GENERAL INFORMATION AND SPECIFICATIONS
FOR ROEBLING T-BAR SKI LIFTS
AND ROEBLING CHAIR LIFTS

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GENERAL INFORMATION

Introduction

A successful and profitable ski lift installation depends to a great extent upon the initial planning - before any purchase agreement is signed or before any grading is done or lift location is fixed. Too often one is overwhelmed with reams of data concerning length, rise, speed, capacity, etc., and not sufficiently informed as to just why a certain type of lift, a certain type of towing outfit, or a certain type of drive might mean the difference between a profitable and successful installation or one that will be a headache for years to come.

The purpose of this manual is to present the basic types of lifts manufactured by John A. Roebling's Sons Division of The Colorado Fuel and Iron Corporation. Variations of these basic types are shown, the hows and whys of the basic components, and the fundamental requirements of the actual lift site which must be provided.

Roebling manufactures three basic types of lifts. Each type has variations. There are specific applications where one particular type will best meet the intended purposes on both physical and economical counts. In addition to the basic types, Roebling is constantly developing new features and components so that even greater practical capacities as well as simpler operation and reduced maintenance may be realized. Also, they are constantly being expanded to provide a wider choice of rugged, dependable lifts to serve the range of requirements from the small open slope to the most rugged mountain. The three basic types are:

1. T-Bar Lift
2. Chair Lift
3. Passengar Car Cableway

These are illustrated in Figure 1. The T-Bar Lift and Chair Lift are offsprings of the industrial, monocable tramway, which was first introduced in America by Roebling more than three quarters of a century ago. The Passenger Car Cableway is a variation of the many types of industrial cableways which Roebling has designed and installed throughout the world for nearly a century.

Specific problems in this entire field are welcomed by Roebling and attention will be given to all inquiries. Roebling's high standard of quality is incorporated in each lift and the use of standard and locally available components assures economical operation.

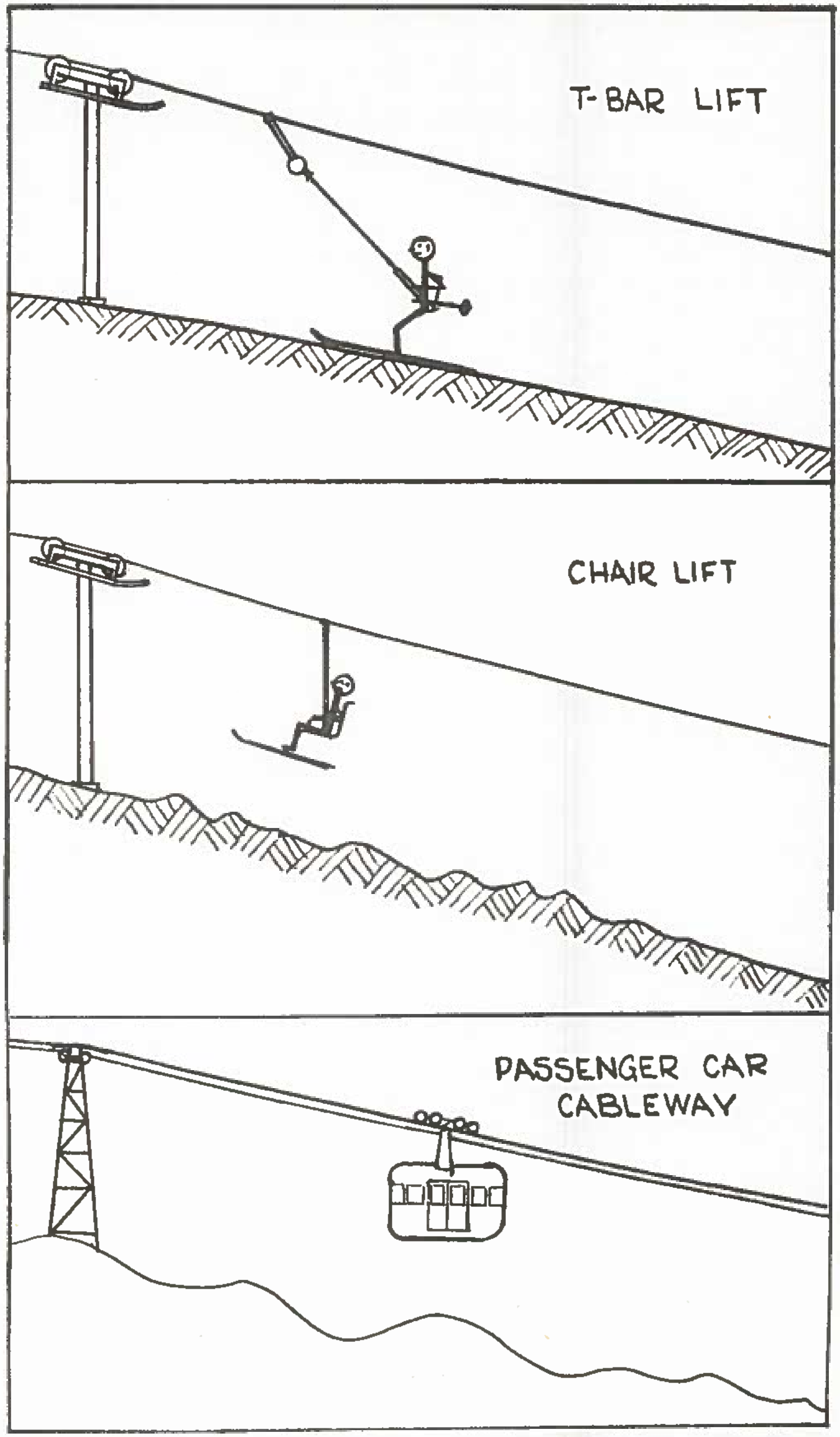

FIGURE 1 – BASIC TYPES OF LIFTS

T-Bar Lifts

In order to furnish the ski area operator with a high capacity, low first cost, uphill transportation system, Roebling has developed a rugged and dependable T-bar lift. The name "T-Bar" stems from the towing device, which is shaped like an inverted "T". It propels the skiers up the lift two at a time, one on each side of the stem of the "T". Actually, the action of the inverted "T" pushes the skier up the slope. (See Figure 2.) Roebling has pioneered in the development of the T-Bar Lift in the eastern United States. The first installations were made prior to World War II.

The basic components of the T-Bar Lift are as follows:

1. Main Hauling Rope
2. Terminals (2)
3. Line Towers
4. Towing Outfits
5. Safety System

The principle of operation is actually very simple: The main hauling rope (often called "cable") is spliced endless and extends from terminal to terminal. It goes around horizontal sheaves (wheels) at the terminals and is supported at the line towers on smaller sheaves. Attached to the main hauling rope are towing outfits which circulate around the lift continuously. The skiers load at the lower terminal, are propelled up the hill, and unload near the upper terminal. Then, empty towing outfits turn about the upper terminal, return down thehill, turn about the lower terminal, and pick up skiers again. These towing outfits are spaced to allow sufficient time for skiers to get into position to be started up the slope, assuring a continuous line of skiers, two by two, going up the lift. The safety system stops the lift if something happens which might endanger life or property (i.e., a skier failing to unload at the proper place).

I. Main Hauling Rope

The main hauling rope is Roebling wire rope, especially processed for lift usage. Spliced endless at installation, it has a strength at least five times greater than can ever be imposed upon it during normal operation. It is composed of many individual high strength wires, lubricated and constructed so that each wire shares the load. This is a "built-in" safety system in itself, since the failure of any individual wire, or even of several wires, reduces the strength only slightly. It also provides adequate warning of need for replacement, well in advance of any total failure, or need for an immediate shut-down. The life of this critical component of the lift depends upon the way the rest of the lift and the operator treat it. The number of line sheaves that it must bend over, the size of these sheaves, the amount of bend over the sheaves, the way the rope was handled at installation, the type of splice and the skill of the splicer, the frequency and care of lubrication, and many other factors all combine to determine just how frequently this "backbone" of the lift must be replaced. Sound engineering, based upon years of experience, is incorporated in the design of every Roebling Lift. The result is one which "treats the rope right" and gives the owner the maximum "mileage". Unfortunately, when basic rope standards are sometimes ignored in the design and sheaves are too small or are overloaded, the owner does not discover the true cost of what he thought was an initial economy until he is faced with repeated rope replacements.

II. Terminals

The terminals are located at the ends of the lift. They serve as a "turn-around" for the main hauling rope, with its towing outfits. Large diameter sheaves, called terminal sheaves, lined with a friction material, are mounted horizontally and do this job. The terminals have two additional jobs to do. First, one terminal must provide the power to make the main hauling rope circulate. This is accomplished by driving one of the terminal sheaves. The friction liner of this sheave grips the main hauling rope and prevents slippage. The second job is to keep the main hauling rope at the proper tension. By mounting one of the terminal sheaves on a carriage, which is in turn supported on rollers, this allows the terminal sheave to increase the length of the lift slightly. The carriage is fastened to wire ropes, which lead over stationary sheaves and are anchored to a suspended block of concrete or other weight. Gravity pulls on the block, keeping a constant pull on the main hauling rope. A "counterweight system" is its name. See Figure 3. Wire rope stretches and temperature and loads tend to cause the rope to change length. This means that sufficient travel of the counterweighted sheave must be provided for, or the owner will be faced with frequent resplicing jobs -- probably on a mid-February weekend. Should the counterweight system be eliminated and the main hauling rope not kept under uniform tension, loads on the tower sheave units will vary excessively, possibly to the extent that loads at certain points would become so light that the rope would not stay in the sheaves. The main hauling rope would sag between towers and slippage could occur at the drive sheave. Since this counterweight system actually "holdsback" one end of the lift, Roebling lifts all have dual counterweight ropes. Each is sufficiently strong to support three times its maximum anticipated load. Acting normally together, the two possess a safety factor of at least six.

With Roebling T-Bar Lifts, terminals may be arranged to suit local conditions. The drive and the counterweight may both be located at one terminal (either upper or lower) and the other terminal then becomes a simple "turn-around". One terminal may be counterweighted (again, either top or bottom) and the opposite end then becomes the drive terminal. Should space to unload at the top be at a premium, the probable best choice would be to make the lower terminal the drive and counterweight end, thus making the upper one a simple "turn-around" terminal. No firm set of rules govern the placement of terminals; however, Roebling has flexible designs to suit all conditions.

The type of power to operate the lift is flexible too. Electric motor, diesel or gasoline engines, or even hydraulic motors, operated remotely by pumps, are available. Direction of rotation of the lift can be clockwise or counterclockwise (when viewed looking down on the lift) to suit the local site conditions.

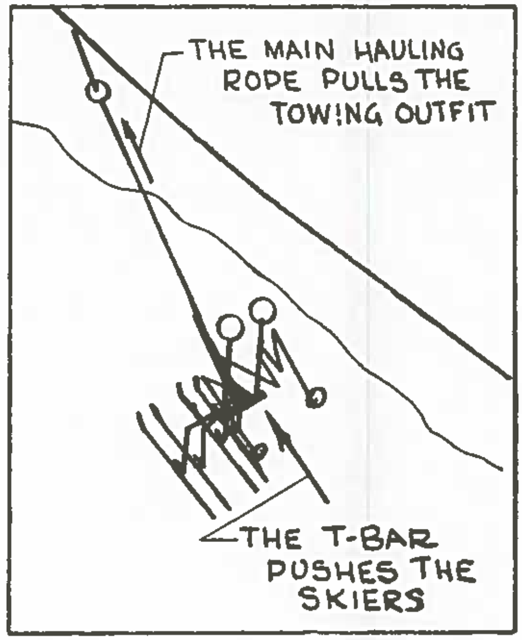

FIGURE 2

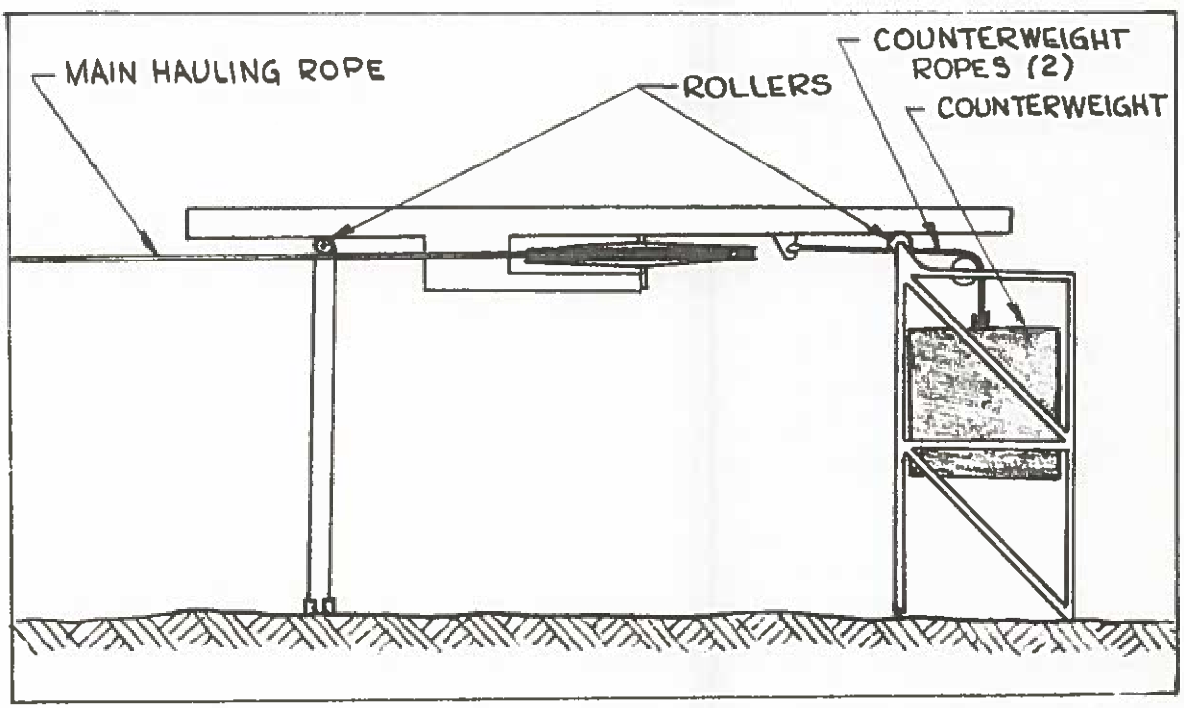

FIGURE 3 COUNTERWEIGHT SYSTEM

III. Line Towers

Between the two terminals the height of the main hauling rope above the ground must be kept between certain limits. It must not be so low as to interfere with the skiers going up the lift, nor allow the empty towing outfits to drag in the snow returning down the lift - nor must the rope be high enough to lift a skier above the snow. This is accomplished by carefully locating line towers along the lift line. At the top of these towers sheave units are placed to support the main hauling rope. Because at times the rope must be pulled down to conform with the contour of the lift, some sheave units are designed to allow the main hauling rope to run beneath the sheaves. Sheave units which hold the rope up are called "support units" and those which hold the rope down are called "depress units".

In addition to maintaining the proper height of the main hauling rope, the towers must be located so as not to impose excessive loads on the sheave units. Excessive loads will result in shortened life of both the sheaves and the main hauling rope. On Roebling lifts sheaves are always mounted in pairs, with a pivot between them so that each sheave shares the total rope load equally. This provides a "rocker" action which results in a smoother passage of the towing outfits over the towers. In addition to the two basic "support" and "depress" units, combinations are sometimes used. These consist of the basic unit of two sheaves with an additional single sheave mounted opposite the pair. They are used where the load, due to a fully loaded lift, might act in one direction (up or down), and the load with an empty lift would act in the opposite direction. Figure 4 illustrates various types of line sheave units.

Line sheaves are available with either a steel tread or a lined tread. The steel tread is more economical, both from the point of view of initial cost and maintenance costs. The lined treads, however, are quieter in operation. Improved main hauling rope life is realized with the lined treads, but not to the extent that it will offset the additional cost of tread replacements.

The correct placing of line towers is based upon engineering calculations referred to as "the line layout". An accurate survey of the lift line is required for these calculations, as well as the resulting location of the tower footings. This total picture is referred to as the "lift profile". Any inaccuracies in the profile will be reflected in the final lift operation and might require additional grading just at the time that the ground is frozen and the first ski crowds are beginning to assemble. Lifts have been "laid out" by eye, with adjustments to the height of the sheave units made after erection by trial and error. Often this results in several additional towers which careful initial design would have eliminated. When you consider that one tower has a minimum of four sheaves, eight bearings and two rocker bushings, you can see that you will have increased maintenance for the life of the lift.

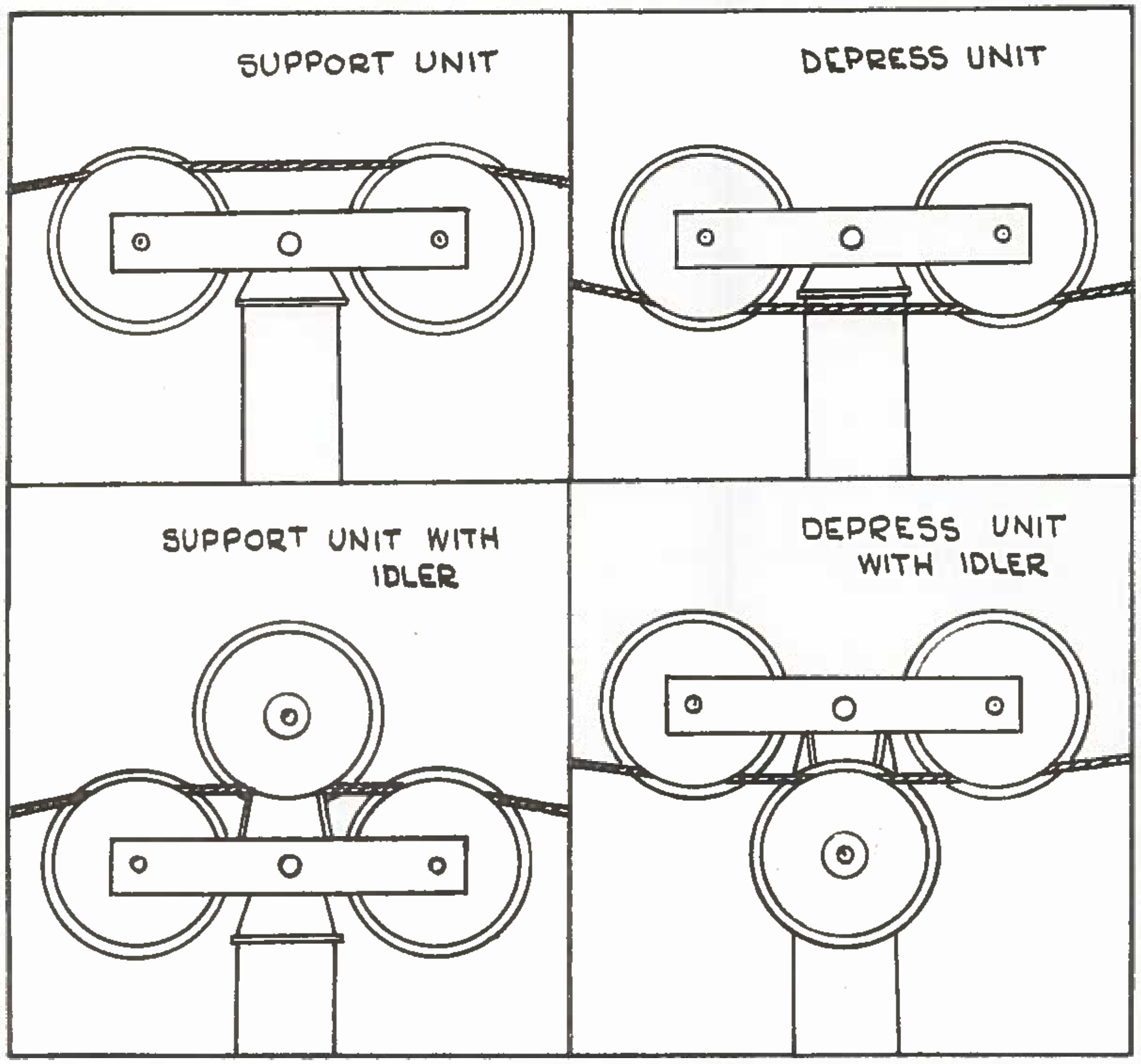

FIGURE 4 TYPICAL LINE SHEAVE UNITS

IV. Towing Outfits

Roebling has two basic types of towing outfits. One is called the "telescoping tube" and the other is called the "spring box". Both types are attached to the main hauling rope by the distinctive "Roebling Grip". This grip is unique in that the main hauling rope is not exposed to sharp edges for gripping. It need not be opened for insertion of the grip. The grip will resist all operational loads without slippage and yet, under extreme loads, will allow the rope to slip through the grip without damage to the rope. Probably no single lift component has caused more troubles for lift operators than rope grips. The present Roebling grip, developed after years of research, testing and field trials, is an effective answer to these problems.

The "telescoping tube" towing outfit consists of one tube telescoping within a second tube. Attached to the exterior tube is the "T" seat; to the interior tube the attachment to the rope grip. A spring within the two tubes keeps the tubes telescoped until a skier loads. The tube then extends and a pneumatic system working with the spring accelerates the skier(s). The total distance that the towing outfit extends is relatively short compared with the "spring box" type, requiring that the main hauling rope be kept within closer height limits and that the lift operate slower, since the distance to accelerate the skier is also shorter. However, lower initial cost and somewhat less maintenance make this type of towing outfit desirable for certain lifts where the terrain is relatively smooth and the variation of snow depth is small.

The "spring box" towing outfit consists of an enclosed box suspended below the main hauling rope. In it is a reel on which a small diameter wire rope is wound. Connected to the reel is a clock-type spring which keeps the towing rope in the reeled position. Attached to the opposite end is a "T" stick. This is pulled down, away from the box, for loading. The towing rope unreels from the box and a pneumatic brake, working with the clock spring, furnishes the necessary force required to smoothly accelerate skier(s). The skier(s) ride the lift to the top with the towing rope fully extended. Upon release of the "T" stick at the unloading station, the towing rope reels up, lifting the stick to the box for the return journey downhill. Due to the longer length of this type of towing outfit, more rugged terrain is acceptable, greater variations in snow depth can be tolerated and greater lift speeds may be realized. Figure 5 illustrates the variations in height between snow and the main hauling rope that may be tolerated by the two types of towing outfits.

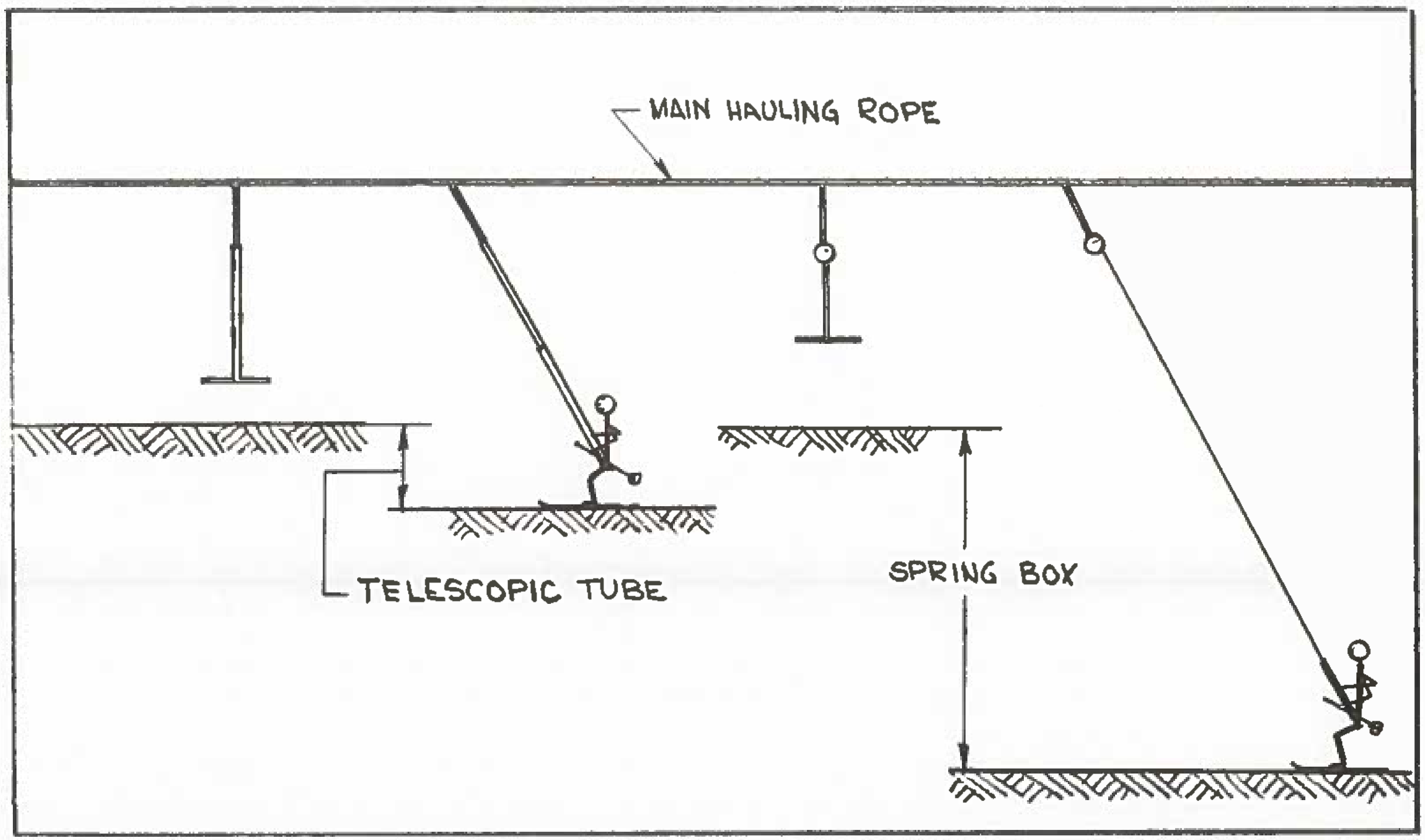

FIGURE 5 VARIATION IN DISTANCE - ROPE TO SNOW - FOR THE TWO BASIC TYPES OF TOWING OUTFITS.

V. Safety System

The safety system of the T-Bar Lift consists of an electrical system that must have all switches closed for the lift to operate. One switch is located at the loading station at the base of the lift. Here the attendant supervising the loading may stop the lift by opening a switch. Should a skier fall during the loading and become entangled with a towing outfit, a simple pressing of a button stops the lift. The second switch is located at the unloading station where the attendant supervising unloading can stop the lift in the same manner. The third switch operates automatically in case a skier fails to dismount at the designated area. The lift cannot be started again unless all three switches are closed. A device is located in the drive system that prevents the lift from moving backwards when stopped. This could easily occur should the lift be loaded with skiers and leave unhappy skiers scattered along the entire length of the lift. However, with the "backstop", the lift may be restarted with a fully loaded lift and not upset a single skier.

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One of the most important factors concerning a prospective lift is that of capacity. How many skiers per hour will this lift carry? Often the speed of the lift is judged to be a measure of the capacity. This is not so. The capacity of the lift is the number of skiers that may be successfully loaded in a given time. If the lift is correctly designed, it may be assumed that nearly all skiers will be loaded on each and every "T" stick. Then the capacity becomes simply the number of "T" sticks that pass the loading area within a given time multiplied by 2, since two skiers may ride each "T" stick. For example, a lift operating at 600 feet per minute may have 400 towing outfits pass the loading station in one hour. The resulting capacity is then 800 skiers per hour. The same lift, if designed to operate at only 300 feet per minute, but having twice the number of towing outfits, would still have 400 towing outfits pass the loading area in an hour. Thus, it has an identical capacity of 800 skiers per hour. In the example above the "T" sticks were spaced 90 feet apart when operating at 600 feet per minute, and 45 feet apart when operating at 300 feet per minute. However, the time interval between "T" sticks was the same (8 seconds). This is the time allowance for two skiers to move into loading position and is the basic factor for determining the maximum capacity that may be obtained. To achieve the higher capacities, the skiers must be organized so that a definite routine at the loading area exists and each pair of skiers moves properly.

The speed at which the lift should operate is, to a great extent, determined by the efficiency of the towing outfit in smoothly accelerating the skiers. If the speed of the lift is too great for the towing outfit to accelerate the novice skier smoothly, he may fall. Not only will that towing outfit go up the lift empty, probably several others will pass before the fallen skier can have moved out of the lift line.

Roebling T-Bar Lifts are recommended, for the above reasons, to be operated at speeds not to exceed the following:

Telescoping Tube..........450 feet per minute
Spring Box................600 feet per minute

Experience has shown that at these speeds capacities designed into the lift can be realized. This is particularly important on busy weekends, when the waiting lines consist, to a great extent, of novice skiers.

Two areas of the ski lift are most important to the correct functioning of the lift. These are the loading and unloading areas. Their exact locations are determined at the time the "line layout" is made. At this time grading of these two areas is usually required. Failure to grade them correctly can only result in difficulties in handling the ski crowds week-in and week-out.

The loading area must be level. To try to load skiers on either an upslope or downslope will result in an unusual number of falls. In addition, provisions for bringing the skiers to the loading area must be arranged so that the skier is not struggling to move up a slope at the time when he simply should be side-stepping to the loading area. Figure 6 illustrates one suggested arrangement for this area.

The unloading area either must be level or slightly downhill and must slope away from the lift. To expect the skier to release the towing outfit, then move laterally out of the way of skiers coming up the slope at rates as high as 2 each 6 seconds, results in one grand pileup. The expense of grading this area so the skiers can naturally ski diagonally away from the lift is small compared to the loss in revenue from continually stopping the lift to clear the unloading area of skiers. Figure 7 shows a suggested flow of skiers in this unloading area. Often trails or slopes are located on both sides of the lift. To get skiers across the lift line to slopes on the side opposite to that which they rode up is a most common problem. Often the returning sticks can be located high enough to ski beneath them without danger of skiers being hit by the sticks. Often it is satisfactory to provide a trail behind the upper terminal to achieve this. Again, the particular conditions of each lift determine the best method of making satisfactory provisions for the flow of traffic in this area.

The Roebling T-Bar Lifts require a minimum of three attendants, unless the lift is short and the top area is clearly visible from the base. One person is considered the lift operator and operates the lift controls. One person, with his own stop switch, acts as the loading attendant. The third person acts as top attendant and merely monitors the unloading and upper terminal areas. To achieve high capacities, often a fourth, or even fifth, attendant, is necessary. They act as assistants to the loading attendant by keeping the line of waiting skiers in the correct positions, warning them to place ski poles in the correct hand, etc. Attempts to operate lifts with insufficient personnel have not proven economical.

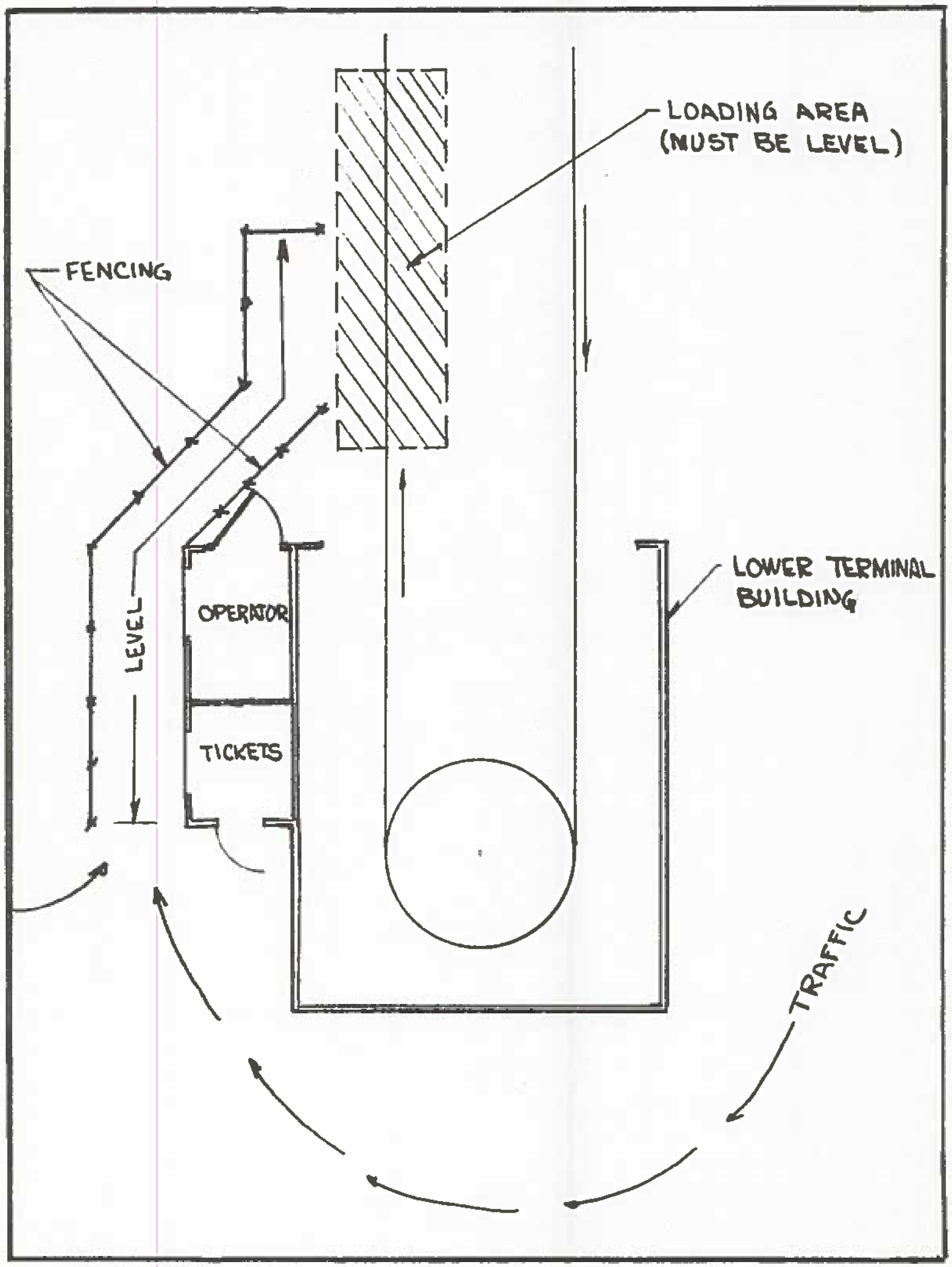

FIGURE 6 ONE SUGGESTED LOADING AREA

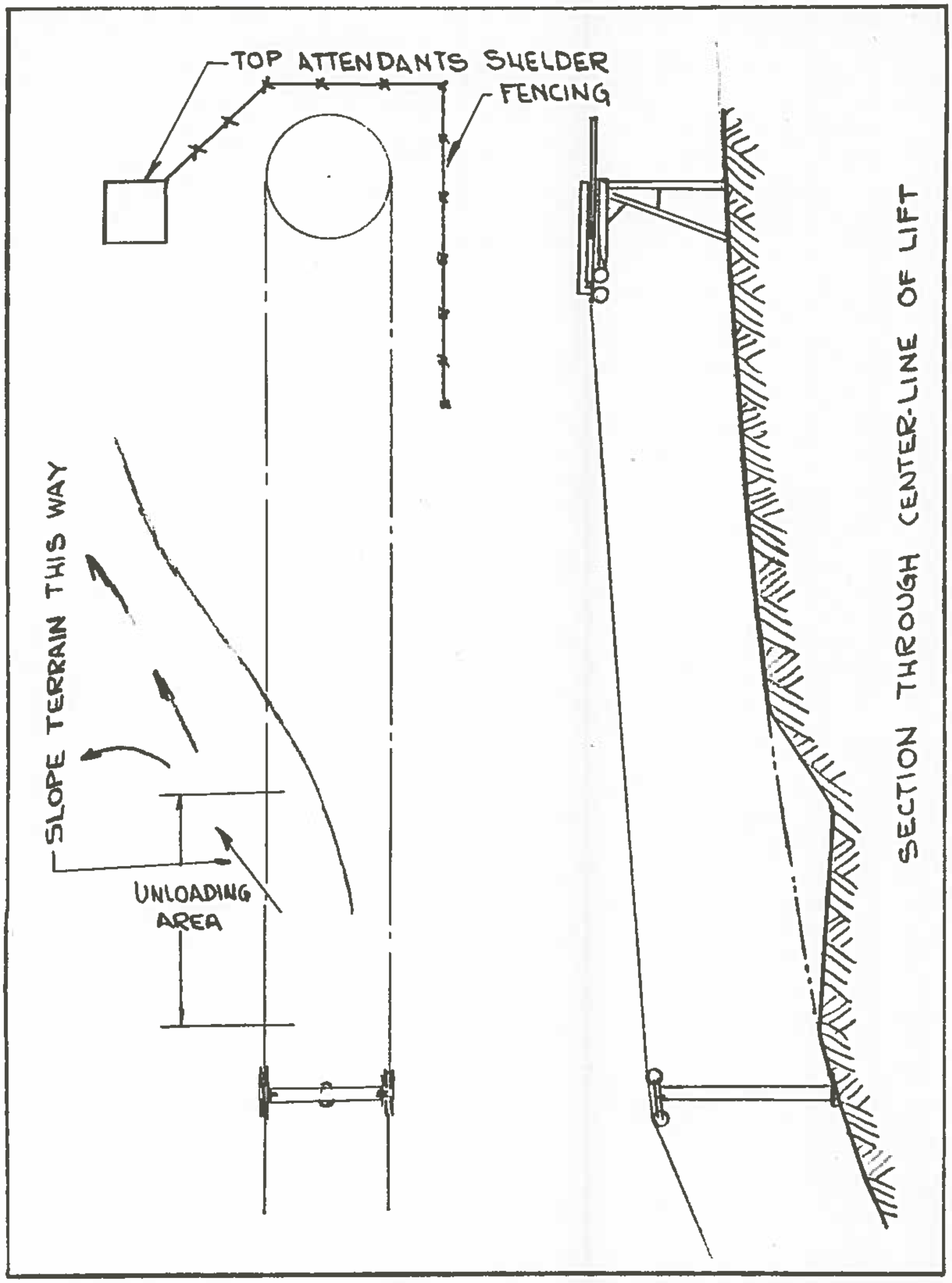

FIGURE 7 TYPICAL WELL-PLANNED UNLOADING ARE

T-Bar Ski Lift Specifications

Engineering.........Each individual lift is carefully designed to keep the number of line towers to a minimum, yet there are no exceptionally heavily loaded towers. All concrete details are completely specified and located. Each lift is supplied with a complete set of erection drawings.

Safety Features.....The Roebling T-Bar Lift will meet all requirements of existing Safety Codes.

Terminals...........Structural steel construction with a rubber lined terminal sheave complete with anti-friction bearings, guide rails and terminal line sheaves with anti-friction bearings.

Drive...............The drive, including back-up safety brake, is designed to utilize either a gasoline or diesel engine or an electric motor as a source of power. The drive unit may be located at either the upper or lower terminal.

Counterweight.......The counterweight may be located at either the upper or lower terminal. The counterweight will have adequate travel to remain in full suspension under normal changes in loading and temperature.

Line Towers.........Structural steel towers with line sheaves mounted in adjustable frames with anti-friction bearings and suitably protected by guard rails.

Towing Outfits......Telescoping tube or spring box type towing outfits complete with hangers and rope grips.

Main Hauling Rope...Specially-Processed Roebling Blue Center Wire Rope.

Telephone System....A complete system of telephone communication between terminals.

Safety System.......(1) Push button stations at each terminal for stopping the lift by remote control.
(2) Automatic safety stop at the dismounting area which automatically stops the lift should a skier pass beyond the proper dismounting area.

Painting............All material normally painted will be furnished with one shop coat of paint.

Special services....Pre-operational inspection of the completed lift by qualified Roebling personnel. An operation and maintenance manual is supplied with each lift.

Items to be Furnished
by the Customer........(1) Survey of the profile of the lift line and topographic survey at the tower and terminal locations. These locations are specified by Roebling's for the customer's approval. Before establishing final location of lift line, consult with Roebling's to determine requirements for loading and unloading areas.

(2) Concrete for the counterweight, terminal structures, line towers and foundations, including small items of bolts and structural steel to be embedded in these foundations which are designed by Roebling's.

(3) The design of and the materials required for a small building at the drive terminal to house the ski lift drive equipment. Roebling's will suggest a layout of space within this building, but assume you will wish to design the structure to suit your own architectural taste.

Costs..................The T-bar lift, including clearing, installation and final operational adjustments, represents a moderate initial investment and is most economical in maintenance and operation. It is sold only as a complete material unit and cannot be purchased in part.

Guarantee..............(1) The John A. Roebling's Sons Division of The Colorado Fuel and Iron Corporation guarantees each ski lift in all of its component parts against failure by reason of defective materials, workmanship or parts of faulty design for a period of one year, provided that for this period its representative(s) be allowed access to all parts of the structure and equipment for inspection and is granted the privilege of issuing reasonable instructions as to operation and upkeep. Roebling's shall design and/or furnish a replacement for any part found so defective, excepting items classified as normal wear and depreciation, but cannot accept contingent liabilities for the cost of installation of replaced parts or loss of revenue.

(2) The John A. Roebling's Sons Division of The Colorado Fuel and Iron Corporation reserves the right to improve its product through changes in design or materials without being obliged to incorporate such changes in ski lifts of prior manufacture.

Chair Lifts

The chair lift provides an uphill transportation system having capacities approaching those of the T-bar lift, and, although the initial cost is slightly higher, it provides the additional advantages of year-round operation, the ability to traverse ground that would not be suitable for a T-bar lift and the use of the cleared area under the lift as ski trails if so desired. Generally, the chair lift may be considered the "big brother" of the T-bar lift. Single or double chairs are used in place of the towing outfits that are hung from the main hauling rope of the T-bar lift. Since the passengers are carried above the ground, additional safety devices and provisions must be made that are not necessary when the skier is in contact with the ground (snow) while using the lift.

Referring to page 3, the basic components and principle of operation of the chair lift are the same as the T-bar lift if item 4 under components is changed from towing outfits to chairs.

The factors which dictate good sound design of the main hauling rope are the same for chair lifts as for T-bar lifts. Terminals, too, may be arranged as described under the T-bar lifts.

The type of power to operate the lift is flexible, as is the case with the T-bar lift. Electric, diesel, or gasoline may be the primary source of power. However, in the drive design of chair lifts, a secondary source of power is almost essential. Stoppage of a chair lift due to failure of the primary source of power may result in passengers being suspended above the ground in areas quite difficult to reach quickly, and the effects of exposure to severe cold for even a short time will, at the least, prove uncomfortable. Capacity of secondary power sources may vary to suit the customer's requirements. One extreme is to provide a secondary power source of equivalent horsepower to the prime source so that the lift may be operated at normal speeds with the secondary source. This secondary source could be an internal combustion engine if the primary source is electricity. The opposite extreme is a manual "hand crank" system which would unload a lift slowly if a primary power failure occurred. The specific design of the secondary system must be based upon the specific conditions encountered with each lift.

The height of the main hauling rope above the ground may be kept to customers' desired limits by careful layout of the lift line. Generally speaking, the more rigid these requirements, the greater the number of line towers that are required. However, the type of operation that is anticipated and the type of terrain of each individual lift must be the final determining consideration for a balance between the variation of height of the chairs above the ground and the number of towers required.

Roebling can furnish any one of several types of chairs. For maximum capacity double chairs are recommended, where two passengers ride the lift side-by-side. The chairs may be of all metal construction, metal framework with wood slats, two chairs side-by-side with a center hanger, one double chair with a bridle-type hanger, with or without footrests. In all cases, a closing hand guard is recommended. It has been found that the type of chair is largely a matter of personal preference and it is suggested that the choice be made after conference with Roebling personnel and review of the several designs has been made.

The safety system of the chair lift is very similar to that of the T-bar lift, except that a positive brake is applied rather than a "backstop". Since the chair lift may be loaded in such a manner that the downhill side has greater loads than the uphill side, the lift would continue to drift were it not for such a positive brake. A second brake, manually operated, similar to the emergency hand brake of an automobile, is also provided on all chair lifts.

The general remarks concerning capacity that were stated on page 10 apply equally well to chair lifts. It must be remembered, however, that in the case of a single chair, capacities are just half of that obtainable with a double chair. The speed that Roebling chair lifts are recommended to be operated are as follows:

Winter Operation (Skiing)......500 feet per minute
Summer Operation...............300 feet per minute

Summer operating speeds may vary widely, and frequently the lift must be stopped to load and unload elderly or crippled passengers.

The loading and unloading areas of the chair lift must be level, and frequently ramps of wood construction best meet these requirements. One of the best loading systems is to paint footprints at the loading stations - in line with the center of each chair - marking the locations where passengers must stand. Intermediate loading and unloading areas may be provided if such are anticipated at the start of the design. Unloading areas must provide sufficient length to allow the skiers to move away from the lift or, in the case of summer passengers, to dismount and walk away quickly. Unloading of skiers is similar to that of the T-bar lift. The speed of the lift allows the skier to move diagonally away from the lift. With passengers without skis, the best method is for each of the two attendants at the unloading area (for a double chair) to hook arms with the passengers, not unlike the routine familiar in the square dances, and pivot them about as they dismount. However, the attendant must evaluate each passenger, and, if any doubt exists as to the ability of the passenger to dismount from a moving chair, he should call for the lift to be stopped. While this routine may at first appear somewhat complicated, a short "break-in" period for attendants will make these operations routine.

The Roebling Chair Lifts require a minimum of two attendants per loading/unloading station in winter and usually three per station in summer, in addition to an operator at the drive controls. Again, as with the T-bar lifts, additional attendants will assure the correct alignment of passengers at times of peak operation.

Chair Lift Specifications

Engineering............Each individual chair lift is carefully designed to keep the number of line towers to a minimum. All concrete details are completely specified and located. Each lift is supplied with a complete set of erection drawings.

Safety Features........The Roebling Chair Lift will meet all requirements of existing Safety Codes.

Main Hauling Rope......The main hauling rope will be Roebling Blue Center Wire Rope, providing a minimum safety factor of five (5) with respect to the maximum static working tension.

Counterweight Rope.....The counterweight rope size and grade will provide a minimum safety factor of seven (7).

Chairs.................The chairs will be of the single or double-seated type. Chairs will be constructed principally of steel and provided with seats, backrests and armrests. Chairs will be of sturdy design and of ample dimensions so as to provide comfort and a feeling of security to the passengers.

If desired, the chairs can be furnished with footrests capable of supporting the rider's skis while in transit and a protective guard to prevent the rider from pitching forward out of the chair; the footrest and guard to be of the type which is closed by the rider after he seats himself in the chair, and is opened by the rider to dismount from the chair while in motion.

The attachment of the chairs to the main hauling rope will be by means of an adequate grip.

Tower Line Sheaves.....Line sheaves will be fitted with replaceable rings of rubber or equivalent, anti-friction bearings with suitable lubrication and provided with means for adjusting sheaves or pairs of sheaves to accurately align them with the hauling rope. A minimum of two sheaves, mounted in pairs with one pivot axle per pair, will be placed on each side of each support tower.

Line Towers............Line towers will be constructed of steel. Towers will be designed to allow safe clearance for passage of chairs, to provide sufficient rigidity and to further provide protective guards to allow safe passage of chairs and passengers under normal wind conditions.

Terminal Equipment.....<u>Terminals</u> - The terminals will contain sufficient structural steel to carry the chair lift load down to the concrete foundations.

<u>Terminal Sheaves</u> - The sheaves will be of high grade material and the groove will be lined with rubber or equivalent to provide traction for the rope and minimize rope wear. The sheaves will be mounted horizontally on a shaft of adequate size, with anti-friction bearings and provided with suitable lubrication.

Terminal sheaves shall be directly supported at a fixed height by the terminal structures. At the tension terminal the sheave frame shall be supported on rigid straight rails.

<u>Counterweight</u> - The counterweight will have adequate travel to remain in full suspension under normal changes in loading and temperature. The counterweight sheaves will be of a diameter suitable for the counterweight rope. These sheaves will be mounted on shafts of suitable size, with bearings and adequate lubrication.

<u>Chair Lift Drive</u> - The chair lift drive will consist principally of a main power unit and, if specified, a standby unit. The power furnished by these units will be transmitted by means of a suitable speed reducer, shafts, etc. to the horizontal drive sheave. The connections between the main unit and the speed reducer, and the standby unit and the speed reducer, will be such that either power unit can drive the chair lift in the event of an engine breakdown and such that the disabled power unit can be removed for repair or overhaul without affecting the operation of the other unit.

The main unit will be of adequate size to drive the chair lift under all weather conditions.

The standby unit will be rated to drive the chair lift at a suitable slow speed under all weather conditions.

Safety Devices.........Push button stations will be provided at all loading and unloading stations for stopping the lift by remote control.

A system of telephone communication will be furnished, one telephone instrument to be located in each loading and unloading station. All necessary wire, batteries and other accessories will be furnished.

The drive sheave will be provided with a brake rim or brake wheel with manually operated brake mechanism for emergency use. This brake will be capable of stopping and holding the chair lift under the worst conditions of loading.

At the drive terminal a brake will be furnished on the drive shaft which is automatically applied when the power is cut off.

Painting...............All material normally painted will be furnished with one shop coat of paint.

Special Services.......Pre-operational inspection of the completed lift by qualified Roebling personnel. An operation and maintenance manual is supplied with each lift.

Items to be Furnished by the Customer........(1) Survey of the profile of the lift line and topographic survey at the tower and terminal locations. These locations are specified by Roebling's for the customer's approval. Before establishing final location of lift line, consult with Roebling's to determine requirements for loading and unloading areas.

(2) Concrete for the counterweight, terminal structures, line towers and foundations, including small items of bolts and structural steel to be embedded in these foundations which are designed by Roebling's.

(3) The design of and the materials required for a small building at the drive terminal to house the chair lift drive equipment. Roebling's will suggest a layout of space within this building, but assume you will wish to design the structure to suit your own architectural taste.

Guarantees.............(1) The John A. Roebling's Sons Division of The Colorado Fuel and Iron Corporation guarantees each chair lift in all of its component parts against failure by reason of defective materials, workmanship or parts of faulty design for a period of one year, provided that for this period its representative(s) be allowed access to all parts of the structure and equipment for inspection and is granted the privilege of issuing reasonable instructions as to operation and upkeep. Roebling's shall design and/or furnish a replacement for any part found so defective excepting items classified as normal wear and depreciation, but cannot accept contingent liabilities for the cost of installation of replaced parts or loss of revenue.

(2) The John A. Roebling's Sons Division of The Colorado Fuel and Iron Corporation reserves the right to improve its product through changes in design or materials without being obliged to incorporate such changes in chair lifts of prior manufacture.

Passenger Car Cableways

The Passenger Car Cableway provides a specialized form of aerial tramway transportation to bridge terrain where large spans, difficult access, or other conditions make the high capacity, continuous flow system of the T-bar or chair lift undesirable. Generally speaking, the principle of the passenger car cableway is as follows:

A passenger car, with capacities generally from 10 to 50 passengers, but not limited thereto, moves on stationary track cables, and is pulled by a towing cable, from one terminal to another. Upon unloading, the car then returns "in reverse" to the original terminal. Two cars may be interlinked so that two parallel sets of track cables are located on either side of the towers and the cars so interconnected that one is moving from terminal A to terminal B while the other is moving from terminal B to terminal A. Single cars may be designed which are self-propelled by having a powerplant located in the car and the car then pulls itself along on a hauling rope that is stretched from terminal to terminal. This system of passenger transportation is quite specialized in nature and a complete discussion of the system must be based upon the specific location and application desired.