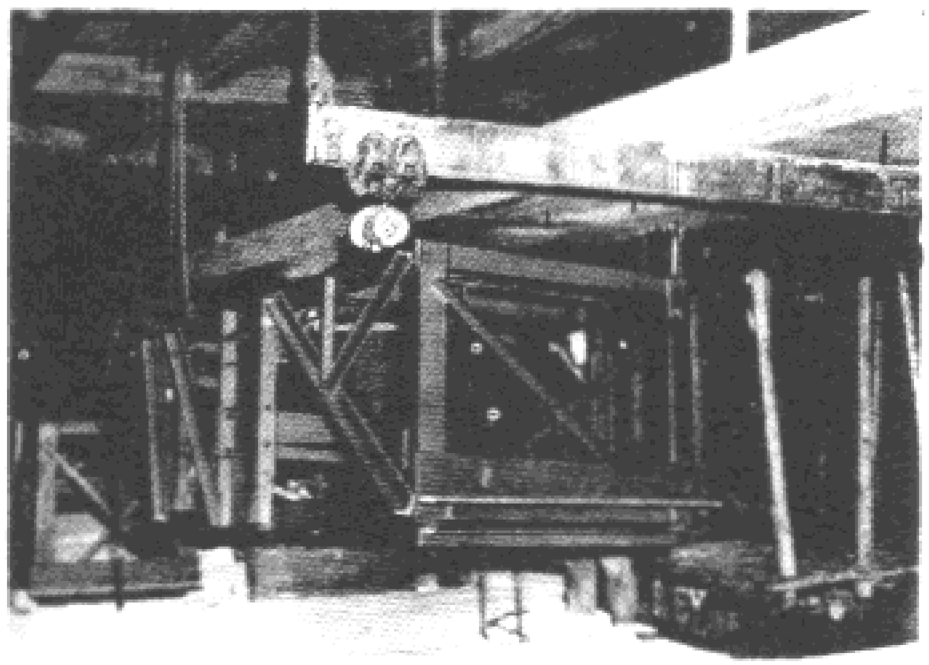
Handling Materials

Suggested:

Materials –
sundries

Tools –
a. chain hoists
b. slings
c. dollies
d. rollers
e. pry-bars
f. electric hoists or tackle drivers
g. "A" frames
h. tarpaulins

1. The work of installing an escalator or group of escalators is primarily a job of mechanical assembly. A number of small parts must be installed in proper sequence within a comparatively confined area. Because of this the order in which materials are delivered and the manner in which they are handled and stored has a direct effect on the efficiency of escalator installation. This is particularly true where multiple units are involved.

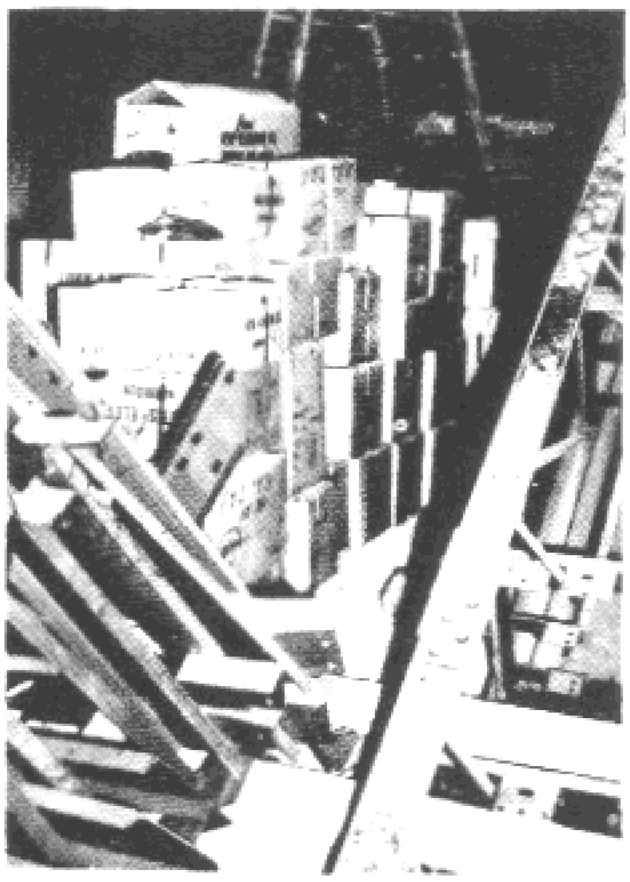


Unloading Truss From Truck

2. There are four distinctly different conditions under which it may be necessary to install escalators in conventional buildings. These are single units in new buildings, multiple units in new buildings, single units in occupied buildings, and multiple units in occupied buildings.

3. Obviously each condition has many variations. Regardless of which condition exists, the work can be made easier by planned and systematic handling of materials.

4. It is basic that the super or some competent man delegated by him should visit the jobsite to study how the truss and other material will be handled and stored. This is particularly important when the truss must be unloaded and moved in an area where plate-glass windows or show cases exist. It may be necessary to unload trucks



Step Material Stored on Jobsite

with the aid of ''A'' frames and chain hoists. Dollies or strong hand trucks can be used to good advantage in such conditions. Electric or gasoline powered winches can often be used to pull the truss into a building on dollies or hand trucks.

5. The escalator truss is normally delivered to the jobsite first. The conventional method of shipment in the past involved the truss shipped in three parts upper, lower, and the incline sections. These parts are not usually very heavy. Few would be three tons in weight. The parts are bulky, however, and they may have to be handled in restricted space, especially in occupied buildings. Otis, Westinghouse and Haughton continue to use the three section truss. The Montgomery truss is shipped in two sections.

6. Generally, it is advisable to set up the rigging before materials are delivered. Where no hoisting facilities are available the ''A'' frames can be easily made of heavy lumber legs such as 4'' x 10'' wood bolted together (i.e., two 2'' x 10'' boards in each leg). Two frames set about ten feet apart and joined by two or three 2'' x 12'' cross members, then braced, would form a satisfactory frame for hoisting the truss on ordinary installations. Sketch 2, section -c2, illustrates a type of ''A'' frame rigged for hoisting. At this point it is worth stressing the fact that building steel or concrete beams should be used for hoisting whenever such suitable framing is available. Emphasis was given to the use of ''A'' frames because they must be used in some installations. The keynote is safety. Use the best supports available for rigging.

7. The truss parts would be skidded directly from the truck onto dollies and pulled into the work area where the parts were to be assembled. Two hoisting rigs would be set up, one near each end of the wellway (hoistway) and chain hoists suspended from them. The load chains should be long enough to reach from the highest escalator level to the loading area.

8. The assembled highest truss is suspended from the two hoists and then lifted into position. Once this truss is set, the chain hoists are removed and hung under the truss to install the truss below. Depending on job conditions, the machine and small parts can be taken up on freight elevators, stairways or even hoisted in the wellway while the truss is being assembled and aligned.

9. In occupied buildings it is customary to barricade a section of floor space to eliminate normal traffic flow from the working area. These barricades should provide a minimum of 6 feet on each side of the ''wellway'' of the escalator and about 15 feet at each end. This restricted space condition often makes it mandatory to schedule several material shipments for installations in buildings of this type. The machine and upper drive are received with the truss and are taken to the upper floor. The truss is assembled and set, then other materials delivered.

10. It can readily be appreciated that where multiple units are to be installed in an occupied building the scheduling of deliveries as well as handling and storage of materials becomes much more complex. Where a common wellway exists and it is to be used for all hoisting, the truss for the escalator most distant from the delivery point must be received, assembled and put in place first.

11. This could mean the top floor and lowest basement escalator materials (at least the trusses) would be delivered first, then the floors next below the top and above the lowest basement and so on until the floor where trucks unload is finally reached.

12. Step chains are shipped in short lengths with axles installed and they are packaged as protection against dirt and moisture. They should not be unpacked until they are to be installed. (Naturally, all of the normal rules which apply to receiving elevator shipments also apply to the handling of escalator parts, i.e., packages should be checked against shipping papers, damaged or missing items reported and safe storage obtained.)

13. Step cleats and wheels can be easily damaged so should be left in their crates until after the step chains and axles are installed.

14. Balustrade panels are crated or boxed, according to the job conditions, company standards and sometimes to purchaser's "specs." They are generally ornamental so should be left boxed until they are required. This would be after as much as possible of the plastering and other rough work is completed.

15. If balustrade strip lighting is involved, the light tubes should be kept in the locker as long as possible. They should be tested at the time of their installation and the balustrade panels put in place as soon thereafter as possible.

16. Handrails and decking are often damaged by careless workmen of other trades or purely malicious persons. Do not install these parts until job conditions warrant it and then be sure no one builds rough scaffolds for plastering or painting on top of them unless some protection is provided for the escalator equipment and ornamental finishes.

17. If an escalator is completely installed before the building is ready for its use, it is advisable to barricade both ends of it and then cover the unit with tarpaulins, drop cloths, pliofilm or some similar protection.

CHAPTER 15
Section -c2

ESCALATORS

Installation – Truss

Suggested:

Materials –
- a. basic materials
- b. sundries

Tools –
- a. electric drills
- b. special gauges per design
- c. welding equipment
- d. chain hoists & rigging
- e. steel measuring tape
- f. 12 plumb bobs

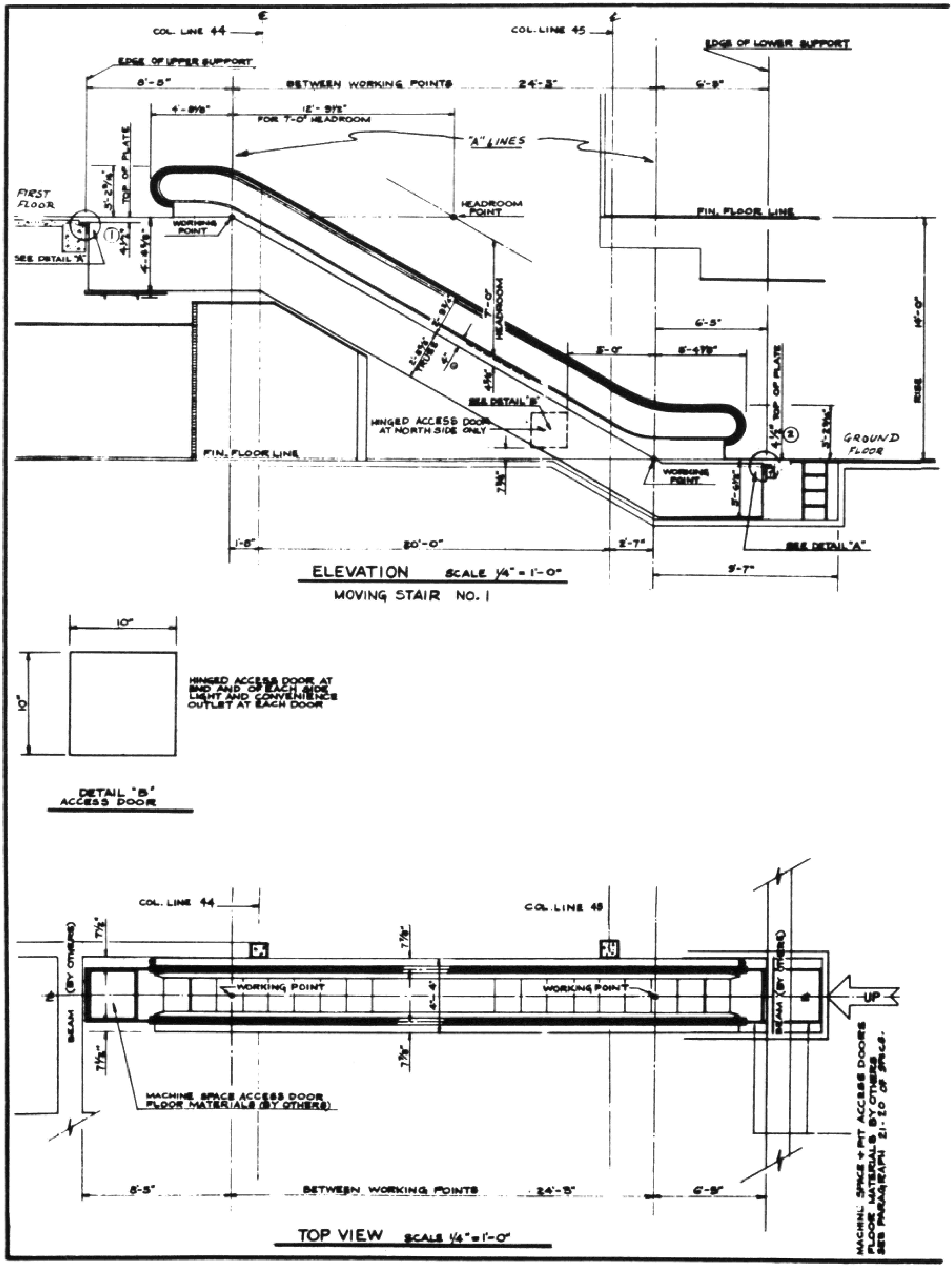
1. Escalator field installation work, like that of elevators, begins with a comparison of job conditions to the layout.

2. The dimensions of the wellway, including floor heights at each end of the opening, location of bearing points and the relation of the wellway center to building column lines should all be checked against the layout before the truss is delivered. Corrective action should be taken through the elevator companies "super," if structural changes are required.

3. It is important to establish center lines and also to drop plumbs at each end of the wellway so that distances between supports, their squareness and the floor heights at each end can be accurately checked. The wellway center line should be clearly marked on the floor at each end of the wellway (on each floor).

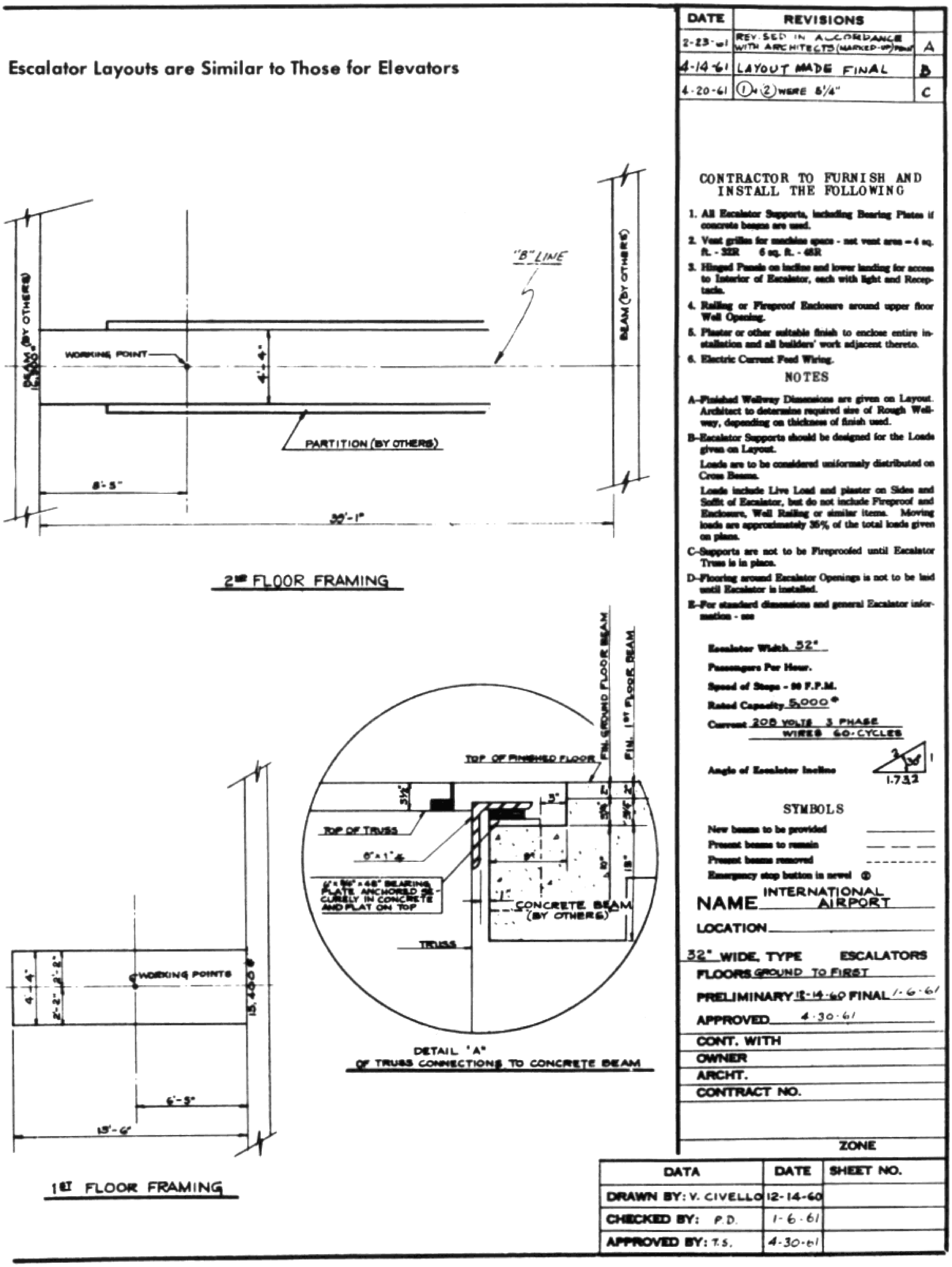
4. Escalator layouts, such as sketch 1, show a center line indicating the center of the wellway. They also indicate one or two plumb line locations at or near the support beams. Where more than one unit is in the wellway, the layout may also show locations for horizontal center line of each truss along the line of travel (or line of incline). The plumbs are referred to as the "A" or ("A-A") lines, whereas the horizontal wellway center line is usually called the "B" line.

5. One method of checking these dimensions is to obtain the column (or corridor) center line from the contractor or architect and measure from that to the center of the wellway. Establish the wellway center line at the top and drop plumb bobs from wood planks at each support. Mark these locations clearly. Check all the dimensions against the layout and try the bearing beams for general squareness. It is important to be sure that the length of the wellway is correct in accordance with the layout. To determine this, measure from the "A" line (or lines) to each building support beam and add the totals. (These support beams do not have to be exactly square since the truss support angles are about 6" deep and allow for some out of square adjustment.

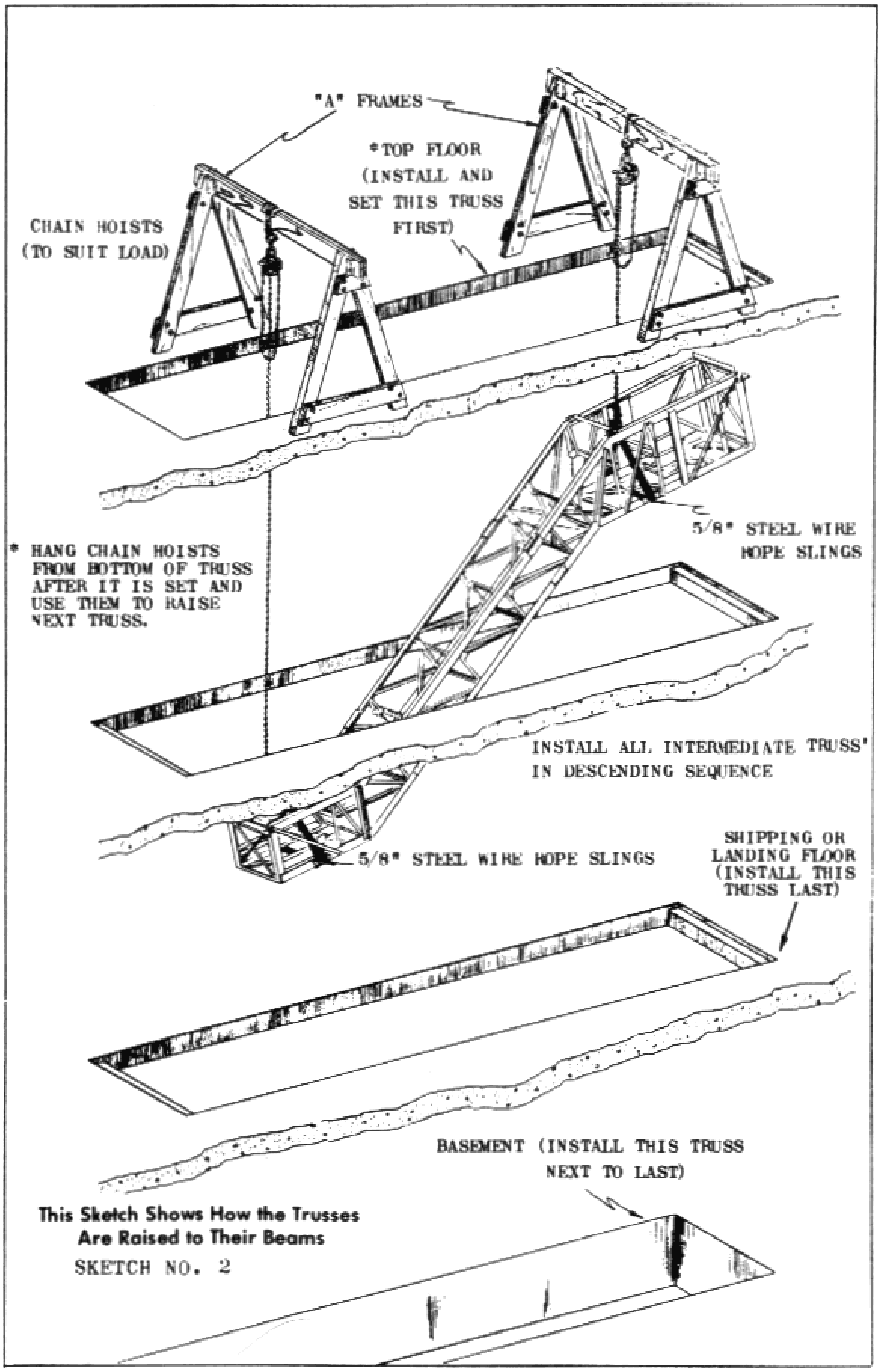

COL. LINE 44
COL. LINE 45
EDGE OF UPPER SUPPORT
EDGE OF LOWER SUPPORT
8'-5"
BETWEEN WORKING POINTS
24'-5"
6'-9"
4'-8½"
12'-9½"
FOR 7'-0" HEADROOM
"A" LINES
FIRST FLOOR
TOP OF PLATE
WORKING POINT
HEADROOM POINT
FIN. FLOOR LINE
SEE DETAIL "A"
7'-0" HEADROOM
TRUSS
6'-5"
5'-0"
5'-4⅞"
RISE
14'-0"
SEE DETAIL "B"
HINGED ACCESS DOOR AT NORTH SIDE ONLY
FIN. FLOOR LINE
GROUND FLOOR
WORKING POINT
SEE DETAIL "A"
1'-8"
20'-0"
2'-7"
9'-7"
ELEVATION SCALE ¼" = 1'-0"
MOVING STAIR NO. 1
10"
10"
HINGED ACCESS DOOR AT END AND OF EACH SIDE LIGHT AND CONVENIENCE OUTLET AT EACH DOOR
DETAIL "B" ACCESS DOOR
COL. LINE 44
COL. LINE 45
BEAM (BY OTHERS)
WORKING POINT
WORKING POINT
4'-4"
7⅛"
UP
MACHINE SPACE ACCESS DOOR FLOOR MATERIALS (BY OTHERS)
MACHINE SPACE + PIT ACCESS DOORS FLOOR MATERIALS BY OTHERS SEE PARAGRAPH 21-20 OF SPECS.
8'-5"
BETWEEN WORKING POINTS
24'-5"
6'-9"
TOP VIEW SCALE ¼" = 1'-0"

SKETCH NO. 1

Escalator Layouts are Similar to Those for Elevators

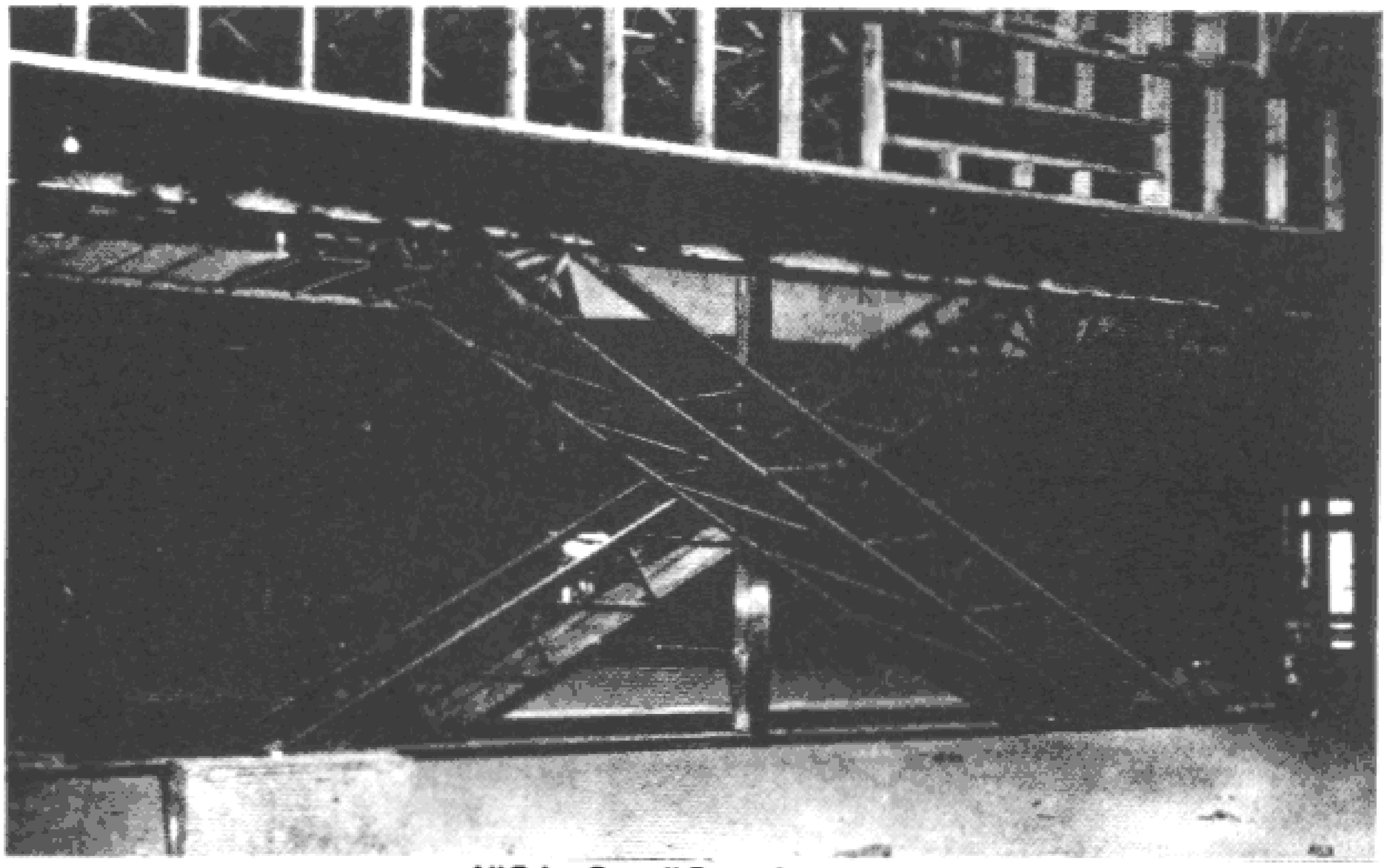


SKETCH NO. 1



This Sketch Shows How the Trusses Are Raised to Their Beams

SKETCH NO. 2



A"Criss-Cross" Truss Arrangement

6. Where multiple units are to be installed the center lines can be dropped from top floor to bottom floor and checked at each floor against each other as well as against the layout.

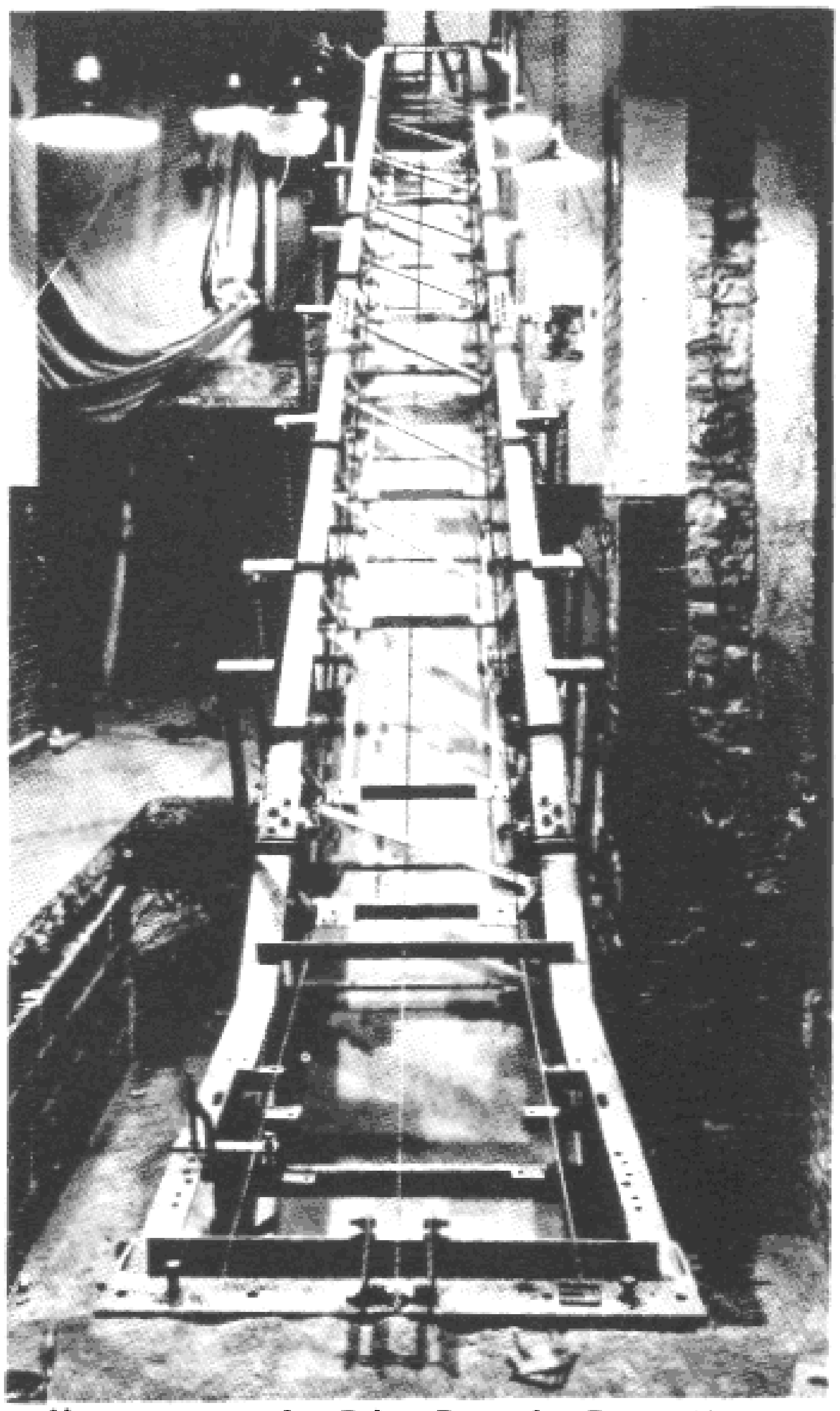
7. Measure from the finished floor line down to the top of the support beams at each level. (If the supports are concrete and bearing plates are to be used, be sure to allow for these when calculating available space.) If all these dimensions mentioned in paragraphs 2 to 8, correspond to the layout, and the bearing beams are reasonably square, the wellway is essentially satisfactory as far as clearances are concerned.

8. The acceptable difference in height that can be allowed between floors can vary somewhat from the layout according to design and trim (i.e., balustrading, decking, plaster grounds, location of adjacent units, etc.). However, it is a general rule that variances of up to 1/8'' per foot of rise can be accommodated in the field assembly. Greater differences may require that the truss be lengthened or shortened. In all cases, variance from the height indicated on the layout should be reported to your superintendent.

9. When the truss arrives at the jobsite and has been skidded to the wellway, the location of the upper and lower support angles on the truss ends should be checked and compared with the space available above the support beams to the finished floor lines as outlined in paragraph 7. If the support angles on the truss are too high (or low), or if the distance from the top of the bearing beams to the floor lines are too small (or large), it may be possible to overcome the trouble by changing the location of the support angles, either raising or lowering them on the truss as required by field conditions.

10. It is presumed that chain hoists have been rigged at each end of the wellway on the upper floor and that the truss sections have been placed in proper sequence beside the wellway. The sections are laid on their sides and blocked to approximately the same height and plane. "Body-fit" bolts are used to secure the sections together, thus assuring close alignment of the parts. The machine and upper drive are taken to the upper floor. Wire rope slings are then placed on the truss near each end and the chain hoists are used to turn the truss to an upright position. If necessary, because of space conditions, the truss can be landed in the wellway on a heavy wood plank shoring or platform.

11. Once the truss is upright, it is again roughly checked for square and alignment of parts. Some trusses have diagonal bracing which is not secured in the factory. One end of each brace is left free for use in possible field alignment. This bracing is fastened once the truss is assembled and set upright in permanent position. (The truss sections can be welded together for added security, after all alignment is completed.)

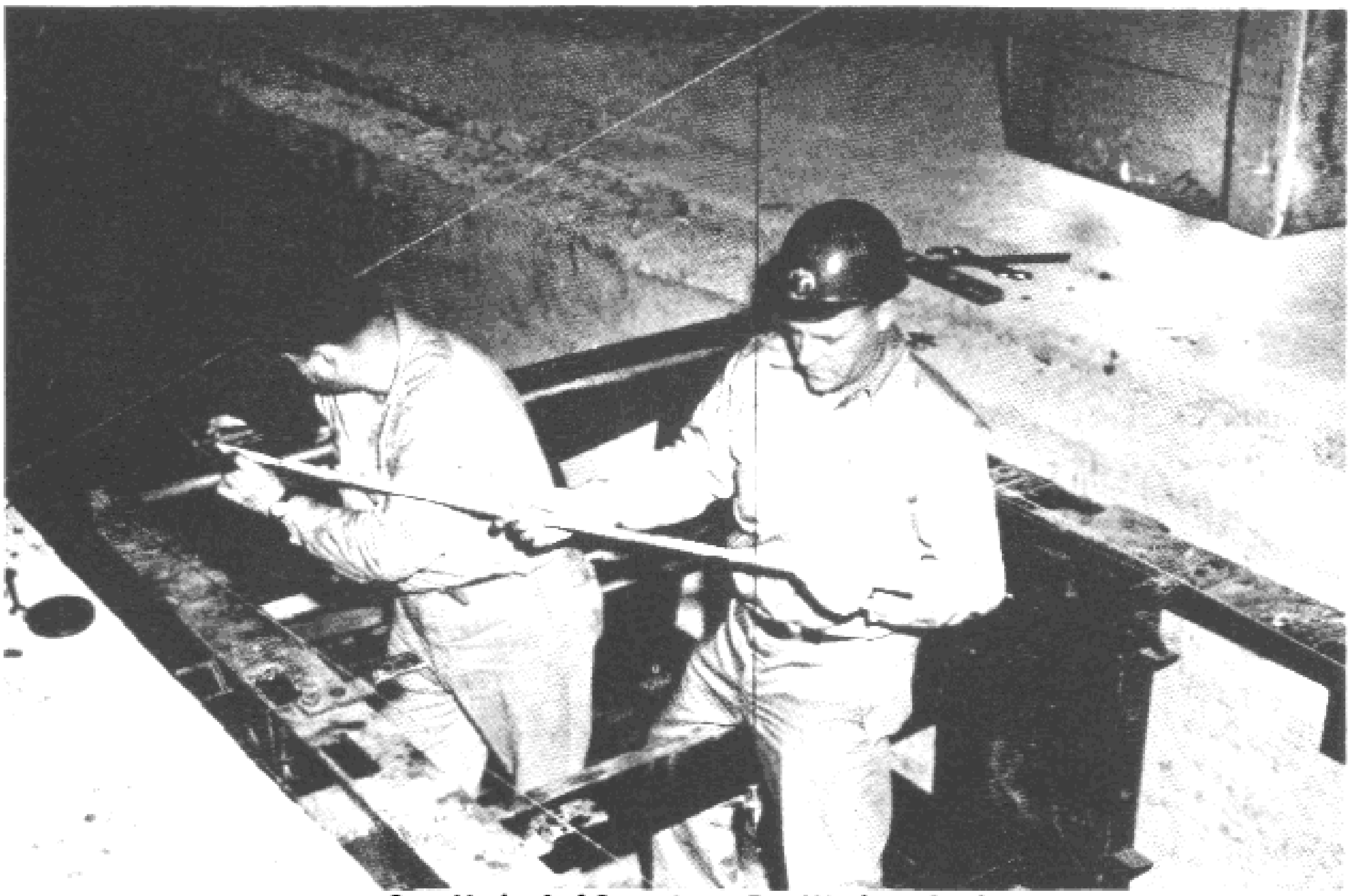


Measurements Are Taken From the Center Line—Note the Top Stanchion

12. The slings are adjusted so the truss will hang about level crosswise and the chain hoists operated to lift the assembly. The ends are raised slightly above their bearing beams and the lower end support angle is then eased onto its bearing. After this, the top end is lowered so its support angle rests on its beam. The support angles are each equipped with jack bolts. These permit the truss to be set level and at the correct distance below the finished floor line.

13. Once the level position is approximately established, the truss is aligned lengthwise to the center lines on the floors. Steel shims are then placed between each support angle and its beam, to ensure a full and solid bearing. The shims should be blocked or pinned so they cannot work out.

14. Truss sections are manufactured from mill stock materials and since each is essentially a custom built unit it is not practical to "tool up" to assemble them to precision tolerances. Also, the deflection of each truss will vary somewhat. It is



One Method of Squaring a Top Working Angle to the Center Line

necessary to determine how far the truss is out of alignment in both vertical and horizontal planes. This check is made after the truss is set on its permanent bearing beams and the required corrective action is taken at that time. Here again the company standards may vary as to amounts of "out of line" values that are acceptable. The construction superintendent should provide information to the mechanics on allowable tolerances.

15. The truss alignment is checked from a center line. This line is established by mounting a stanchion approximately at the point where the incline meets the top (horizontal) landing section of the truss and a second stanchion at the bottom landing. The line is usually piano wire of about #14 gauge, made very taut by a turnbuckle fastened to a truss end. The line is adjusted to be exactly centered on the top and bottom sections, by checking its position with plumb bobs dropped from the line to the truss, as well as with a square and level. The line is made parallel to the angle of the incline at the top and bottom.

16. Once the center line has been established, the truss incline is checked at standard intervals to determine its alignment. Some corrections can be made by loosening the body-fit bolts holding the truss sections together and shifting relative positions with jacks and wood timbers or with chain hoists and slings.

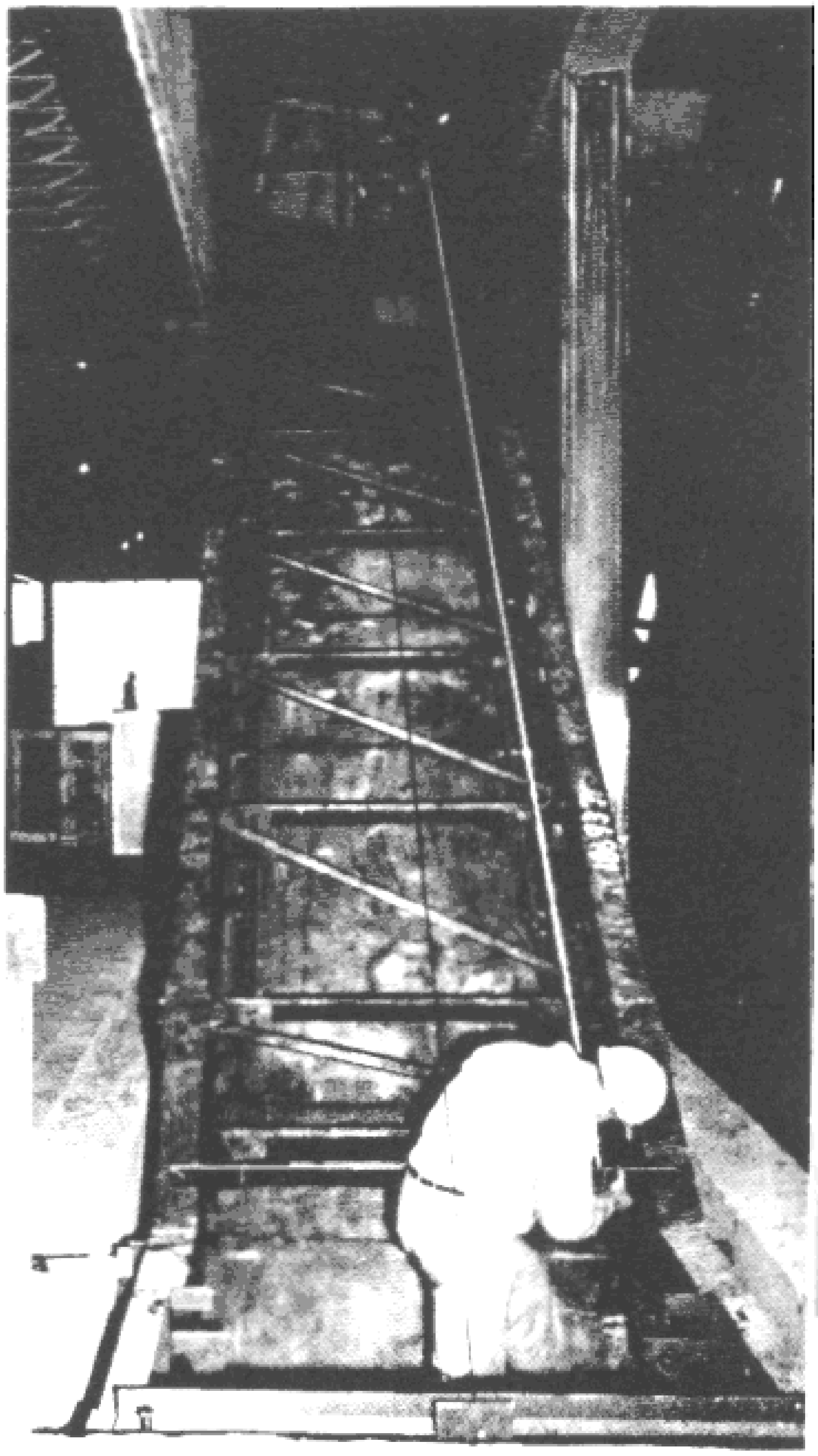
17. Extreme cases might require that some body-fit bolts be removed, alignment made and the holes reamed for oversized body-bolts. Welding can also be used to secure truss sections in these cases, either to supplement or replace the bolts.

18. Once truss alignment is established, plumb bobs should be dropped from the center line at top and bottom sections. The plumb points can be extended with squares so permanent chisel or punch marks can be made on the truss ends. These marks are first used to make final alignment of the escalator truss with the wellway center lines previously made. The truss is re-leveled at each end and the proper "distance below floor level" is reconfirmed. When required, "full width" shims are placed between the top and bottom support angles and their beams. It is important to secure such shims so they cannot work loose or fall out. The jack bolts are removed. Where floor surfaces in buildings are not level, it is customary to set the escalator so its floor plates at the newel lines will be level with the building floor. The floor men then work to the escalator floor-plates.

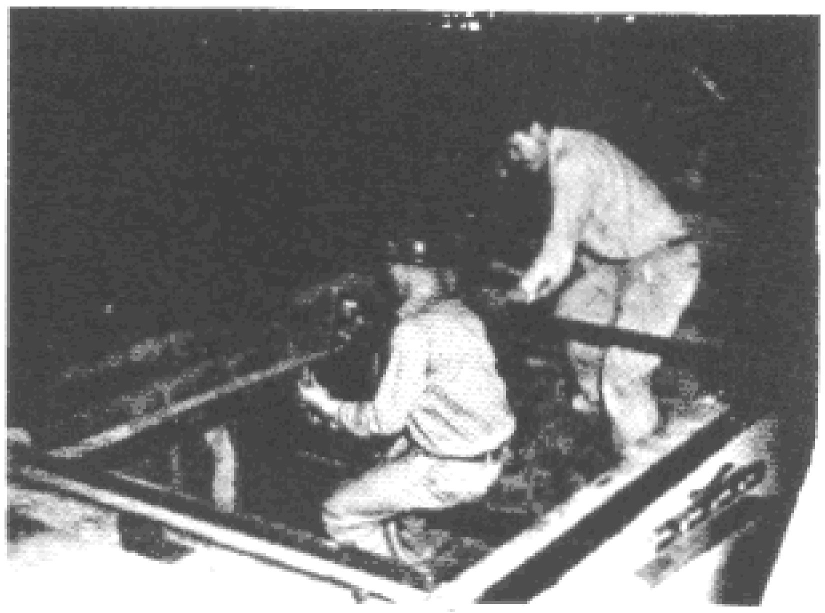
19. Other working lines are established from the center line. They are carefully set, generally, from four "working angles" which are placed across the truss top chords. These angles are set across the truss at the extreme ends of the top and bottom sections, and at the junctions of the incline with the two flat sections. The angles are squared to the center line and leveled. Their tops are held to an exact distance above the truss chords. This distance is obtained by shimming between the working angles and the truss. The distance above the truss is specified in detail drawings.

20. The "30 degree angle" must be accurately made between the working lines on the horizontal parts and those on the incline. Some companies confirm these by measurement, on the 30-60-90 degree triangle theorem, whereas others use special tools to confirm the exact angle. Regardless of which method the "super" instructs the mechanics to use, the accurate establishment of the angle is most important. Manufacture of all trackage and ornamental covering material is based on the 30 degree angle.

21. Each truss is factory equipped with a tray or "drip pan." This pan is a part of the truss assembly but short connecting lengths are supplied to be installed in the field. These pieces are installed so that the upper end of the connecting length overlaps but is under the lower end of the pan section above. The lower end of the short section is placed so it overlaps and is on top of the top edge of the section below. The pans are bolted to the truss with 1/4"-20 tap bolts or through bolts.

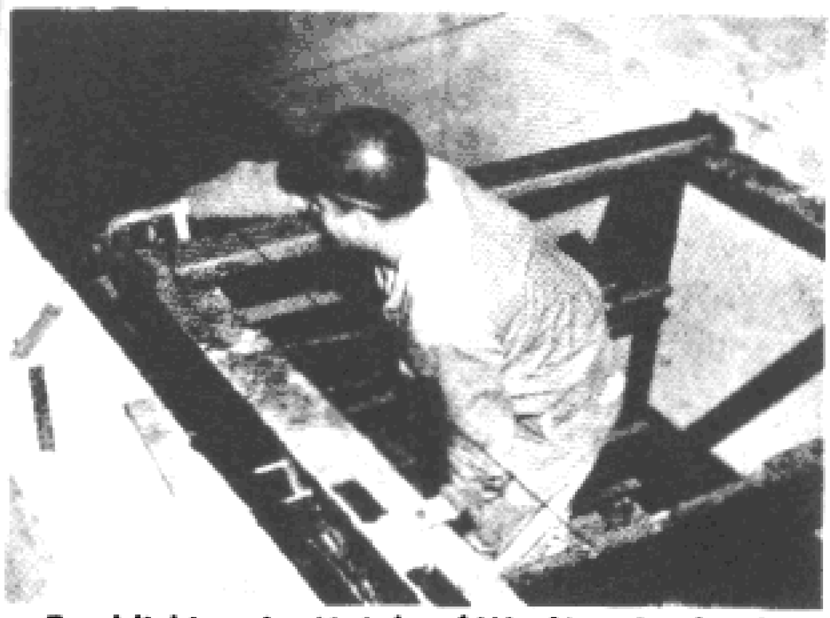


Measuring Distance Between Working Angles #2 and #3 With a Steel Tape



Establishing the 30° Working Line With a Special "Inclinometer" Level

Verifying Level Position of #3 Working Angle



Establishing the Height of Working Angle #3 — The Level Is Being Used as a Straightedge in this Operation

CHAPTER 15
Section -c3

ESCALATORS

Installation—Drives, Machine, Controller, Lower Tension Device, Balustrades, Sub-Decking and Handrail Guides

Suggested:

Materials –
- a. sundries

Tools –
- a. chain hoist
- b. special gauges & templates
- c. electric drill
- d. regular hand tool kit

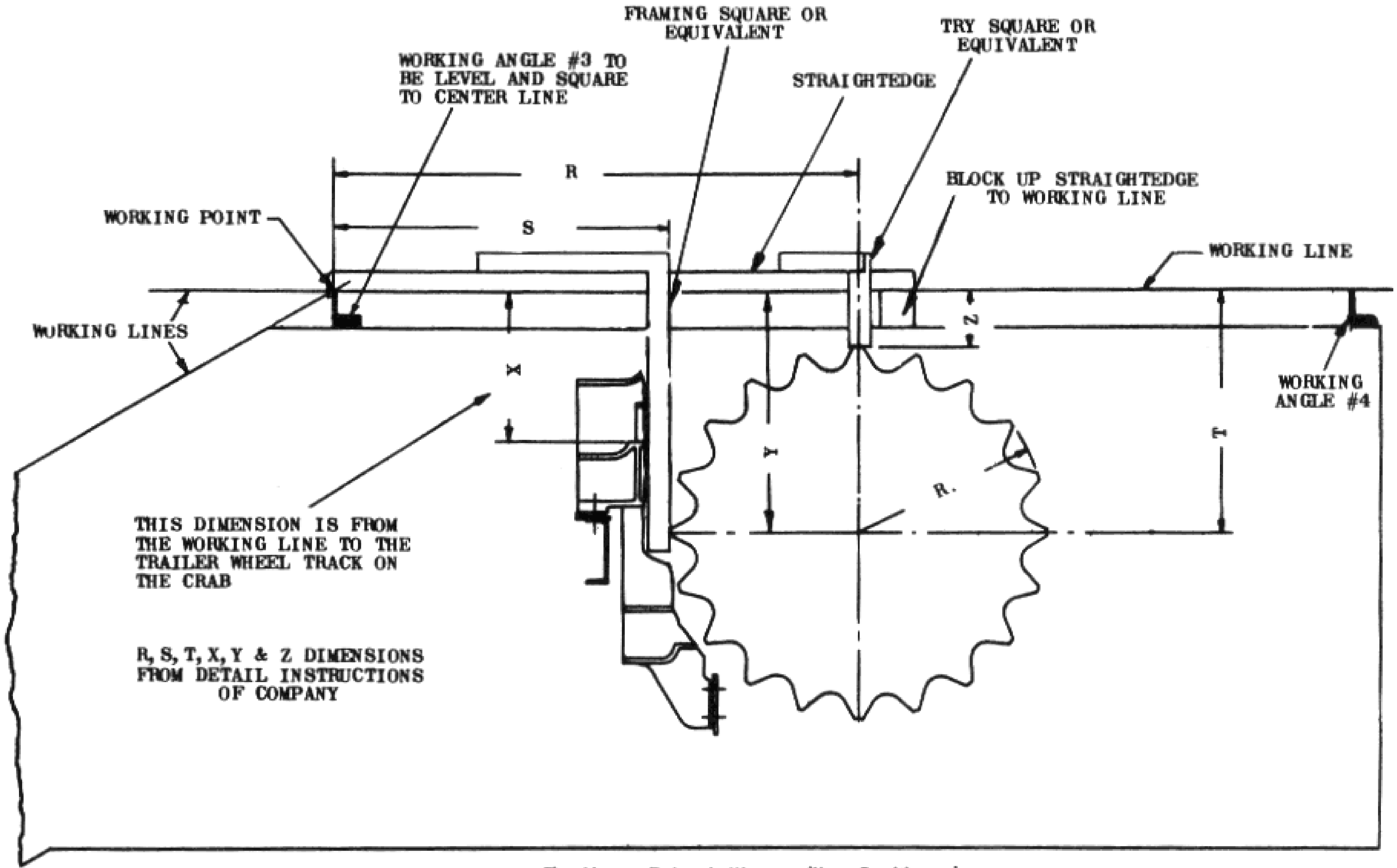
1. After the truss has been set and secured, all slings removed and working lines established, the upper drive and lower tension carriage can be installed and set.

2. The upper drive is essentially a shaft which is equipped with two large diameter sprockets which drive the step chains, and several smaller sprockets. If the escalator is a gear driven type, the main drive will include a gear to mesh with the machine. On others the main-drive shaft may have sprockets to suit the driving chain from the machine. Two sprockets for chains to handrail drives are usually a part of the main drive assembly also. Some or all of these sprockets may be mounted on a cast "spider" that is pressed onto the drive shaft or the sprockets may be secured to the shaft itself through hubs. The shaft bearings are fastened to the truss.

3. The upper drive is hung on a chain hoist, and lowered into the truss. It is then moved to its approximate location and the bearings bolted to plates on the truss. Some designs require that the drive be turned horizontally 90 degrees from normal until lowered into the truss. They are then turned to normal position.

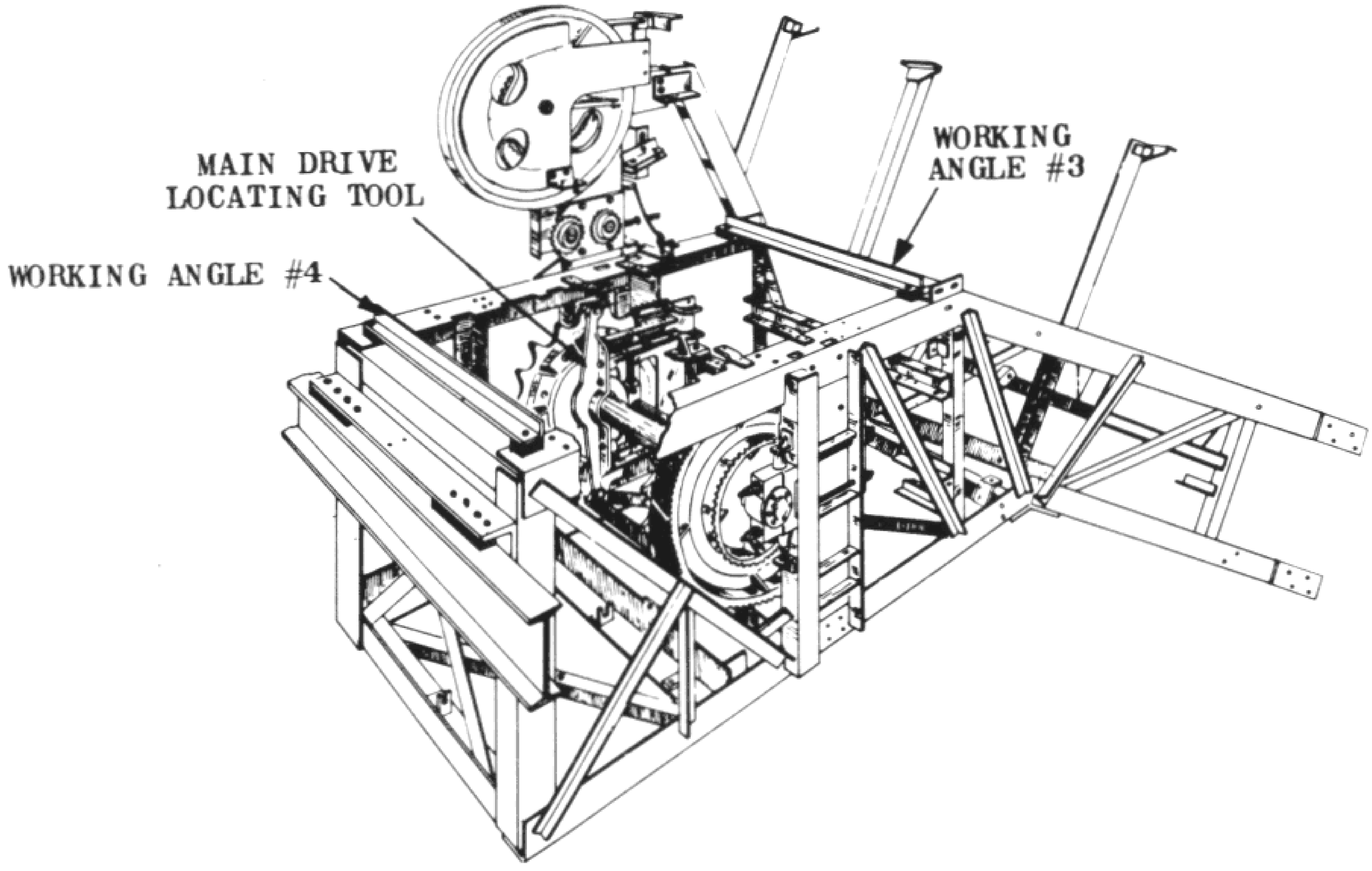
4. The important points about setting the drive are: the sprockets must be parallel with the center line, they must be at the proper equal distance from it and at the correct distance vertically from the newel (and, of course from the center line) so the step chains will mesh properly. The sprockets must be level across. The teeth must be exactly "in step" with each other or the two step-chains will not be even. (This point is extremely important and should be checked even though the sprocket and shaft assembly is made by the factory.)

5. Usually a large "T" square is used to aid in checking the setting of the upper drive. For emphasis, we repeat that it is extremely important that the upper drive be accurately located with respect to the center line, working lines and other points mentioned. Dimensions shown on the layout and detail drawings must be carefully maintained. Some companies use special templates as well as the "T" square for setting the main drives. The "super" should see that these tools arrive on the job in ample time for the mechanics to use them.



The Upper Drive Is "Located" or Positioned
From the Working Point at #3 Angle

SKETCH NO. 1

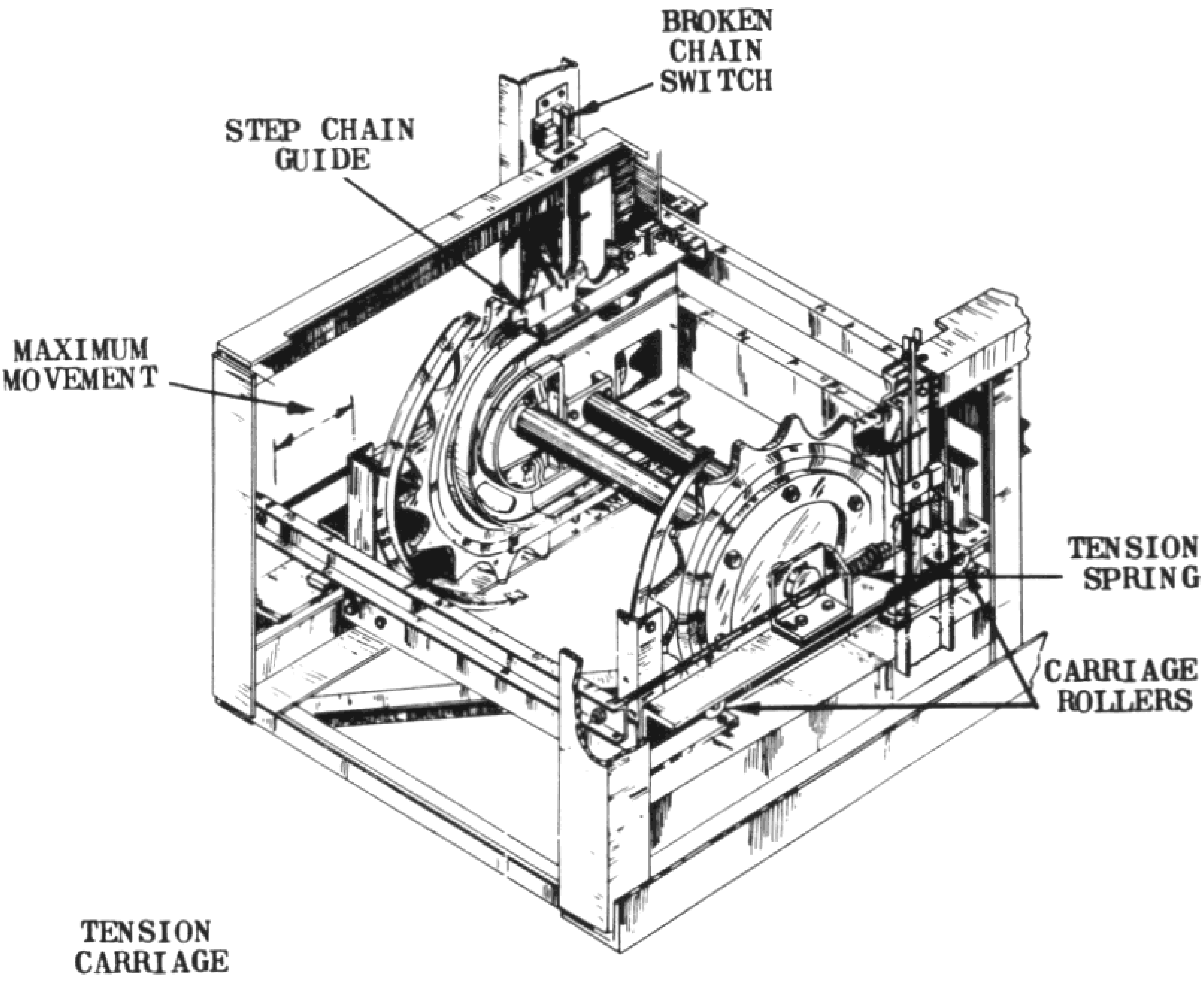


General View of Upper Landing Equipment

6. The curved reversing tracks (sometimes called "the crab") were in the past considered a part of the upper drive assembly, although they also form a part of the step and step-chain wheel track systems. This assembly is installed after the upper drive shaft is permanently set and is aligned to the upper drive. A template or gauge is often used here, also, to assure accuracy since in effect the tracks form the tie-in between the incline track system and the upper drive.

7. The lower tension device is designed to keep the step chains taut. Generally, it is a small, tram like unit that is installed on rails in the lower horizontal end of the truss. The tram type device is made up of structural shapes, together with two step chain sprockets mounted on a shaft set in bearings placed on the tram. Appropriate guides channel the chains. Springs provide required tension. The tracks for the tension device are installed and aligned with the "working lines." They are adjusted for alignment and "parallelity" to each other.

8. The tension device is lowered onto the rails with a chain hoist. The action of the device is tested by being rolled along its rails and is also checked to be sure that all the wheels or rollers of the device bear on the tracks and, also, that full travel is



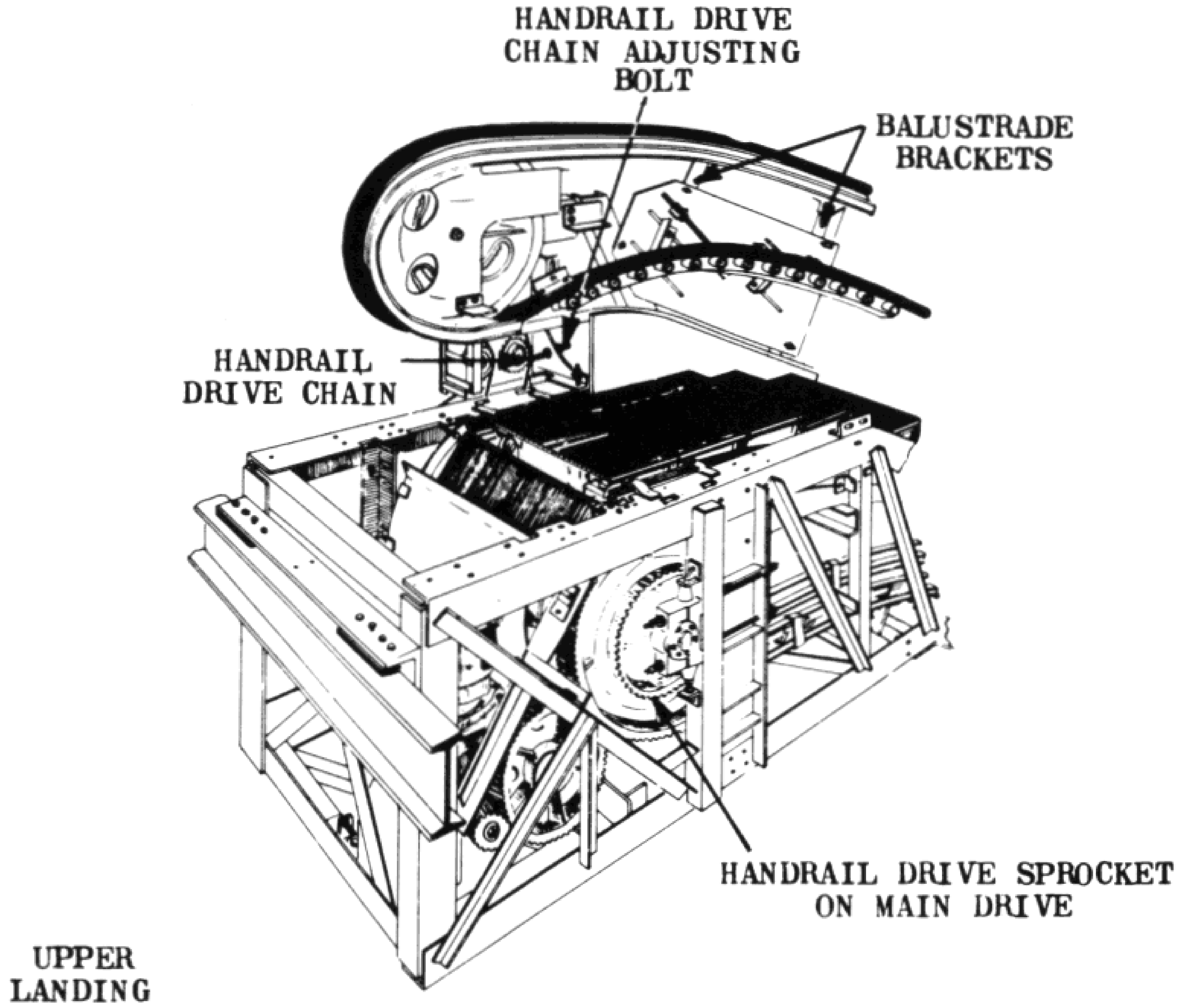
SKETCH NO. 3

One Type of Lower Carriage Assembly

obtainable. Be sure to check that at any point in travel of the tension device the sprockets are parallel to and equidistant from the center line, i.e., that the guides are installed so that the carriage must run true to the center line both horizontally and vertically at any position. The tension springs are left inoperative until the step chains are installed. Broken step-chain device switches may be mounted but will be wired and adjusted later.

9. Some companies do not use moving trams or carriages in the lower landing. Chain tautness is maintained by spring tension device on the sprockets.

10. The machine can be installed at any convenient time after the upper drive is in place. It is lowered into the truss with a chain hoist and set on the fabricated base



SKETCH NO. 4

This Sketch Shows the Relation of the Handrail Drive and Balustrade Brackets to the Top Landing and Truss

channels provided for this purpose. Whether the machine is gear or chain drive, some adjustment is provided either to obtain proper gear mesh or to tighten the driving chains to the "upper drive device." Gear drives are set to obtain straight alignment with the gear on the upper drive. This can be done with a long straightedge or a line. Proper gear tooth clearance is set to company standards. Chain drive sprockets are aligned with a line or a straightedge as a rule and are re-checked when the chain is installed and made taunt.

11. Controllers are usually set in the machine room after the machine is in place. Escalator controllers are generally compact and lightweight. A number of them are "portable" to the extent that they are designed to hang on brackets on the machine-room wall and can be lifted out onto the floor. This provides more working space in the machine area and facilitates controller adjustment and maintenance. Wiring connections for these are made with short lengths of conventional traveling cable.

12. The upper and lower newel sheaves are designed to provide terminal turning points for the handrails. Usually the upper sheaves drive the handrails and are, therefore, equipped with rims of rubber or other material to develop the necessary friction.

13. The newel stands are bolted to the truss and are located in exact relation to the center line and working angles and lines.

14. The newels must be carefully adjusted so their sheave faces are parallel, the rims level and at the correct distance from the center line and at the proper height. Obviously these newels and their handrail sheaves must be set before the handrail chain sprockets can be aligned.

15. Balustrade brackets can be formed by casting but today are more commonly made of structural angles. They consist of a base angle, one or more uprights and top angles which support the decking assembly. Braces or gussets may be used, depending on design. The brackets are made "right-hand" and "left-hand" so are not interchangeable. Since the top or shelf angle is made to suit the contour of the decking, not all balustrade brackets are identical. Generally, those on the lower curve differ widely from those for the incline.

16. Installation is made by bolting the brackets to the truss at fixed distances from the center and working lines. The brackets are placed at specific intervals in accordance with layout detail.

17. Refer to the drawing and determine the distance from the center line to the balustrade brackets and the height of the bracket above the truss top chord or working line. Set the right and left-hand brackets in the second position up the incline. Square them to the truss chord and establish the proper height. Place a straightedge across the two top angles. They should be level and in alignment with each other. Shim under the bases to obtain this condition, if it does not exist.

18. Install the right-hand and left-hand blustrade brackets at the top of the incline in the same manner.

19. Extend lengths of •21 gauge wire between the shelf angles of the top and bottom brackets on each side of the incline. Make the wires taunt, then use them as guides to set all the other balustrade brackets except the bottom pair. These will be set later to the deck assembly (or sub decking, if used).

20. All of the ornamental portions of the escalator are manufactured to close tolerances and there is relatively little chance for alteration in the field. Because of this the need for accuracy in establishing working lines and installing material to them has been stressed.

21. Almost all of the older types of escalators used a frame called "sub-decking" on top of balustrade brackets. This was a formed sheathing that acted primarily as a base on which to mount the finished ornamental decking. Although some modern designs continue to use sub-decking, most companies fix finished decking directly or by support members to the flat top angles of the balustrade brackets.

22. When sub-decking is used, it may be considered the connecting link between the escalator frame and the ornamental coverings. There is some small leeway for adjustment in the installation of the sub-decking. The assembly is shipped to the field in pre-fabricated sections that fit closely around the newels, then extend down the incline to form tightly around the bottom newels.

23. The newel sections of the sub-decking are necessarily "split" to fit around the handrail sheaves. The newel sections are installed first. They and their mouldings fasten to the newel frame and shield. Reference must be made to the manufacturer's detail drawings to assure correct fit.

24. The sections of sub-decking intended for the incline are marked for identification (as are the four newel sections, of course). The incline sections are laid on the balustrade-bracket shelf angles in proper sequence, then bolted together. They are aligned and shimmed as required to meet layout details, then bolted to the newel sections and to all balustrade brackets.

25. When decking of stainless steel or other hard finished material is used and the plastering will be run to adjacent screeds, the decking is installed as soon as possible so the plasterers can finish their work and thus clear the escalator for our men.

26. When installations are provided with anodized aluminum decking, this is generally left off until after plastering is completed. The reason for this is that the aluminum surface is easily damaged and very hard, if not impossible, to refinish properly in the field.

27. Regardless of whether sub-decking is used or not, the balustrade brackets for the bottom of the incline are installed to suit the position of the particular arrangement involved.

28. Accessory moulding and clips are installed. The base mouldings for the handrail guides are generally considered a part of this work.

29. The handrail tension device may be one of several types. Older but still current types are "double" sheave arrangements where the handrail passes over a pair of tension sheaves that are set in the incline just below the handrail drive sheave. This type is equipped with either a tension counterweight set in inclined rails concealed in the incline balustrade or have a rod tension device that acts like a reverse turnbuckle. Later handrail drive designs rely on the weight of their suspended lower portion to provide tension. Some of these types are equipped with a roller or set of rollers placed under the bottom of the handrail at the top newel. A turnscrew device is arranged to raise the roller or rollers and thus increase the tension on the rail induced by the weight of the rail hanging in its catenary curve. Still others rely completely on the drive friction and have no tighteners.

30. The handrail tension device is installed after the balustrade brackets or after the sub-decking, according to the design used. Its installation is relatively simple. Reference to drawings will indicate the manner in which it is bolted into place and aligned to other parts.

31. The handrail guides for conventional handrails are extruded metal and extend approximately from the upper handrail drive to the lower newel wheel. The general location of the guides is established during the installation of the sub-decking assembly, which includes the base moulding for the handrail guides, or by brackets to the balustrade supports.

32. The guides are bolted onto their moulding. The lower curved sections are installed first. The ends of the curved sections are aligned to the handrail drive-sheave rim height by means of a standard block that is bolted in place. The rail terminates a few inches from the sheave rim center line. (Detail drawings should be checked for company standard dimensions.) The curved sections leading to the sheaves are slightly wider than the guide on the incline. The installing mechanic must file the rail with a second cut or mill file so the two rails join in a tapered fit that cannot snag the inside canvas of the handrail.

33. The handrail guides are screwed into place along the incline and set so they overhang the base moulding equally on both sides. All joints must be smooth on the sides, bottoms and the tops. Any protruding screw heads must be filed so they are not above the top edges of the guides. The lengths of finished rails must be aligned with each other, of course.

34. It is worth emphasizing that the mechanic should have plasterers do any necessary work as soon as possible and thereby avoid having plaster and refuse fall onto steps, chains and other parts that are easily damaged. Plaster grounds and screeds are not to be attached to the escalator, so it is advisable for the escalator mechanic to review this and delineate scribe lines with the plasterer's superintendent.

35. While plastering is in process, the main drive and machine alignment can be re-checked or confirmed, if not done before. Guards can be installed. Conduit work for the machine room and lower landing can be done. Conduit and wiring for the incline can be laid out for later installation. Track brackets, tracks and other material can be prepared. "A" frames and chain hoists can be removed, if not done prior to this time.

CHAPTER 15
Section -c4

ESCALATORS

Installation — Incline Wiring, Track Brackets and Tracks, Skirt Guard Panel Brackets, Handrails, Lubricators, Step Chains and Steps, Comb and Floor Plates

Suggested:

Material –	Tools –
a. sundries	a. track gauges
b. basic materials	b. electric drills
	c. regular hand tools
	d. blocks and rope fall

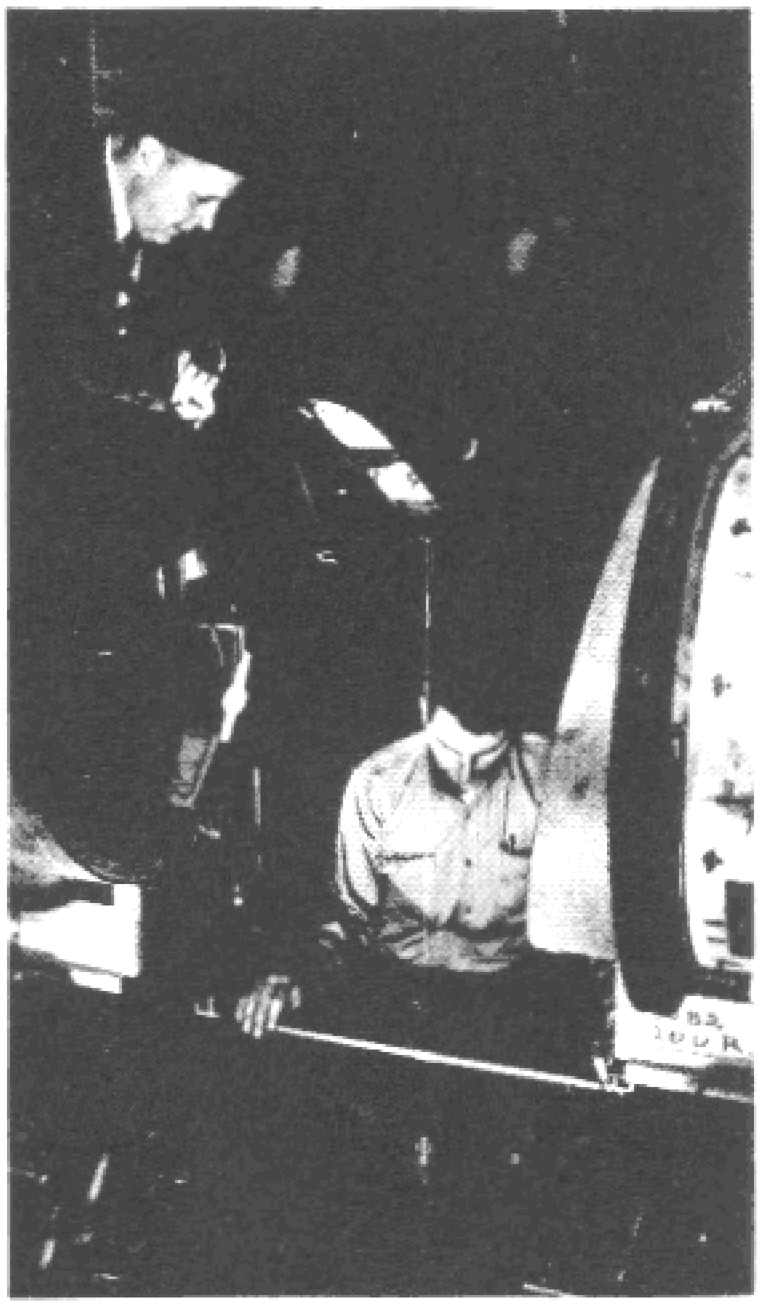
1. When the plastering is completed and the escalator is again clear for our work, the incline wiring and other work can be completed. A conduit layout is customarily provided with the erection data. This indicates the size and location of the conduit as well as the number of wires to be pulled into each section. The methods used are similar to those for regular elevator work except in the case of escalators the ''main riser'' is secured inside the truss or balustrade brackets and, of course, there is no traveling cable to a car. Broken step-chain switches in the lower landing are connected with the main riser by means of short lengths of flexible conduit to permit adjustment of the switches. Similar arrangements are used for the governor switch and other auxiliary devices. Comb light fixtures are sometimes made removable and if so have flexible leads.

2. Normal wiring must conform to the National Electric Code and local regulations in the United States. Article 620 of the N.E.C. covers escalators as well as elevators so the information contained in chapter 10 of this N.E.M.I. Manual, applies to the wiring phase of escalator work in general.

3. In earlier sections of the present chapter we noted that installation methods vary from company to company and even job to job. This fact is very evident when assembly of incline components are reviewed. Because of this, the present article is written with the aim of suggesting a sequence that will be practical in the majority of installations. The important point is to be sure that parts installed first will not hinder installation of other parts at a later time.

4. Handrail drive chains can be installed at any convenient time after the upper drive and newels are set, and the plastering is cleaned up. The chains are commonly the conventional heavy duty ''roller'' type. Sprockets on the handrail drive sheaves in the newels are checked for alignment with those on the main drive. Chain tightener sprockets, generally in the newels, are moved to the ''slack'' position and the chain is measured and shortened if necessary. A split link joins the ends after they are passed over their sprockets. The chain is usually made taut by forcing the tighteners forward and bolting them in those positions.

5. Track brackets and tracks are installed when all the work behind the track and step line has been done so step tracks can be installed without hampering other work. There are two lines of tracks in each side of the escalator. These are called the "upper line" and "lower" or "return line." The tracks on the two sides of the truss are set exactly parallel to and in the same plane with each other as well as equidistant from the center line. They are installed on brackets that are fastened to the truss members. Some tracks are extruded shapes. Others are angles of steel or other material. The contour of the tracks is such that the step treads remain horizontal at all exposed points of travel and the treads flatten out into platforms as they approach the top and bottom landings. Some escalators use one wide track to support all the step wheels on the upper line. Others use two separate sets of tracks for the same purpose. Regardless of which type is used, it is, as noted, necessary for the corresponding lines to be equidistant from the center line and parallel to each other and in the same plane as well as in exact relation to each other as shown in detailed data.

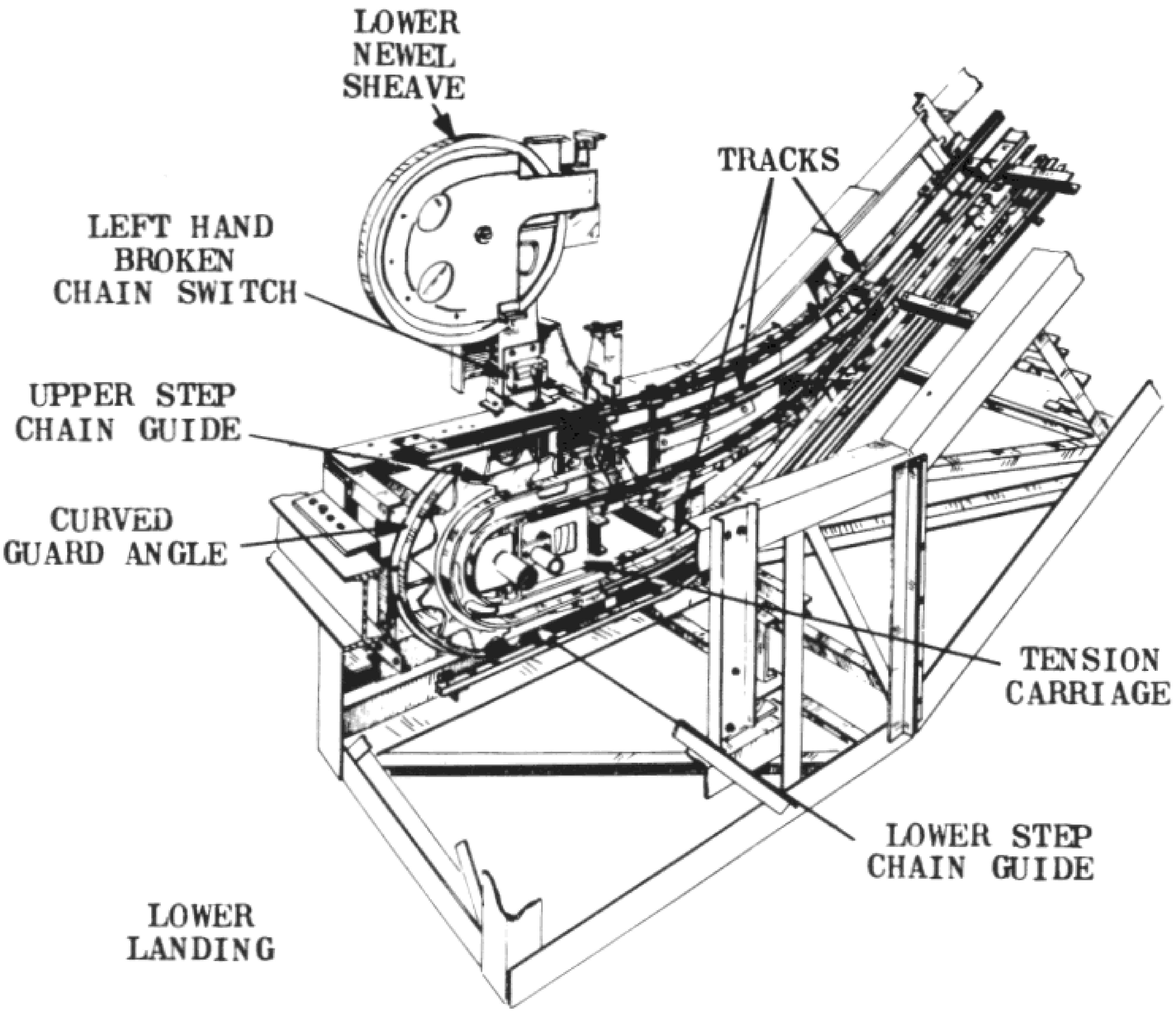


Checking Track Location to Center Line With a Special Gauge

6. Brackets are designed to fit the particular track and truss made by each company. They are set in pairs and must be accurately installed with reference to the working lines and center line. The brackets for the lower line are generally installed first, then the upper line, beginning at the top of the truss and working down. The pairs must be level with each other from top to bottom of the truss. It is good practice to use a long straightedge across three or more brackets in line to be sure bracket faces are in the same plane. The faces must be lined up by bending or resetting as required. Each company has developed its own techniques and tools to do this work.

7. As a rule, shims are not used to align brackets. If used at all, they must be secured so they cannot work out or loosen.

8. Some companies use gauges or templates to aid in setting track brackets. They are referenced to the center line plumb bobs and/or the working lines.



The General Arrangement of the Tracks at the Lower Landing

9. Depending on the particular design used, the end curved sections of tracks may be fastened to the upper drive assembly or to brackets set on the truss. This was noted in the description of setting the upper drive. Regardless of what design is used, the curved return tracks are aligned to the main drive sprocket and, thus, to the center line.

10. The tracks on the incline are bolted to their brackets with the riding surfaces exactly level with each other and at the correct distance from center and working lines. The ends are aligned to the curved tracks. All splices (rail joints) are smoothed with mill or other fine cutting files. ''Distance between tracks'' are carefully checked for correctness, generally with a gauge.

11. The exact arrangements of the curved tracks at the bottom landings are also subject to variation depending on design. Those companies which use the moving carriage for a tension device must provide an area of split or ''overlapping'' track

sections so the carriage wheels can move along the extended or compressed tracks without disturbing the transfer of step chain rollers from the fixed to moving tracks.

12. In both types the incline tracks are aligned to the curved sections for smooth roller action at all points.

13. Curved guard or guide tracks are provided on the return curves to keep the steps in position. These guides lead into or form a part of the return line of tracks. As the step rollers run around the upper drive or the tension device, all the step wheels are led onto the lower or return lines of tracks. They are held in fixed relation to each other by the step wheel chains and the return tracks as they move along the lower incline to the opposite end.

14. After all tracks are installed and aligned, the working lines (and center line) can be removed. If the track brackets used are two piece and slotted for adjustment, it is advisable to pin the two pieces of each bracket together after all track alignment is completed. This is usually done by drilling the brackets and installing a 5/16'' through bolt in each assembly.

15. Step chains can be installed at this point on some designs but it may be more convenient to install brackets for skirt guard panels before the chains are placed. The construction data or the super should provide instructions on which to perform first.

16. The skirt guard is a low, vertical panel placed along each side for the length of the escalator interior. The panels are placed on brackets that are adjusted to provide minimum clearances to the steps. The code specifies that clearance between either side of any step and the adjacent skirt guard shall not be more than 3/16'' and the sum of the clearances on both sides shall not be more than 1/4''

17. Since skirt-guard brackets are fastened to the balustrade brackets or other fixed parts, they can usually be installed after the track work is completed. Generally, the brackets are steel angle sections with clips, bolts or studs provided to locate and hold the skirt panels. The brackets are set from the working and center lines or the track lines in accordance with manufacturer's detail drawings and data. They are placed equidistant from the center line, as well as parallel and level with each other.

18. Step chains are made to special company designs as a rule. Their prime function is to move the steps, of course. Step wheel axles are built into the chains on most modern designs. If the step chains have not previously been installed, this work can be done after the skirt-guard brackets are set.

19. Satisfactory operation of an escalator depends to a great extent on proper installation of well made, free running step chains. To assure satisfactory chain operation the installing mechanic should make every effort to check the chains carefully and install them in a clean, well lubricated condition. The escalator should be clean before the chains are placed. A few lengths of clean plywood (4' x 8') should be laid at the lower landing. A rope fall is rigged above the top landing and the hook brought to the lower landing.

20. A section of chain with its axles is laid out on the plywood. The end is fed into the track system and the rope fall hooked onto the first axle. All wheels and links are inspected and corrective action taken if any fault is discovered. The chain assembly is pulled into the tracks. A second section of chain is connected to the last links just before they enter the tracks. Connecting links and pins are lubricated and tested for freedom of movement. All possible care is used to avoid chance of dirt getting on the chains.

21. As the first links reach the top they are tied in position with a manila rope sling until the rope-fall hitch can be transferred to a lower point. The chain then is continued around the upper drive and new sections added until the leading end reaches the lower tension carriage.

22. The tension carriage is placed as far toward the incline section as its tracks permit. The chain is passed around the carriage tracks and the final link made up at the lower landing. Tension is taken up on the carriage. Any chain guards required and not already in place are installed at top and bottom landings in accordance with company practice.

23. Some experienced mechanics use the machine to pull a rope sling that drags the step chains into place. This is a good procedure and is alternative to the basic system of using the rope fall.

24. The broken-chain switch and its cams can be set after the chain is in tension. The final position of the tension carriage is determined by the vertical rise of the escalator.

25. Steps consist essentially of frames with treads, risers, axles and wheels. Each step is supported or rides on four wheels and two sets of axles. The first set of these is the one installed with the step chain. The second set is shipped with the step assembly.

26. Certain steps have removable treads. These are spaced at regular intervals in accordance with company practice. The balance of steps have "fixed" treads.

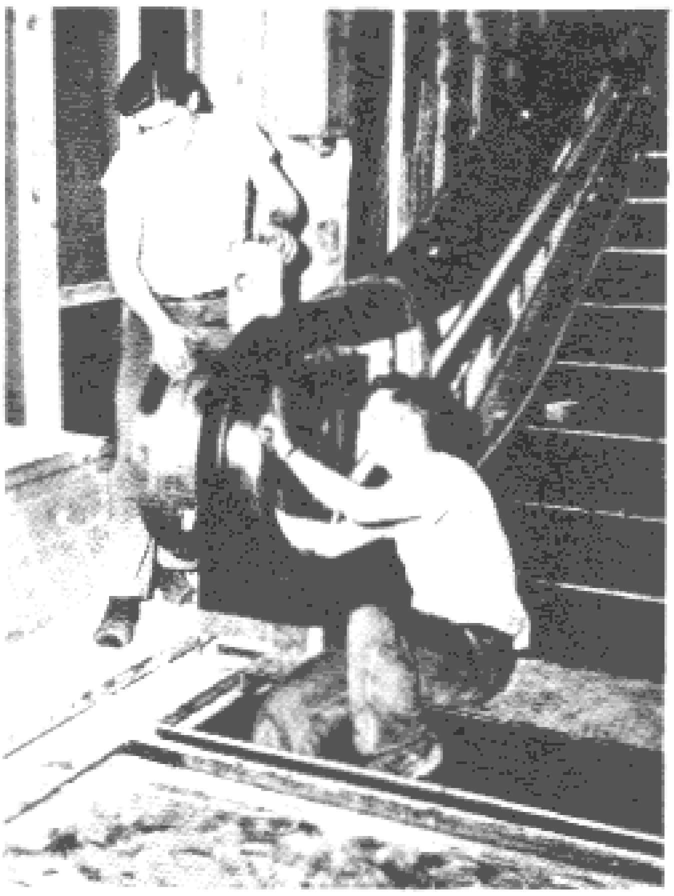
27. Before installation, each step assembly should be examined. If all parts are satisfactory, the work of step installation is begun.

28. Normally, steps are placed in the escalator at the bottom landing and the chains are moved down to permit installation of the next. As previously noted, steps with removable treads are put in line at specified intervals. The step or "trailer" wheels are rested on the lower track. Clamps or clips are provided with bushings arranged to be fastened to the long axle in the step chain. These bushings are tested for freedom of movement, lubricated and the step fastened in place.

29. This procedure is repeated until all but about 10 or 12 steps are installed. These are left out until skirt panels have been installed.

30. The comb plates can be installed after the steps have been placed and moved around the track system. Power should be available at this point, if it has not been earlier, so the steps can be checked under "inching" operation. Floor plates should be installed and the motor-room hinged hatch cover adjusted.

31. One piece handrails are installed comparatively easily. The handrail is unrolled on the escalator but special care must be taken to prevent sliding on sharp step edges or on dirt. Because of this it is advisable to use more than two men for this particular operation. The upper part of the handrail is laid over its drive sheave and the lower newel idler-sheave. The rail is then worked onto the handrail guide from the top drive sheave to the lower newel. The lower part of the handrail is then lifted into position and placed on the tension device and into the balustrade area.



This Picture Shows Skirt Guards and Steps in Place—The Main-Line Switch is Open!

32. When both handrails are installed and the escalator is running, the tension is adjusted so that the rails travel at the same speed as the steps. (Some designs omit tension devices.) A test is made to determine if the tension is excessive by stationing a man at the top landing. The average mechanic should be able to stall a "down" traveling handrail with moderate effort. Excessive tension can cause needless wear and may deform the handrail.

33. Skirt-guard panels can be installed at any convenient time after some steps are in. (Company field practices and design determine the time that this work should be done.) They are fastened to their brackets from the inside so as to present a smooth surface at the step side.

34. To begin skirt guard installation it is general practice to move the steps so the open areas (i.e., without steps) are near the top newels, to permit installation of the top skirt panels. The curved pieces just below the upper landing are the next installed. The steps are rotated so the clearance from step sides to the skirt panels can be measured and adjusted. The lower newel skirt panels and the curved sections above them are set next. The inclined section skirt panels on both sides are then installed, one after another. The last section on each side is deliberately supplied too long. It must be cut in the field. This cut must be very carefully laid out and made. New men should not fit these joints unless under direction of the superintendent.

35. Skirt panels are set to a fixed height that is usually measured from the chain wheel track or some similar constant. It is emphasized that the joints must be well aligned, both for appearance and safety.

36. The comb ''kick plates'' are installed last. They butt against the comb or newel skirt panel and the wall or panel adjacent to the outside of the escalator balustrade.

37. Most escalators have lubricator devices for sheave bearings, step chains, drive chains and other parts. They must be installed before the escalator is closed in completely. Each company must issue instructions regarding the time at which these devices should be installed. All necessary points should be lubricated.

38. Handrail guards can be installed when convenient, after the handrails are in place. It is advisable to rotate the handrails and check the clearances to the guard for the entire run of the handrail. The guards are made in many designs from various types of materials. Some of these guards are equipped with pressure type safety switches which operate to stop the escalator when pressure exceeds a specific amount.

CHAPTER 15
Section -c5

ESCALATORS

Test, Adjustments and Installation of Final Parts

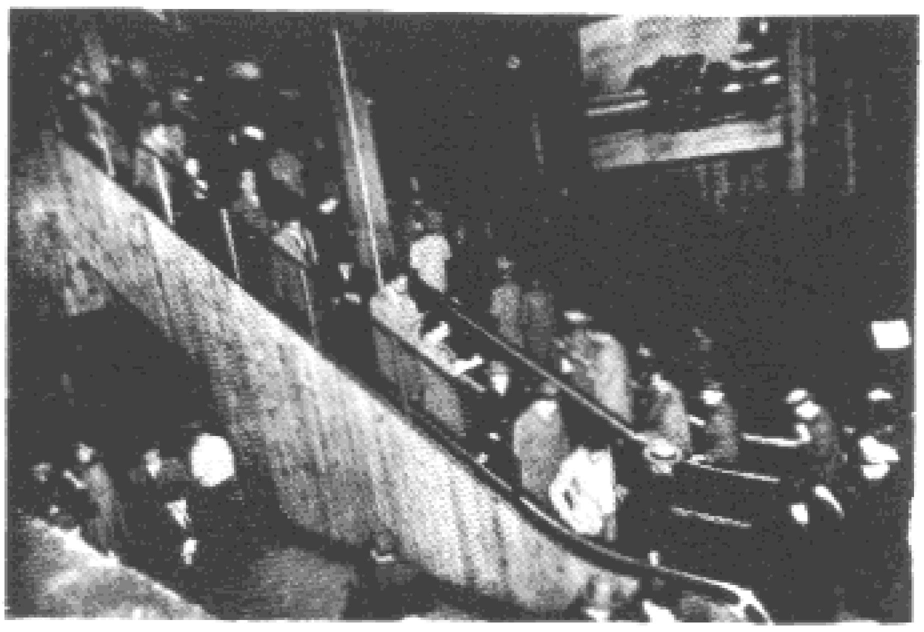
Suggested:

Materials –
- a. balustrade interior panels
- b. sundries

Tools –
- a. gauges
- b. regular tool kit
- c. ammeter
- d. voltmeter
- e. tachometer, other adjusting and testing tools
- f. fine files
- g. hack-saws
- h. grinders, cleaning and polishing materials

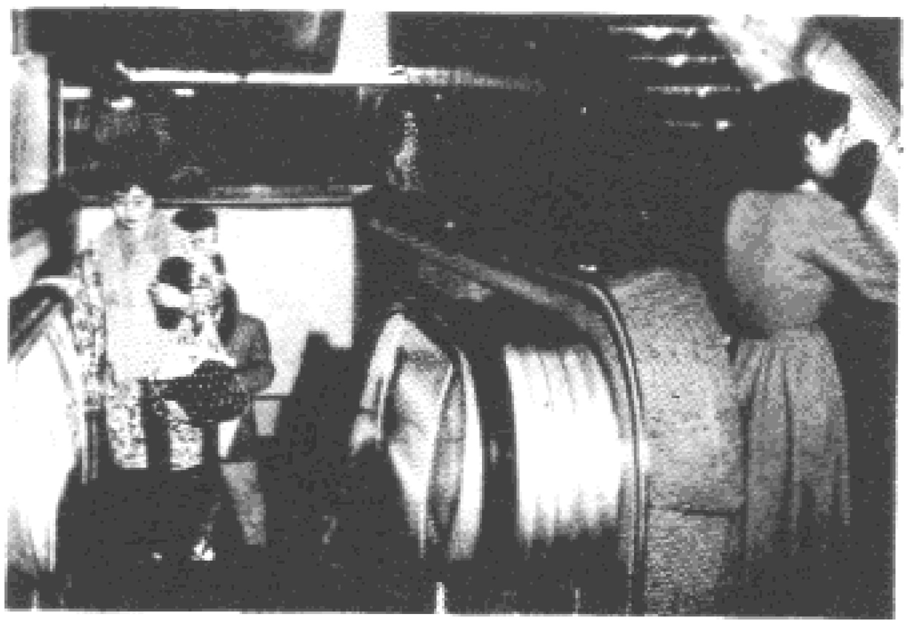
1. Certain parts of the escalator are left accessible until a final inspection is made of all work previously done and until the equipment is adjusted. The sequence of inspection, tests and adjustments are subject to company practices and local code regulations. It is obvious that all safety features should be tested and adjustments made, if required. These would include governor, stop buttons and switches. Speed should be checked. Most authorities will accept a ''tach'' reading of handrail speed as equivalent to step speed. Wiring, fuses and circuit breakers are examined. All mechanical parts are given at least a visual check.

2. Adjustments would include controller switch timing and contact adjustment, setting of overload or circuit breaker operation points, machine brake and/or pawl brake adjustments, gear alignment test, tension device spring setting, adjusting handrail tension and other items. Voltage and amperage readings are taken and settings adjusted.



Escalators are Popular in New York ——

3. Some companies practices require this work to be done by the installing mechanic under the super's direction. Others have special teams of "adjustors" or "inspectors" who do the work. Most cities and many other localities require a governmental inspection of completed escalators. The superintendent advises and instructs the mechanic when these "code" inspections are to be made.



—— In Tokyo and Around the World!

4. It is relatively unimportant whether a company elects to have its own inspection work done by the mechanic or by special men. The really important point is that the super and mechanic should be satisfied that all work is properly completed before the escalator is completely closed in. Rework at a later date may require otherwise unnecessary removal of interior panels or steps.

5. After inspection and adjustment work is completed, any steps previously left out should be installed. The last step to be installed must have removable threads.

6. Interior panels, like decking, are ornamental. They must be handled carefully and fitted very accurately. The newel sections are installed first, then the inclined panels, working from the bottom up. The last (top) panel on each side of the incline is often supplied with enough excess length so it must be marked, cut and fitted in the field. This permits the mechanic to overcome any slight discrepancies between layout, manufacturing and field conditions.

7. Some panels are held in place with mouldings, which may be flat or rounded strips. These in turn may be held in place by screws with oval or non-protruding heads. After panel installation, all work should be examined and rough edges or screw heads dressed. Any part that might catch a passenger's clothing or hands must be smoothed.

8. It should be strongly emphasized that the cutting and fitting of such architectural material as decking, skirt guards and interior panels should not be attempted by inexperienced mechanics except under the direction of the super. Generally, a mechanic is specially trained to do this work. This is very important since the parts for the expensively finished architectural portions of the escalator are usually made to special order. Spoilage could require total replacement of a component and might impose a delay on completion greater than the total time anticipated for installation of the entire escalator. Finish colors are often difficult to match on individual parts and could cause further delay.

9. If not previously set, the "ceiling" guard must be installed if the layout requires it (i.e., if the intersection of the outside balustrade deck board with the ceiling is less than twenty-four inches from the center line of the handrail).

10. Once all the physical work of installing the escalator is completed, the ornamental work should be cleaned. Due to the number of types of materials used on panels and decking, there is no general rule for cleaning. Certain materials require special handling to avoid stains or permanent damage. Before attempting to use any cleaners or solvents on panels and decks, get full instructions from the manufacturer and follow them.

11. After all work is completed, the mechanic or super demonstrates the escalator to the owner or his representative. A written "acceptance" should be obtained before any passenger is permitted to use the equipment. The form of acceptance should follow standard practice of the elevator company. Generally, the owner's attention is called to the satisfactory condition of the architectural finishes, step treads and comb plates, so the escalator contractor is acknowledged to have turned over a unit that is in good condition.

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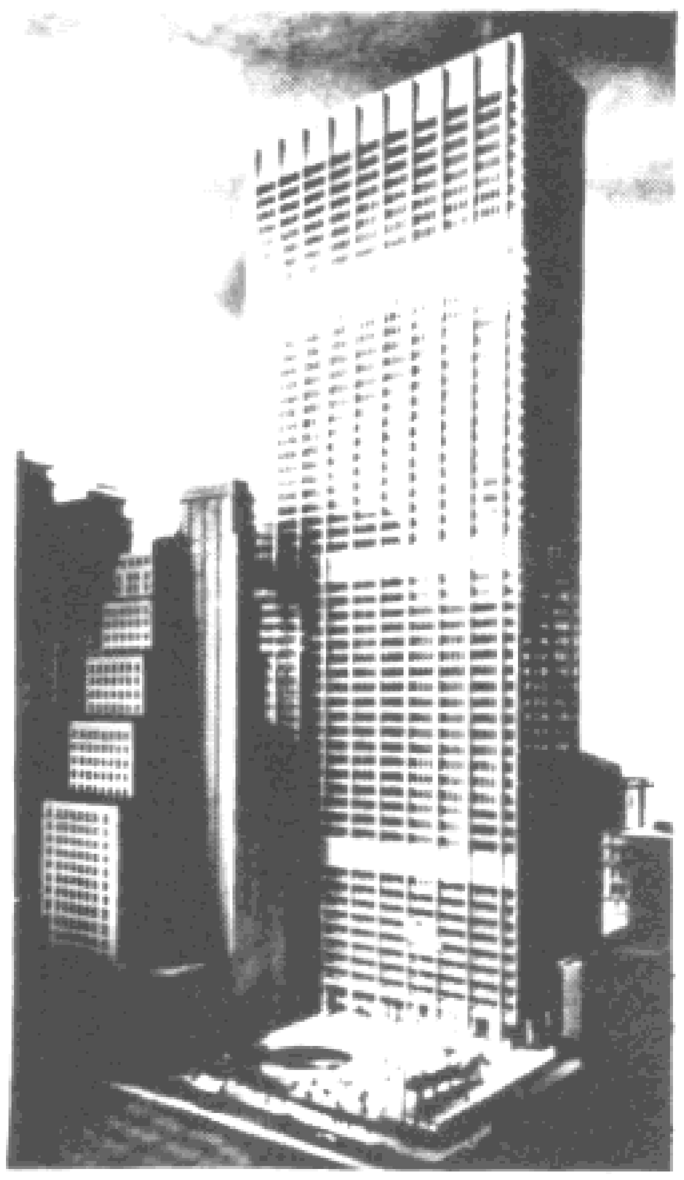

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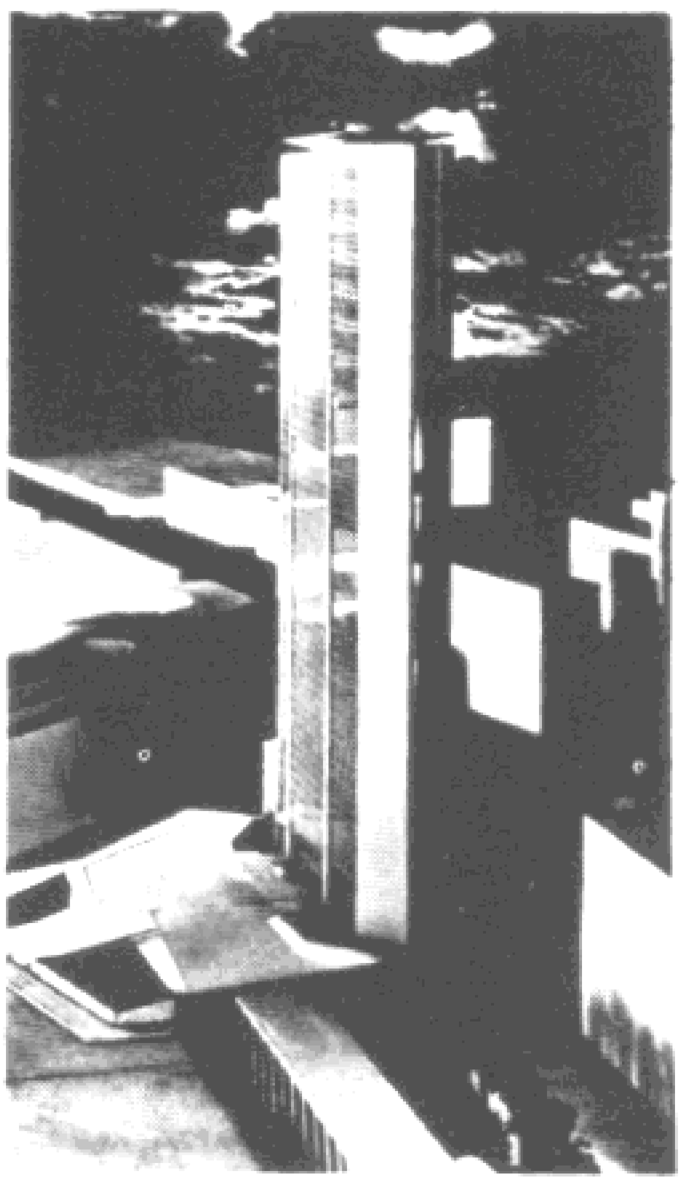

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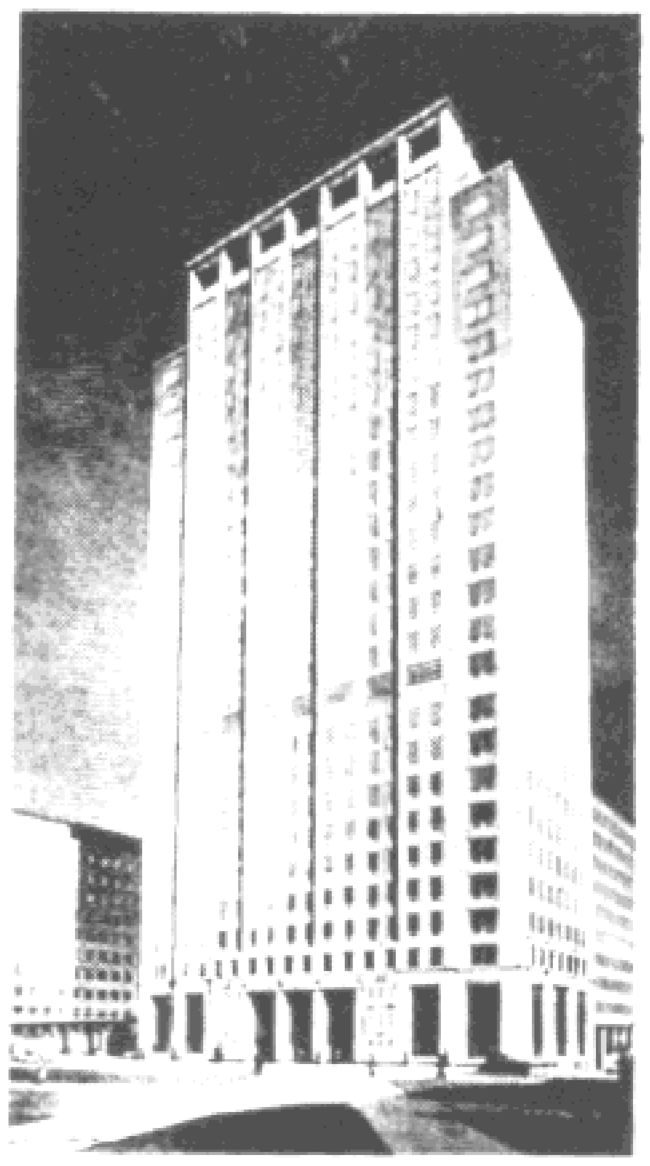

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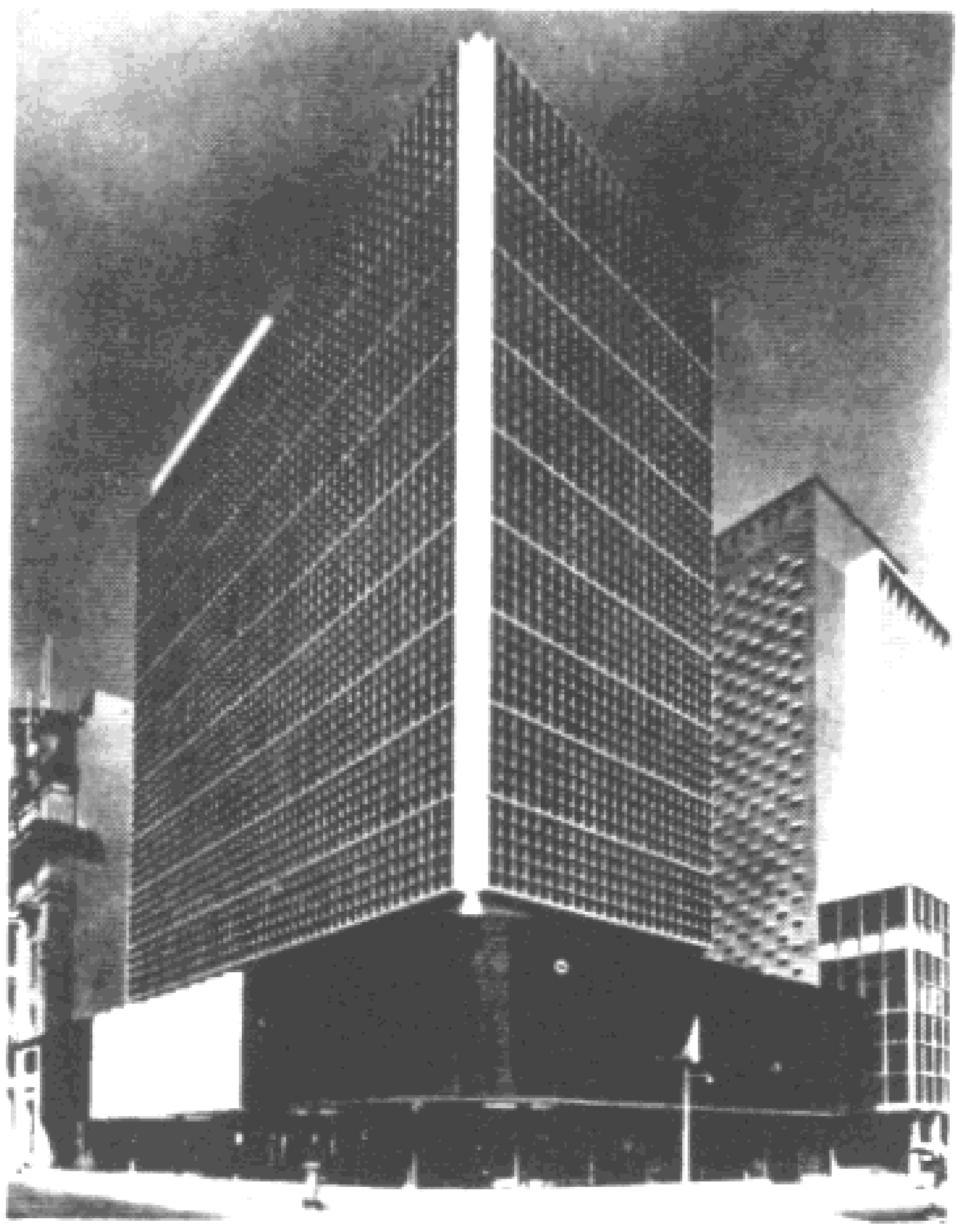


Singapore

Elevators Make These Buildings Practical

CHAPTER 16
Section -a1

THE ELEVATOR INDUSTRY

1. Human nature being what it is, most of us fall into the belief that the work we are doing is the most important part of the job or industry in which we are engaged. This is undoubtedly a good thing from the philosophical standpoint. It builds a man's pride in his work and tends to lift the status of daily work from just a job to the plane of craftsmanship.

2. We elevator constructors do have a good trade, one that is respected and which demands increasing skills and techniques so that we can fully exploit the advantages offered by new engineering and materials.

3. However, we must recognize that our functions as elevator constructors are not unrelated to other work but are a part of a team operation. Many people eventually become involved in the over-all sale, manufacture, installation and servicing of an elevator. Extending this to the ultimate we could say that the men who mine the copper and iron ore, as well as those who made the miner's chisels, are beneficiaries of the sale of each elevator.

4. This article is not to be considered ambitious enough to attempt to describe the infinite effect on society of the activities of our elevator salesmen. The object of this chapter is to briefly outline some of the operational groups within our industry structure that become involved in each elevator or escalator contract. It will also describe a few of the more important functions as related to negotiation and contract processing. A flow chart and typical organization tables are included to illustrate the operations schematically.

5. It has been stated that the armies of the Napoleonic era moved on their stomachs. Anyone who has had an Armed Forces "I.D." card in recent years could be excused, if he believed modern armies move on loads and loads of paper. There seem to be forms for every action and it often appears that twelve is the minimum number of copies required for each.

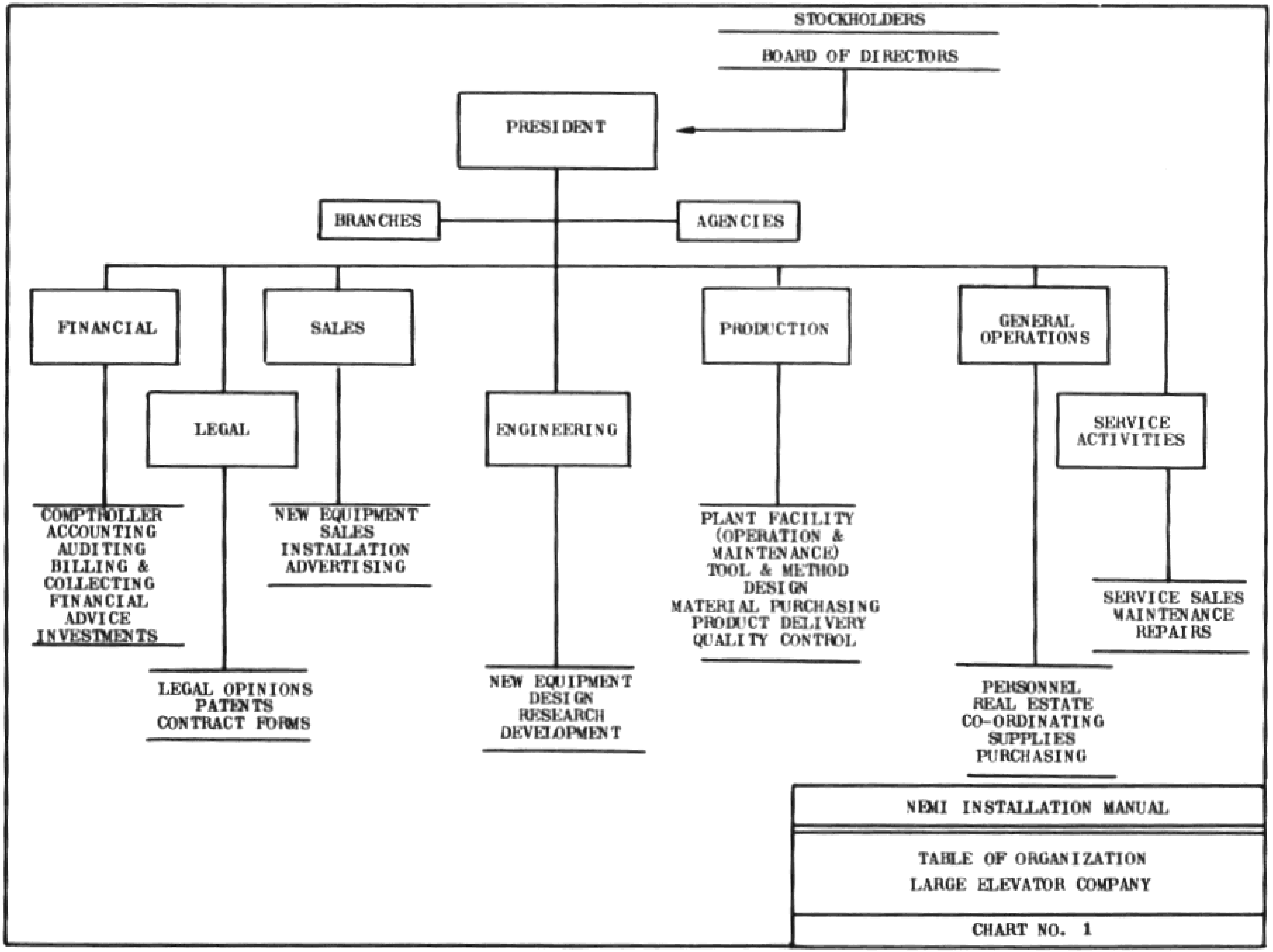
6. While business organizations may not require paper work to the extent facetiously attributed to the armies, "paper work" is important and necessary. It establishes what equipment is offered for sale, what contract terms are established and, also, it details information for manufacturing, installing and servicing the equipment, as well as many other functions, such as transmission of billing, receipt of payments and, most directly important to us, means of paying wages and salaries.

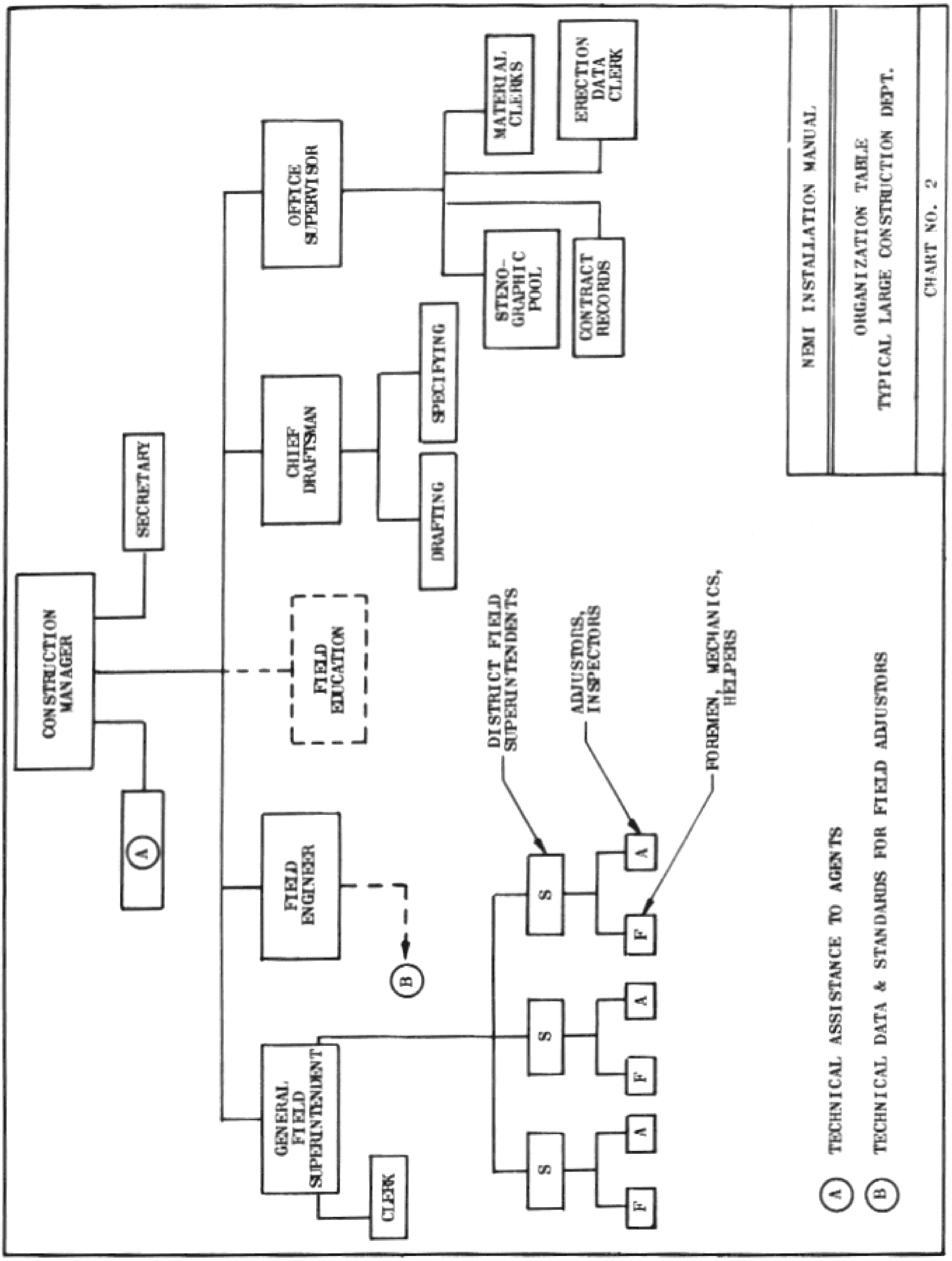
7. Once we concede the need for "paper" in our work and proceed with the assumption that an elevator manufacturing company is in existence, we can review some of the many steps that each form a part of the elevator contract. The first is the structure of an elevator company.

8. An elevator company may consist of only a manager, a small staff, and field men, using other firms to supply components. It may also be a division or branch of a larger corporation and have its own officers, staff, office, manufacturing and field employees. Another form could be an entirely independent incorporated concern with a president, board of directors and management staff in addition to office, factory and field men. Our industry today includes numerous variations of these forms. Chart 1 illustrates an organization chart for a company similar to that last described. Chart 2 outlines a construction department.

9. Regardless of their size and organizational structure, all types of companies must perform certain items of work in order to complete an elevator contract. Roughly, this work is to establish company policies, design equipment, advertise and sell it and then arrange for manufacture and installation of it. Installation or "construction" is an extension of the sales function, just as engineering is an instrument to convert policy into product design. Certain elevator components can be made in advance and stocked, while others are made to suit layout conditions. All of these components must be manufactured, therefore, a productive or manufacturing procedure is required. Before factory or shop manufacturing to a design can be started, raw materials must be obtained, so a capacity for purchasing is needed. Finished products must be sent to jobsites by a "shipping" group. Legal counsel is required throughout all operations to assure that the company is protected against patent infringement problems, adverse contract conditions and various liabilities. Specific accounting personnel have numerous duties beyond recording and billing. These extend from detailed advices on practical bookkeeping coordination for all other departments, to financial and procedural recommendations to management staff and company officers. Service operations represent a further extension of company policy and often are carried on as an almost independent branch of the elevator company. Service performance can have a very strong impact on a company's reputation and thus be influential in the successful procurement of new sales contracts.

10. Although all elevator sales companies must, of necessity, involve themselves in all of the functions mentioned, it does not hold that they must perform the work directly. Many companies have limited facilities and assign the work of manufacturing parts to sub-contractors. These parts may be only toggle switches for car light circuits, or may include major components of the elevator such as machines, controllers, car enclosures and hoistway entrances. All elevator sales companies do some sub-contracting. The extent to which sub-contracting is utilized depends on many circumstances; such as amount and type of factory facilities (if any), special equipment design and its volume, and availability of suitable commercial items to satisfactorily perform certain functions. The most important point involved is that an elevator company assumes specific responsibilities when it makes a contract with a customer and the decision as to how and to whom those responsibilities will be delegated is a function of the company management. Thus, if elevator sales company "X" purchases a gearless machine from an electrical manufacturer and installs it as a part of its elevator, this machine becomes a component of the "X" elevator company equipment.


STOCKHOLDERS
BOARD OF DIRECTORS
PRESIDENT
BRANCHES
AGENCIES
FINANCIAL
LEGAL
SALES
ENGINEERING
PRODUCTION
GENERAL OPERATIONS
SERVICE ACTIVITIES
COMPTROLLER
ACCOUNTING
AUDITING
BILLING & COLLECTING
FINANCIAL ADVICE
INVESTMENTS
LEGAL OPINIONS
PATENTS
CONTRACT FORMS
NEW EQUIPMENT SALES
INSTALLATION
ADVERTISING
NEW EQUIPMENT DESIGN
RESEARCH
DEVELOPMENT
PLANT FACILITY
(OPERATION & MAINTENANCE)
TOOL & METHOD DESIGN
MATERIAL PURCHASING
PRODUCT DELIVERY
QUALITY CONTROL
PERSONNEL
REAL ESTATE
CO-ORDINATING
SUPPLIES
PURCHASING
SERVICE SALES
MAINTENANCE
REPAIRS
NEMI INSTALLATION MANUAL
TABLE OF ORGANIZATION
LARGE ELEVATOR COMPANY
CHART NO. 1


CONSTRUCTION MANAGER
SECRETARY
A
FIELD EDUCATION
GENERAL FIELD SUPERINTENDENT
CLERK
FIELD ENGINEER
B
CHIEF DRAFTSMAN
DRAFTING
SPECIFYING
OFFICE SUPERVISOR
STENO-GRAPHIC POOL
CONTRACT RECORDS
MATERIAL CLERKS
ERECTION DATA CLERK
S
S
S
F
A
F
A
F
A
DISTRICT FIELD SUPERINTENDENTS
ADJUSTORS, INSPECTORS
FOREMEN, MECHANICS, HELPERS
A TECHNICAL ASSISTANCE TO AGENTS
B TECHNICAL DATA & STANDARDS FOR FIELD ADJUSTORS
NEMI INSTALLATION MANUAL
ORGANIZATION TABLE
TYPICAL LARGE CONSTRUCTION DEPT.
CHART NO. 2

11. The parts of an elevator that are obtained by means of purchase (or subcontract) are ordered to specifications of the elevator company. The "specs" may be lengthy, formal documents or may be simple order forms which refer to only the manufacturer's stock or part number.

12. It can be seen from the foregoing paragraphs that companies operating in a manner similar to the "X" elevator company must be basically responsible for the application of the chosen designs, and performance of components but that they delegate the actual work of making the parts to others.

13. Contract handling routine is another phase of the elevator business and is the one in which we construction men are directly involved. The sales manager has direct responsibility in this from the negotiation stage to the completed installation. He is the man whom the customer recognizes as the authority. Portions of his duties may be delegated to others in large organizations, such as to a construction manager.

14. The steps in obtaining and processing a contract are approximately as follows:

a) The sales department and management place a line of elevator equipment on the market, advertising it by letters, personal visits to potential customers and formal trade paper releases. A customer becomes interested and sales enters preliminary negotiations.

b) A "typical" sketch or preliminary layout is made and submitted to the customer and architect. The layout is often made by the construction draftsman. It includes sales recommendations for car sizes, speeds, control types and general arrangement. Door and car designs are given.

c) Once the basic details are established, the sales department "prices" the job. (Major contracts are reviewed with top management.) The competitive position is considered.

d) After a contract is received, sales obtains owners approval of layout conditions, ornamental finishes, and other items. The layout is made "final" and contract processing begins.

e) Sales advises management and accounting that a contract has been made and a number assigned. Accounting "books" this contract and thus establishes means for charging costs and issuing billing.

f) Construction is given final layouts. The superintendent sets up a construction record of the contract. Arrangements are made to check the jobsite at necessary intervals and coordinate elevator work with the general contractor and other trades. The starting and completion dates of the contract are planned and a work schedule established. Rails and brackets are specified and ordered from the layout. Wiring material is also planned and ordered. Tooling and manpower requirements are planned. Special job requirements are studied and necessary action taken.

g) At an appropriate time during contract processing, sales gets the engineering department's assistance on any ''special'' features, if required.

h) Sales department also provides the manufacturing or production facility with orders to make the elevator components. This may become a set of routine orders to the company's factory or may instead be a number of orders to sub-contractors. The production staff must first learn what equipment is wanted and the proposed delivery dates, then determine if the factory can manufacture to meet those dates. This may require a lot of research when subcontracting if several factories are involved. Adjustments of delivery dates often must be made to the best date acceptable to customer and factories.

i) Once the sources of supply or factories have been selected, production schedules the contract, or ''puts the job in the slot.'' Routine follow-ups are made during the manufacturing period to assure conformance with delivery dates. Purchases of sundry items, ropes, lubricants, and other components made to insure a consolidated shipment of the elevator equipment and to avoid long storage of pre-delivered parts. Shipping arrangements are made. Details of special designs must be worked out with sales and engineering early enough to permit meeting shipping schedules.

j) Tentative and final shipping dates are confirmed to construction by a production or factory group. The superintendent checks the jobsite to be sure it is ready and then assigns field men to be at the job to receive materials and tools. Any building delays are reported to the production department to avoid premature shipments.

k) When material is delivered, construction field work proceeds.

l) Accounting is advised of shipments and of field work progress so billing can be made in accordance with contract terms. Factory and vendor billing is processed and forwarded to accounting for payment. Field time-tickets and sundry costs are approved by the construction super, then passed through channels to the accounting so payrolls can be met on time.

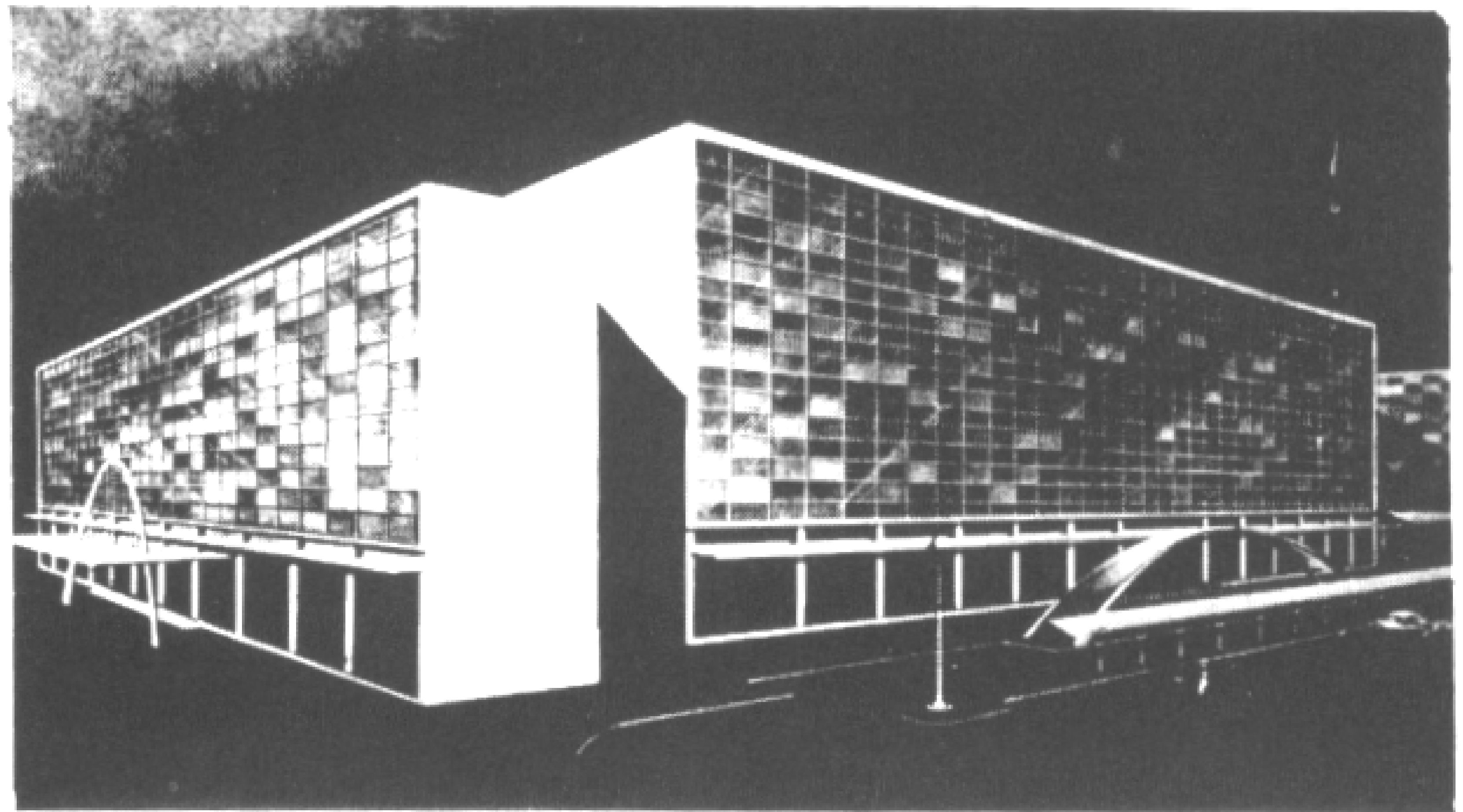
m) All departments from sales to service may become involved, if contract changes are required by the customer. These changes may range from only an additional hall sign at some lobby location to the major revisions in the control system. Delays in field work may also involve all departments, regardless of who is responsible for the delays.

n) During the installation phase and before contract completion, the sales or construction staff generally introduce the service sales representative to the customer. On major contracts this contact is made at an early date. Negotiations are begun for service or maintenance contracts or for sale of spare parts and lubricants.

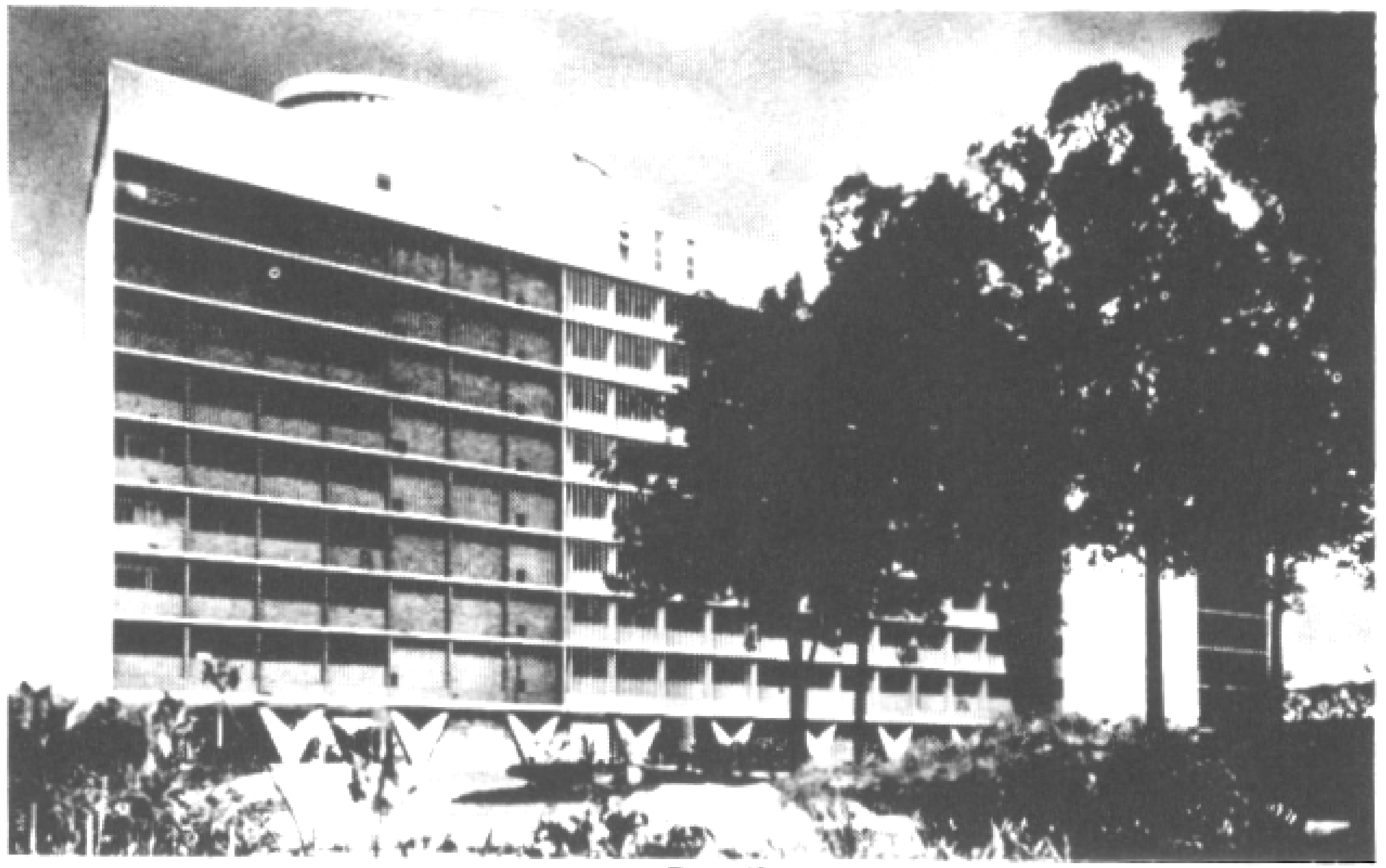
o) When the elevator has been completely installed and adjusted, the salesman and/or construction super inspect the job with the owner. He is asked to sign an acceptance letter or form to indicate that the elevator meets contract specifications.

Japan

Australia



Kuwait



Brazil

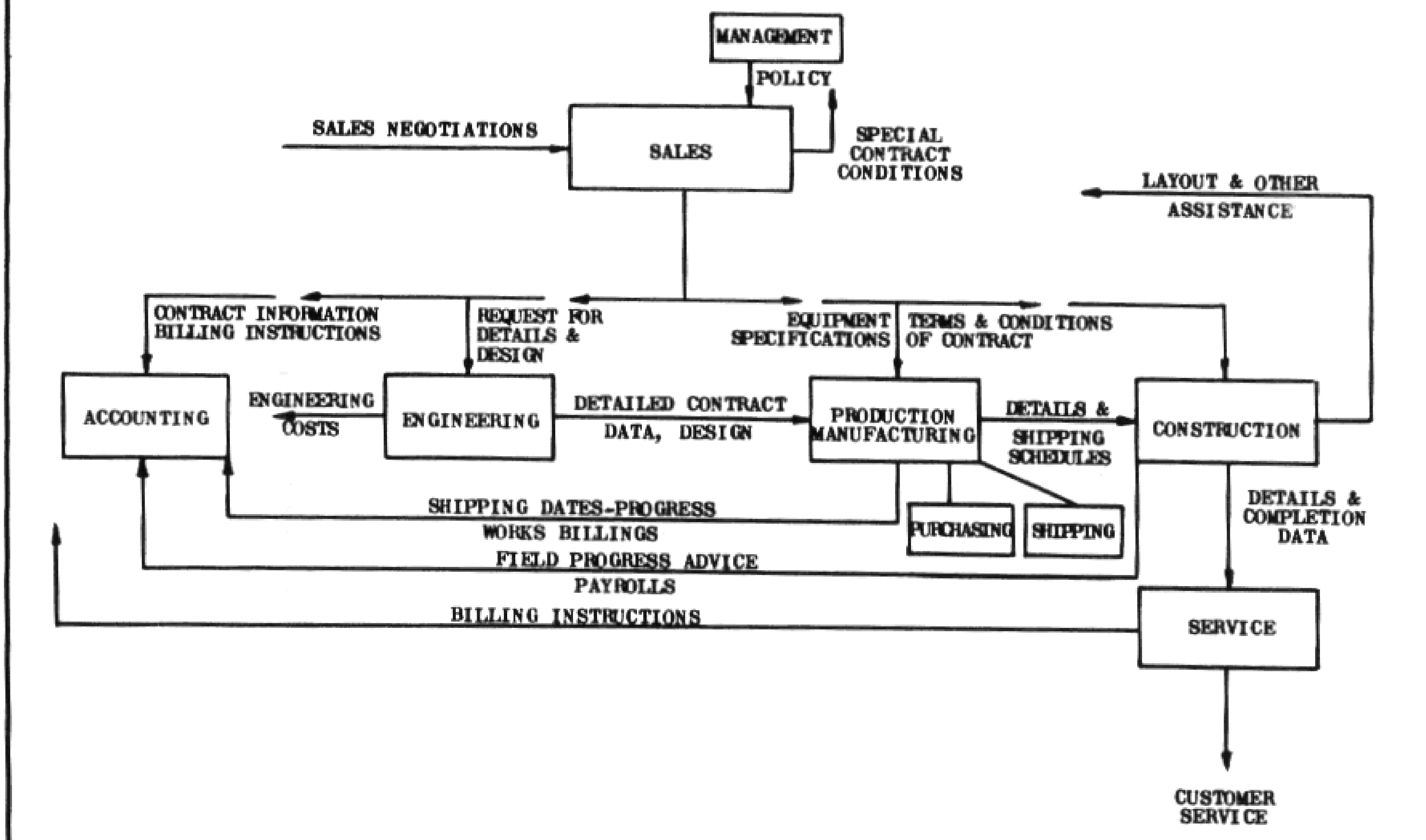
American Designed Elevators Serve These Buildings

p) The period of ''free'' or contract supplied service begins when construction advises the accounting and service departments that the owner has accepted the elevator.

q) Construction also provides the information on completion to management. Final billing is made as indicated by the contract terms and after bills are received and paid, accouting ''closes'' the sales contract. This completes the basic sales contract but normally a ''sales'' guarantee is given to the customer. This may require accounting action, crediting or establishing a special reserve account. Other departments such as engineering, sales, production, construction and service may all become involved, if need for action develops.

r) The second distinct phase of elevator contract business begins with the service department handling of the customer. This relationship continues for the life of the equipment. The service department may call on any or all other departments to assist it in modernization, alteration, or in other unusual situations.

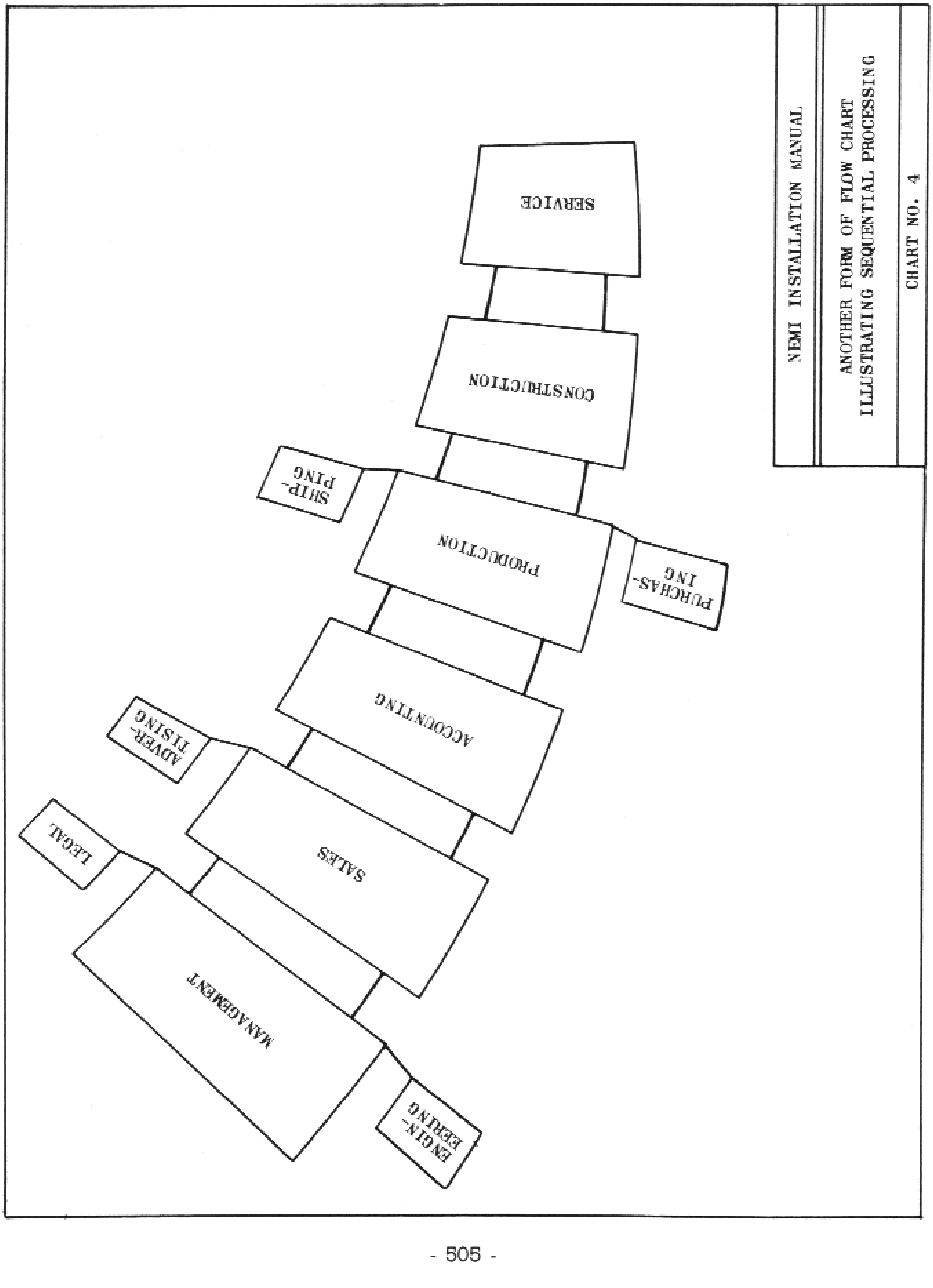
s) The association of the accounting department with the customer continues through periodic billings. Thus accounting becomes the department with the longest time of contact with any owner of an elevator. This, in brief, is the outline of activities in the elevator industry. The details vary widely, of course, but as indicated in earlier paragraphs, all of the work must be covered, regardless of the size of the company. One man may wear many hats or a number may share the same hat. Charts 3 and 4 outline the flow of work from sales to completed elevators, ready to go under service.



NEMI INSTALLATION MANUAL

CONTRACT PROCESSING FLOW-CHART
TO ILLUSTRATE INTERLOCKING NATURE
OF DEPARTMENTAL ACTIVITIES

CHART NO. 3


NEMI INSTALLATION MANUAL
ANOTHER FORM OF FLOW CHART ILLUSTRATING SEQUENTIAL PROCESSING
CHART NO. 4
SERVICE
CONSTRUCTION
SHIP-PING
PRODUCTION
PURCHAS-ING
ACCOUNTING
ADVER-TISING
SALES
LEGAL
MANAGEMENT
ENGIN-EERING