Aerial Tramways

American Steel & Wire Company

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Steel & Wire Company

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American Steel & Wire Company's

Trenton-Bleichert System of Aerial Tramways

Reversible Aerial Tramways and Aerial Tramways of Special Design

American Steel & Wire Company

Manufacturers and Sole Licensees in America under the Bleichert Patents

Length of line, 13,300 feet. Hourly capacity, 12 tons.

Trenton-Bleichert Tramway of the Eureka Slate Co., Slatington, Cal.
View of 2,400-foot span across the American River Canyon.

American Steel & Wire Company's Tramways—Trenton-Bleichert System

THIS system of aerial tramways is one whereby the material is carried in receptacles suspended from carriages on stationary track cables of special construction, supported at varying elevations above the ground. The carriers move in a continuous circuit, at definite intervals, determined by the individual loads and the amount of material to be transported in a given time, and at distances apart varying in accordance with the speed; the loaded carriers traveling along a line of cable graduated in size to the weight it has to support, and the empties returning along a lighter line of cable parallel with the loaded line. Motion is imparted to the carriers by means of a comparatively light endless wire rope, of the ordinary or Lang lay, commonly known as the traction rope, to which the carriers are gripped. These Tramways belong to that class of aerial tramways known to many as the "Double-rope," in contradistinction to the "Single-rope" class, wherein one rope performs both the functions of support and propulsion.

This system is especially adapted to the transportation of ores, coal, crushed stone, slate, clay, sand, and all kinds of raw materials. It is also well adapted to the conveyance of fruits, cereals and other plantation produce, cordwood and sawmill products, manufacturers' supplies, refuse, materials in process of manufacture, merchandise of all kinds, and particularly products requiring careful manipulation, such as explosives, liquids, glassware, and, in fact, all materials that admit of being carried in moderate loads.

The materials are carried in bee lines, directly from the loading stations to the places of delivery, without rehandling, at costs per mile varying from *2 cents to 5 cents per ton.*

These Tramways are especially adapted to mountainous localities, and *are* recommended for heavy service. *The ruggedness of contour, steepness of grades, and width of valleys or rivers, are no bar to the successful operation of such a line.* The costly grading of circuitous routes, and the building of expensive bridges or viaducts, requisite in the construction of mountain railways, are entirely avoided. In fact, this system of tramway often affords a means of communication with points inaccessible by any kind of a surface road.

More than 3,000 lines have been built, aggregating over 1,800 miles in length, and about 200 million tons annual capacity. One *line, carrying 40 tons hourly of ore a distance of 21 miles, the longest aerial tramway ever built, has a vertical descent of 11,000 feet. Spans occur in this line exceeding half a mile in the clear.*

Even in cases where the ground favors the construction of a railway, a Trenton-Bleichert tramway will often be found the more economical installation, owing to the additional cost of loading and unloading the railway cars, due to the fact that such cars cannot be brought close to the places where the material is obtained or delivered, and this additional cost may exceed the entire cost of operating a Trenton-Bleichert tramway.

Every detail has been thoroughly worked out to meet the varying conditions incident to the construction and operation of our installations, and *particular attention is invited in the following pages to our* Locked-Coil Track Cable and our Patent Compression Grips, the merits of which have contributed so largely to the economy, durability and superior efficiency of our tramways.

Track Cables

THE TRACK CABLES used exclusively in the aerial tramways built by the American Steel & Wire Company, known as the Trenton *locked-coil cables*, are so named from the fact that the outer wires, which are drawn to shape, interlock one with the other, as illustrated in Fig. 1. The smooth surface of this cable results in a *uniform distribution of wear not obtained in any other kind of cable*, which adds to the life not only of the cable itself, but also of the carriage wheels that traverse it. *No other track cables made can compare with the Trenton locked-coil cable in durability.* This cable is made in lengths varying from 800 to 1,500 feet, and owing to its peculiar construction is quite stiff, but sufficiently flexible to be shipped in coils from 5 feet to 6 feet in diameter.

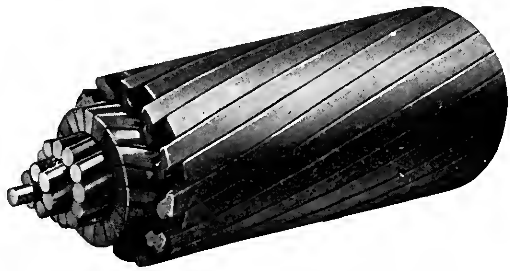


Fig. 1. Trenton Locked-Coil Track Cable.

Wire cable of the ordinary construction, composed of round wire strands, laid about a hemp or wire strand core, is not at all adapted to the purpose, on account of the rapid wearing out and fracturing of the comparatively small wires under the constant traction of the carriage wheels. The special forms of cables with approximately cylindrical surfaces, composed of strands made of round wires wrapped about triangular or other shaped core wires, are little better. In the effort to obtain from such cables a reasonable service,

Fig. 2. Ordinary Wire Cable after 4 months' service as a Track Cable.

Fig. 3. Trenton Locked-Coil Track Cable (1 ¼ inch diam.), from the Highland Boy Tramway, Bingham, Utah, after carrying two million tons of ore in a period of 6 years. (From photographs.)

larger sizes have been used than actually required as far as strength is concerned, but these large cables are cumbersome, and experience has shown that the additional service obtained is hardly commensurate with the difference in cost, nor anything like equal to the service obtained from the smaller sizes of the locked-coil cables. With the locked-coil cable, in event of any of the outer wires breaking—which rarely happens until after years of service—the ends of the wires do not protrude and result in a ragged surface of tangled wires as with the ordinary or special forms of cables referred to, but always present a smooth surface.

The superintendent of a concern operating one of our tramways, after having tried various kinds of track cables, writes as follows:

> "Your locked-coil cables have unquestionably given us better service than any of the different designs we have tried so far. As a matter of business courtesy we would not care to specify the different types of cables we have tried for carrying cables. We believe it is quite sufficient to state that for our purpose, and based on our experience, the locked-coil cable is the best, and we are so far satisfied of this fact that we shall make no further experiments along this line."

When a lower-priced equipment is desired, and the conditions are favorable, we offer what is known as the *smooth-coil cable,* illustrated in Fig. 4. This cable is composed simply of a number of comparatively large round wires coiled in concentric layers about a core wire, the number of layers and size of the wires varying according to the size of the cable, which is in reality simply a large strand, the surface of which, when new, resembles that of a spirally-fluted cylinder, and when worn approximates that of a smooth round bar. The smooth-coil cable is more durable than the track cables offered by other makers at the same price, made of smaller wires, and barring

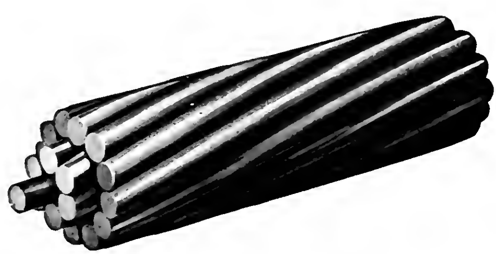


Fig. 4. Smooth-Coil Track Cable.

the locked-coil cable, is unsurpassed as a track cable in its wearing qualifications.

Track Cable Oiler.—We manufacture a special carrier, illustrated in Fig. 18, for coating the track cables with oil, or with any standard cable coating sufficiently fluid to pass through the pump. The oil or standard compound is carried in a cylindrical tank, to which is attached a small rotary pump, driven from the carriage wheels by a belt and gears, that forces the material up through a small pipe to the cable at a point just under the middle of the carriage.

Couplings.—Particular attention is invited to the facility with which the locked-coil and the smooth-coil track cables can be installed, renewed, or extended from time to time as occasion may require, owing to the comparatively short lengths, varying, as already stated, from 800 to 1,500 feet, which are joined by patented steel couplings, illustrated in Fig. 5. Each coupling consists of three pieces, two taper sockets of nickel steel which are attached, by means of a press, specially designed for the purpose, illustrated in

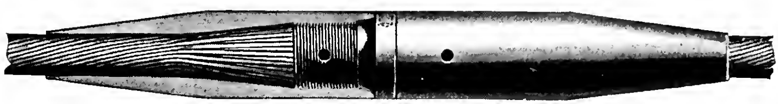


Fig 5. Patent Coupling.

Fig. 6, to the respective ends of the cables to be joined, and a central plug, which has a right and left hand thread corresponding to the threads in the coupling sockets.

By inserting the plug and turning it, the sockets are drawn together against the central collar of the plug, forming a perfectly

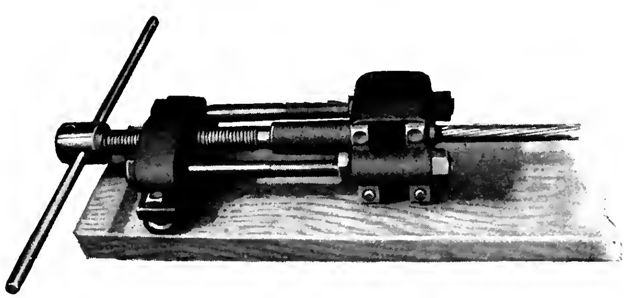
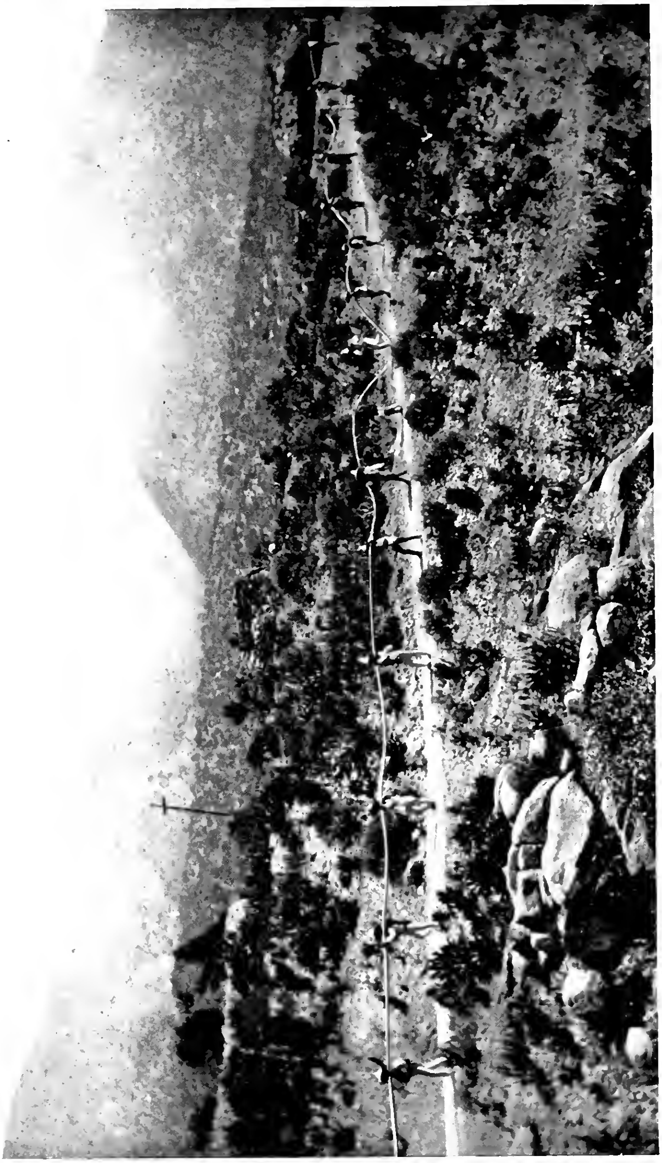


Fig. 6. Press for attaching Coupling Sockets to Track Cables.

secure and serviceable joint possessing the same tensile strength as the cables, and offering no obstruction to the free passage over them of the carriages from which the buckets are suspended. This not only facilitates the handling of the cables, but if at any time any one section or portion of a section becomes worn in service, or is in any way injured, the worn place—whether it be a few feet or more—can be cut out, and a new piece of cable of the required length inserted by means of the couplings. An opportunity is thus afforded of renewing the cable as occasion requires, which cannot be done with cables made of twisted strands, since the splices that would have to be made do not give good results, and the operation of making such a splice is generally a very difficult and expensive undertaking.

Advantages of Stationary Track Cables.—The track cables are graduated to the loads and pressure they have to sustain, and, being stationary, possess the great advantage of relieving the traction rope of the weight of the loads, so that on comparatively level lines the tension upon the traction rope is but little more than the tractive force required to move the loads. Upon slopes, however, the weight of the loads is shared, to a certain extent, by both the track cable and traction rope, the amount borne by each depending on the inclination; the steeper the inclination the greater the weight on the traction rope and the less on the track cable, and *vice versa.* The stress upon the track cable, however, varies little with differences in the inclinations, since it is weighted to a maximum safe tension so that such differences result only in corresponding variations in the deflections, but the stress upon the traction rope will depend on the slope, and it is important, therefore, in estimating upon any line, to know what the grades are. A further advantage derived from the use of stationary track cables is the decreased wear and tear due to the high tension to which these are stretched, thus securing to the loads a comparatively direct path; in other words, they are subject to less fluctuations of rise and fall, or wave motion, than in single rope lines, since, in the latter, the deflections for similar loads must necessarily be greater to correspond with a practical safe working tension, and the double duty the rope has to perform of supporting and moving the loads. For this reason, also, and owing to the greater strength of the track cables, the Trenton-Bleichert System is adapted to the transportation of much heavier loads than is practicable in any kind of single-rope tramway.

The curves of the track cables are carefully plotted to the contour of the ground for a safe working tension, and the heights of the supports determined accordingly. For this purpose a profile of the ground made from an accurate survey is required in any case. The cables, however, when the line is erected, are actually stretched to a somewhat lower tension, so that there may be no



Packing Track Cable over a Mountain Trail possibility of their lifting out of the saddles upon which they rest.

TRANSPORTING TRACK CABLES OVER MOUNTAIN TRAILS—Track cables that have to be transported over mountain trails are generally cut in lengths of 500 to 800 feet, which are most conveniently carried on the shoulders of men, as shown in the picture on the preceding page.

Loading Terminal, Trenton-Bleichert Tramway of the United States Mining Company, Bingham, Utah. Showing Detacher and Loaded Carrier in position for attaching to the Traction Rope.

Traction Rope

THE traction rope is made of six strands coiled about a hemp core in the usual way, each strand being composed of selected steel wires, varying in number and grade according to the size of the rope and the duty it has to perform. Our lines are generally equipped with the style of rope illustrated in Fig. 7, commonly known as the "Lang-lay." The peculiarity of this rope is that the strands and the wires of which they are composed are both twisted in the same relative direction, whereas in the ordinary rope they are twisted reversely one to the other. In the Lang-lay rope the wires of one strand are approximately parallel with the wires in the adjoining strands, which renders it somewhat more flexible than ordinary wire rope of the same diameter and the same size of wires. The chief advantage, however, is due to the diagonal lay of the

Fig. 7. Lang-Lay Traction Rope as it appeared after having transported over 660,000 tons of ore.

exposed surfaces of the wires with respect to the axis of the rope, which makes the surface contact with any particular wire much greater than in ropes of the ordinary lay, in which the exposed wires are parallel with the axis, and the wires of one strand cross those of the adjoining strands at nearly right angles.

The above illustration is from a photograph of a piece of a ¾-inch rope taken from the Highland Boy tramway of the Utah Consolidated Mining Co., after it had been in constant service 4 years and 9 months, during which time 661,125 tons of ore were transported. With the rope replacing this over a million tons of ore was transported.

The following from the general manager of the Camp Bird Ltd., Ouray, Col., relates to a ⅝-inch cast steel traction rope of the Lang-lay:

"We are to-day changing the traction rope on our tramway, and it may interest you to know that this rope was installed November 8, 1898, has been in constant use until January 25, 1905, and during that period 387,050 tons of ore have been conveyed from the mine to the mills, a distance of about 8,800 feet. We have no accurate record of the tonnage delivered back from mills to mine, but it is approximately 8,000 tons."

Traction Rope Coating Device.—The traction rope should be coated occasionally with some standard cable coating, especially in cases where the line remains idle at times, to protect it from rust. A convenient device for coating or varnishing the traction rope is illustrated in Fig. 8. This consists of a U-shaped receptacle containing the oil or coating, which is suspended near one of the terminal guide sheaves. The rope passes over a small roller in this receptacle, which in revolving slushes it with the coating material, and then between some brushes that wipe off the drip.

Transporting Traction Rope Over Mountain Trails.—With equipments that have to be packed over mountain trails on the backs of mules, the traction rope is put up in coils weighing about 150 pounds each, which are arranged in pairs so as to be conveniently carried astride the animals' backs, leaving a space between each pair of coils of about 25 feet. In this manner a very long rope can be carried unbroken over a narrow trail by a train of mules, as shown in the picture on the opposite page.

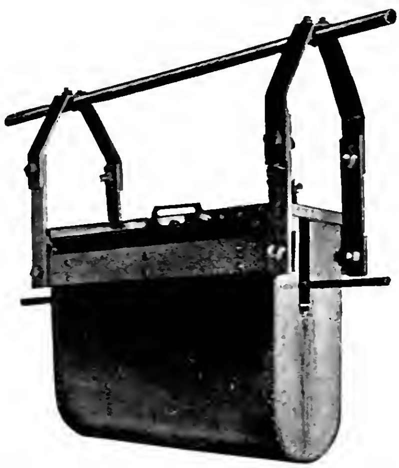
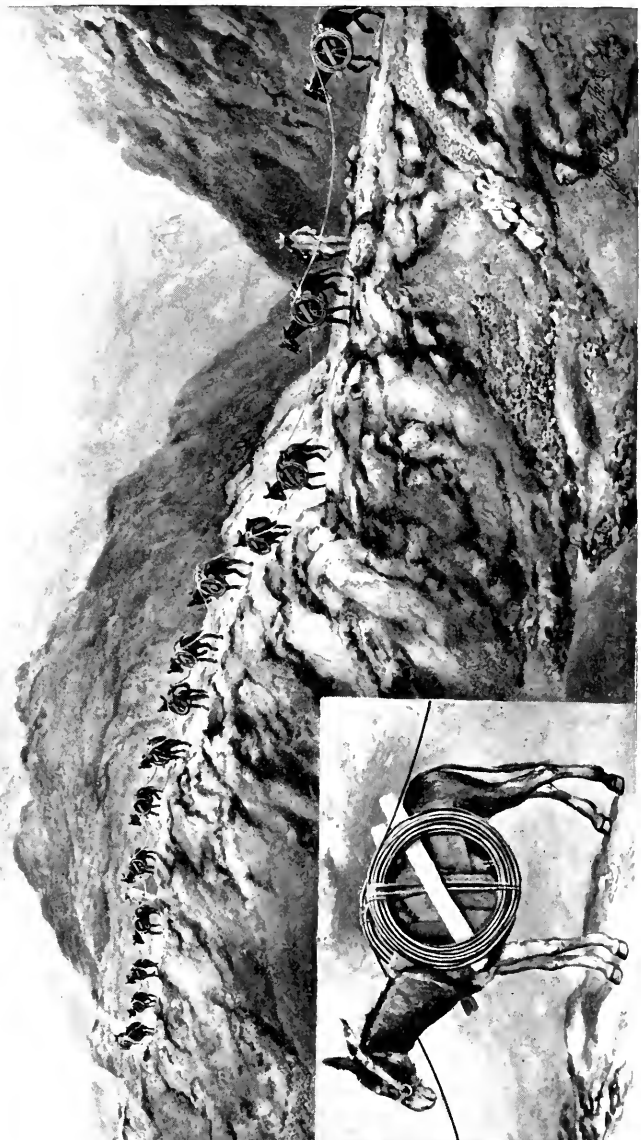


Fig. 8. Coating Device for Traction Rope.



Packing Traction Rope over a Mountain Trail.

Rolling Stock

THE ordinary carrier, such as used for transporting ore and like material, illustrated in Fig. 9, consists of a carriage that traverses the track cables, from which is pivoted in suspension a hanger that supports a bucket or other receptacle, and above which is a grip by means of which attachment to the traction rope is effected.

The carriers move in a continuous circuit at definite intervals, the loaded carriers traveling along one line of track cable, and the empties returning by the companion cable, which in the ordinary constructions is parallel with the loaded line, as already stated. When the carriers arrive at either terminal, or other loading or discharge stations, the grips detach automatically and the carriages are shunted to overhead rails, supported by the structure of the station, and by means of which they are conveyed to the various points of loading or discharge as the case may be.

CARRIAGES.—The carriages each consist of two steel side plates, between which are mounted two cast steel wheels, fitted with phosphor-bronze pins, so designed that as the upper surfaces become worn, they can be turned around underside up. The hanger pins are made of the best machinery steel.

GRIPS.—THE WEBBER PATENT COMPRESSION GRIP *with which the ordinary carriers are equipped can be used on the steepest grades. With this grip no buttons, lugs or knots of any kind are required on the traction rope, and the troubles incident to the slipping of such contrivances are entirely avoided. A great economy is also effected in the life of the rope, owing to the fact that the wear is not confined to certain spots, but is distributed over the entire rope. The gripping of the traction rope is also effected with certainty, and automatically, by means of a patented device shown in Fig. 9, the operation of which is such that the jaws take hold of the rope without the slightest jerk as the carrier is pushed out from the station.* The wearing parts are all of cast steel. This grip has given such universal satisfaction that it has entirely superseded the old friction and lug grips formerly used.

At angle and terminal stations, where the buckets are not discharged, but merely have to pass around the sheaves, it is reasonable to look for an economy of labor in the passage of the carriers without detaching from the traction rope. This is more especially the case with lines equipped with self-dumping buckets, such as illustrated in Figs. 13 and 14, page 19, which are discharged at various points along the line. With the ordinary carrier equipped with an underhung grip attached to the hanger between the carriage and the bucket, it is obvious that this is impossible, not necessarily because the grip must come in contact with the flanges of the sheaves, but because on the angle side of the bend the hangers would come between the rope and the sheaves, which would be objectionable, to say the least, if not altogether infeasible. This difficulty is readily overcome by running the traction rope just above the track cables, and making the grip an integral part of the carriage mechanism, as in Figs. 10 and 11.

The construction of the Trenton-Bleichert Patent Automatic Overhead Grip illustrated in Fig. 10 is such that the weight of the carrier acts as the gripping force, which varies with the inclination of the cable, but this construction possesses the advantage of being independent of any nice adjustment of the grip jaws, so that the grip automatically accommodates itself to irregularities in the wear of the traction rope.

The overhead grip illustrated in Figs. 13 and 14, page 19, is similar in its action to the Webber grip, the bite of the jaws being self-locking under a positive invariable pressure, determined by adjusting screws.

It is not practicable, however, to run the traction rope above the track cables in cases where the line crosses mountain ridges, or other points where sharp vertical angles or sudden changes of grade occur, owing to the downward pressure of the rope which would throw the empty carriers out of plumb. The Trenton-Bleichert Patent Automatic Underhung Grip illustrated in Fig. 12 may be used in such cases. This grip is similar in its action to the Trenton-Bleichert Overhead Grip illustrated in Fig. 10—the gripping force being exerted by the weight of the carrier—and possesses the same advantage in not requiring any adjustment of the jaws to the wear of the traction rope. Since the grip forms an integral part of the carriage, it also possesses the advantage of accommodating itself to varying inclinations of the cable, without pulling the bucket out of plumb, as it does with an underhung grip attached to the hanger.

Receptacles.—The ordinary buckets and other receptacles are shown in the illustrations. Self-dumping buckets are furnished when required, which may be both self-dumping and self-righting, as illustrated in Fig. 21, page 21, or simply self-dumping as illustrated in Figs. 13 and 14, page 19. The latter, which are somewhat lighter and cheaper than the self-righting buckets, are generally used, since it requires little or no effort on the part of the operator in loading to right and latch the bucket. Self-righting buckets are only required in cases where the construction is such that it is

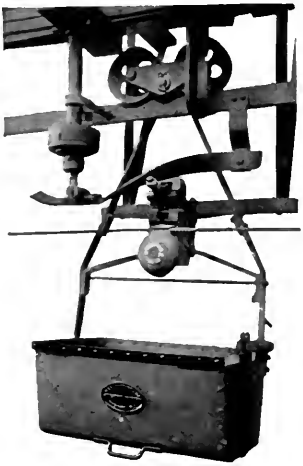


Fig. 9. Carrier, with Webber Patent Compression Grip, showing Patent Automatic Attacher

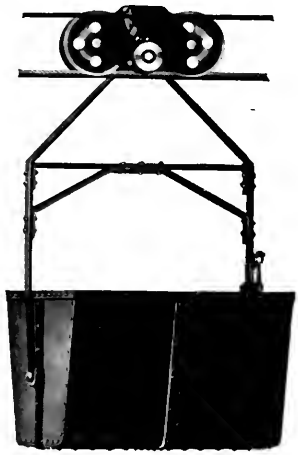


Fig. 10. Carrier, with Bleichert Patent Automatic Overhead Grip.

Fig. 11. Bale Carrier, with Overhead Grip.

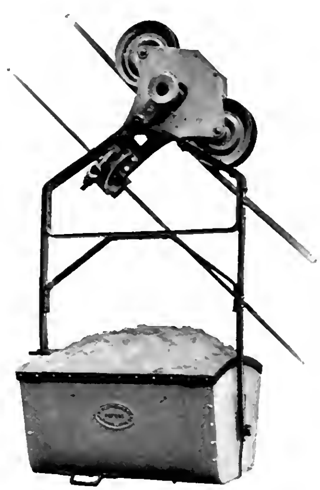
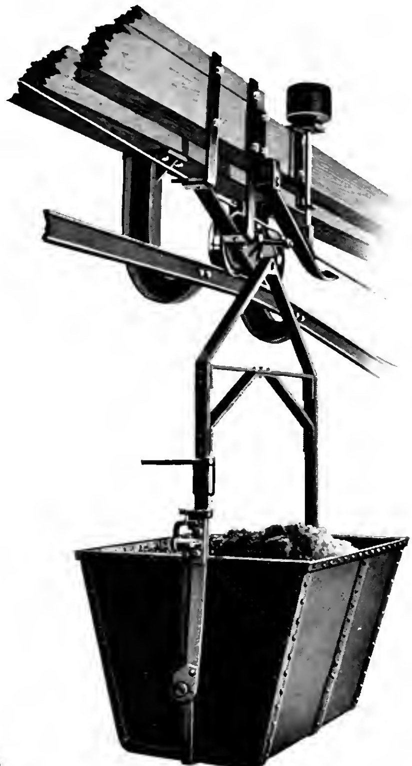


Fig. 12. Carrier, with Bleichert Patent Automatic Underhung Grip.

Fig. 13. Carrier, with Self-Dumping Bucket loaded, showing arrangement of Automatic Attacher and Detacher as used with Single-Cable Reversible Tramways.



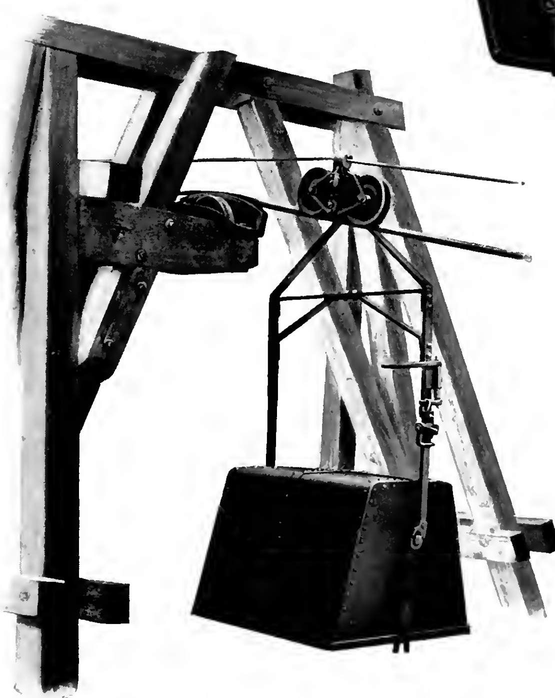


Fig. 14. Carrier, with Self-Dumping Bucket empty, passing support on return trip after dumping.

Fig. 15. Platform Carrier, for barrels, boxes, etc.

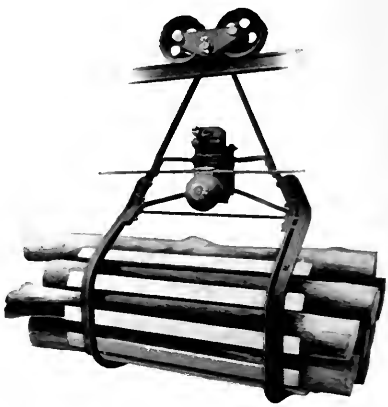


Fig. 16. Cordwood Carrier.

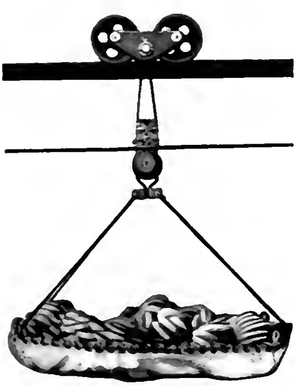


Fig. 17. Banana Carrier.

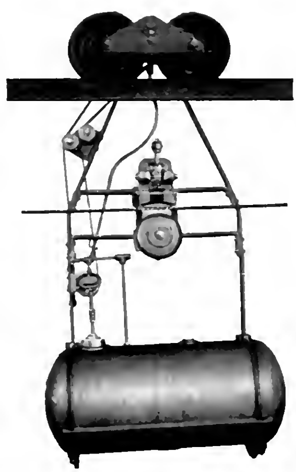


Fig. 18. Track-Cable Oiler.

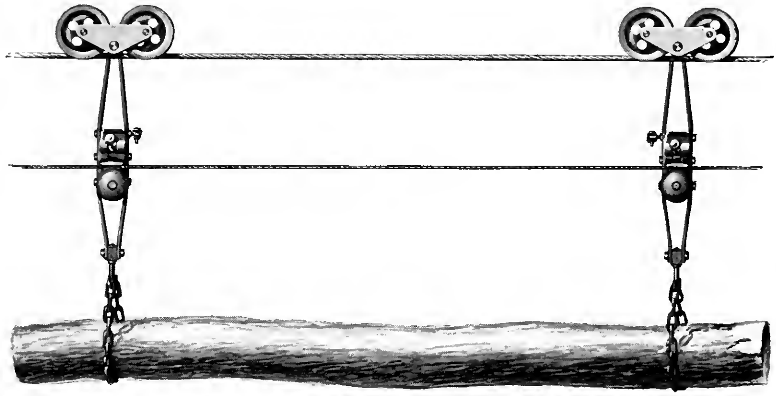


Fig. 19. Log Carrier

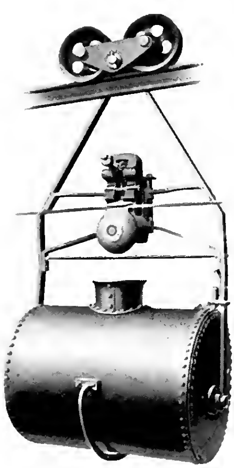


Fig. 20. Liquid Carrier.

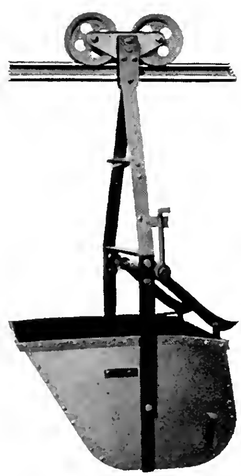


Fig. 21. Carrier, with Self-Dumping and Self-Righting Bucket, for Reversible Tramways.

inconvenient for the operator to attend to both righting and loading the buckets, or where the empty bucket in returning enters the loading station close to the ground or floor, and there would be insufficient clearance for the ordinary bucket to come in as it does upside down. In either case the latch that secures the bucket is disengaged at the desired point of dumping by a specially designed tripping bar attached to the track cable or station rail as the case may be, the bucket being so hung that it instantly turns over and discharges its contents. In dumping along the line at a high elevation between supports at a considerable distance apart, this tripping bar is generally attached to a frame, guyed to the ground by wire ropes, in order to prevent the rebounding of the cable in dumping and consequent possibility of the carrier being thrown off. This construction is shown in Fig. 22. Special receptacles are made to suit the material to be carried, a few of which are illustrated on pages 18 to 21 inclusive.

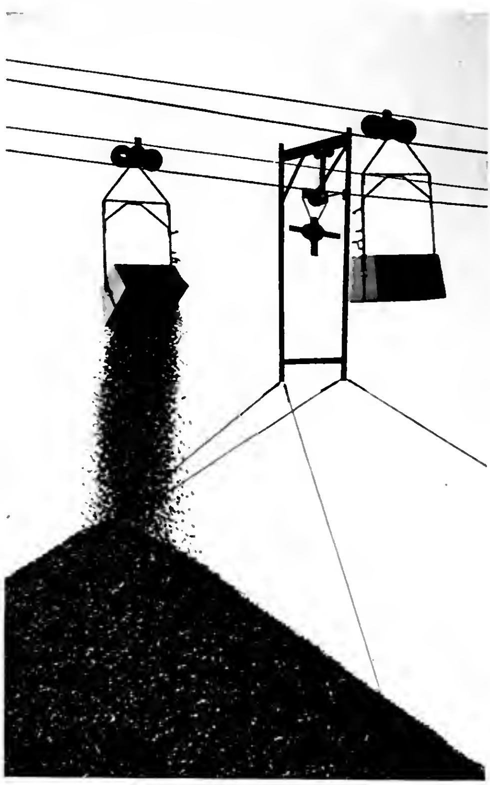


Fig. 22. Self-Dumping Buckets, showing Tripper and Cable Hold-Down Frame, on line of the Colorado Fuel and Iron Co., Sopris, Col.

Supports

THE supports may be of wood or steel, as preferred, and the accompanying views, Figs. 23, 25 and 26, show the ordinary constructions of wooden supports. Other designs, however, are made to correspond with the weight they have to sustain and to meet the special conditions involved, as shown in the views on pages 24 and 26, Figs. 24 and 27.

Fig. 23. Support on line of The Nevada Gypsum Co., Mound House, Nev.

The spacing of the supports is governed by the contour of the ground and the capacity of the line. Over level ground the distance apart will vary from 200 to 300 feet. In mountainous localities, where the contour is rugged (see profile sheet at back of book), the distances between the supports will vary greatly, being closer on the ridges and wider apart in the valleys.

TRESTLES.—Where much of a vertical angle occurs in passing

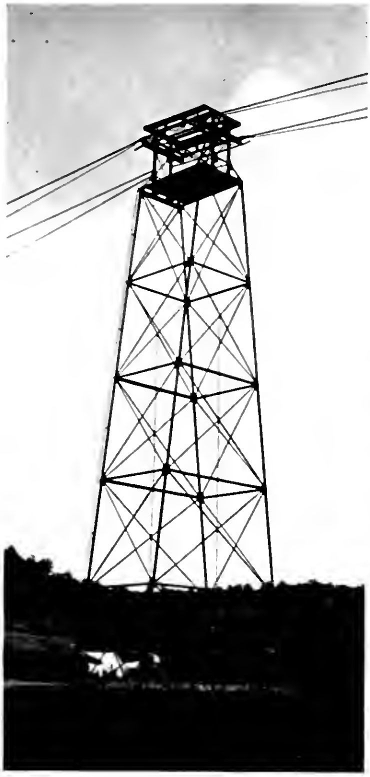


Fig. 24. Steel Support, 100 feet high, on line of the Carbon Coal and Coke Co., Trinidad, Col.

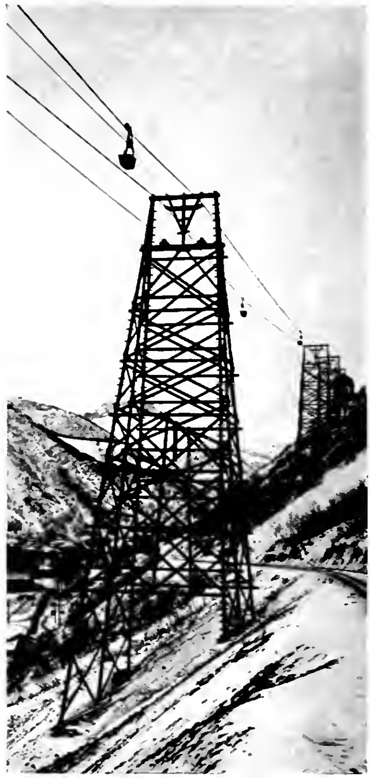


Fig. 25. Support 90 feet high, on line of The Yampa Smelting Co., Bingham, Utah.

over a ridge or bluff, structures are erected, consisting of a series of bents, from 15 to 20 feet apart, that usually support lines of rails overlaying the track cables, although where the traffic is light, ordinary saddles are sometimes used in place of the rails. The rails, which are the same as used at the terminal and other stations, relieve the cables of the undue wear to which they would otherwise be subjected. A structure of this kind in the line of the San Toy Mining Co. is illustrated on page 26.

Long Spans.—In crossing ravines, valleys and rivers, on the other hand, spans have been made exceeding half a mile in the clear. The frontispiece shows a 2,400-foot span across the American River Canyon, in the line of the Eureka Slate Co., Slatington, California. Spans over 1,000 feet are common. Long spans are not

Fig. 26. Support on line of The Eureka Slate Co., Slatington, Cal.

Length of line, 900 feet. Hourly capacity, 50 tons.

Trenton-Bleichert Tramway, Great Scott Coal Co., Star City, W. Va.

Fig. 27. Side Hill Support on line of the Old Hundred Mining Co., Howardsville. Col.

Length of line, 20,500 feet. Hourly capacity, 50 tons.

Trenton-Bleichert Tramway Rail Station. San Toy Mining Co., Chihuahua. Mexico.

objectionable provided the loads are not so great as to produce too sharp an angle at either support. Special saddles known as "protection saddles" are used on such supports (illustrated in Fig. 28). These saddles are provided with hinged steel hoods, that cover a certain portion of the cable on both sides of the saddle, and protect it from undue wear. They are also used on supports where there may occur occasionally, with certain positions of the carriers, such a tension as to cause the cables to lift out of the saddle grooves.

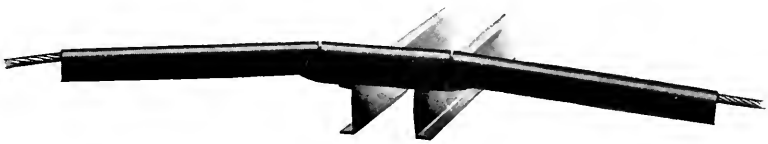


Fig. 28. Protection Saddle.

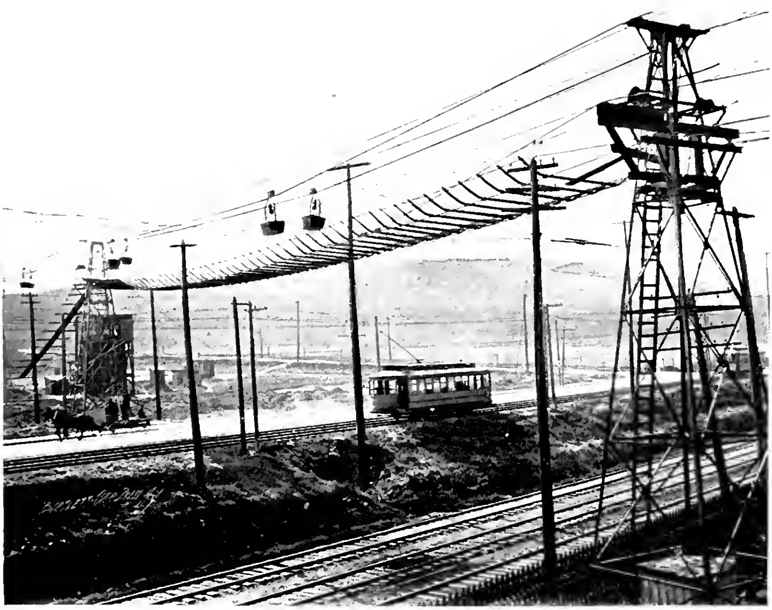
Tension Stations.—In lines of considerable length it is necessary to apply tension to the track cables at intermediate points on account of the saddle friction. Special structures known as "tension stations" are erected for this purpose, at which the track cables are parted, the ends of which are either rigidly anchored or counterweighted. The carriers pass from one section of cable to the next by means of intervening rails, such as used at the terminal and other stations, without being detached from the traction rope, so that no interruption occurs in the continuity of the track, and the so-called station therefore is in reality only a special type of support. The cable ends of each section may be anchored, or one section may be anchored and the other counterweighted, or both sections may be counterweighted, according to the exigencies of the location, and such stations therefore are respectively designated as double anchorage, anchorage tension, and double tension stations. The views of anchorage tension stations on the next page illustrate the ordinary timber and steel constructions.

Guard Nets and Bridges.—In crossing public highways or railroads, where it is desired to guard against the risk of accident from the premature discharge of a bucket or other cause, wire nets are usually suspended between supports on either side, or structures specially erected for the purpose. Illustrations of such nets are shown on page 29. These nets are supported by wire ropes stretched between the supports and firmly secured at each end to ground anchorages or braced bents. Accidents, however, are of very rare occurrence, and unless the traffic is considerable, a guard net is unnecessary. A possibility of such construction is

Fig. 29. Tension Station. Steel Structure.

Fig. 30. Tension Station. Timber Structure.

Guard Net on line of The Farnam-Cheshire Lime Co., Cheshire, Mass.



Guard Net on line of The Solvay Process Co., Solvay, N. Y.

illustrated in the view on page 31, showing an aerial tramway crossing a number of railroad tracks over a suspension bridge, which not only serves as a protection to the railroad, but also as a supporting structure for the track cables and traction rope of the tramway. A steel bridge covered with sheet iron spans the main tracks of the Pennsylvania Railroad near Johnstown, Pa., where the aerial tramway of the Cambria Steel Co. crosses, and a similar bridge at Plymouth, Mass., protects some tracks under the line of the Plymouth Cordage Co. Such structures, however, are only required where extreme precaution is necessary.

Along the line of the Utah Consolidated Mining Co.'s
Trenton-Bleichert Tramway,
Bingham Canyon, Utah.

Trenton-Bleichert Tramway crossing a Suspension Guard Bridge.

Stations

THE TRENTON-BLEICHERT SYSTEM of aerial tramways is more especially adapted to long hauls between definite points of loading and discharge, and finds its widest application as a means of communication with mines or quarries in mountainous or other localities where a surface line of any kind would be impracticable or could only be built at great expense. The stations are so designed and equipped as to make the operation of the tramway as nearly automatic as practicable, so that but little labor is required.

TERMINALS AND INTERMEDIATE STATIONS.—Ordinarily the only stations required are the terminals, one where the receptacles are loaded and the other where they are discharged, designated respectively as the loading and discharge terminals.

It is often desired, however, to load or discharge at intermediate points, in which case stations are erected, so designed that the carriers may be detached from the traction rope and switched off along shunt rails for such purposes, or may be run through without detaching, as circumstances may require.

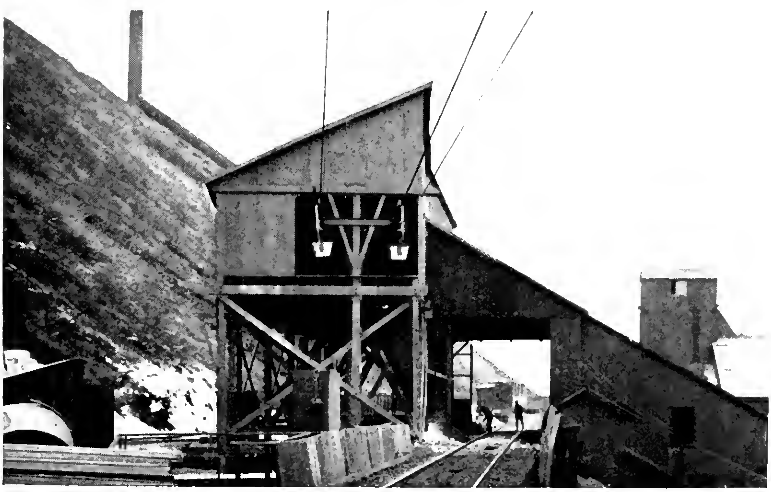
Lines of great length or very heavy capacity sometimes have to be divided in sections, owing to bends in the line, or on account of the stress in the traction rope, which if operated in one length would be so great as to preclude the ordinary sizes of rope such as the grips are constructed for. In such cases the connecting stations of course are located where the division of the line can be made to best advantage. If angles happen to occur in such a line, the connecting stations are most advantageously located at such points, but in any event due allowance must be made for the stress in the traction rope.

SHUNT RAILS, SWITCHES, ETC.—The carriers upon arriving at any station are automatically detached and shunted to overhead rails of our double-head pattern, made especially for this purpose, by means of which they are taken to the various points of loading or discharge, as the case may be, and thence to the opposite cable where they are attached mechanically to the traction rope, and again sent out over the line, loaded or empty, as the case may be.

At the points where the carriers enter or depart from a station, the shunt rails terminate in what are known as "terminal shoes"—a special form of saddle so designed that the transition of carriers to and from the cables is without jar. These shoes are provided with hinged steel hoods, similar to those used on the "protection saddles" described and illustrated on page 27, which save the cables from undue wear.

Length of line, 5,300 feet. Hourly capacity, 62½ tons.

Loading Terminal. Parley's Cañon Lime and Stone Co., Parley's Cañon, Utah.



Length of line, 12,270 feet. Hourly capacity, 60 tons.

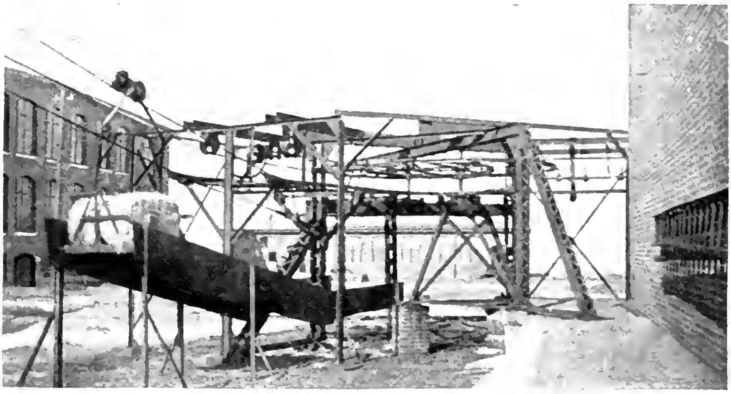
Discharge Terminal. Yampa Smelting Co., Bingham, Utah.

The diagrams on the inset sheet opposite this page illustrate the usual constructions of the terminal stations in a line operated by gravity. The ordinary shunt rails for taking the carriers around the terminal sheaves are shown in the plans by the full lines. These shunt rails may be extended by means of switches, so as to reach distant points of discharge as indicated by the dotted lines; so also at the loading terminal where the material is taken from several bins or various points of loading. Turntables are used where angles have to be turned and the space will not admit of a switch.

With such switches or turntables it is practicable to operate a system of shunt rails whereby a large area may be covered for purposes of loading or discharge.

The views of stations on page 38 show carriers in position about to be attached to the traction rope.

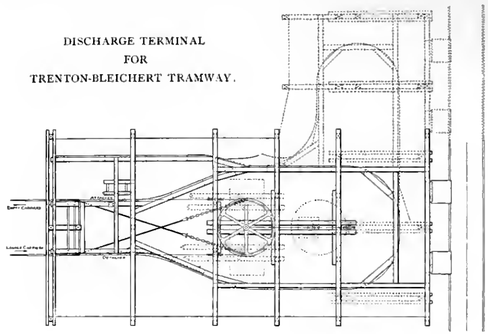
ANGLE STATIONS.—In selecting the route for any line it should be distinctly borne in mind that *it is impracticable to operate along curves, and that differences in vertical elevations, no matter how rugged the ground, are seldom considered, from a practical point of view, as obstacles to a perfectly straight course.* It is not always possible, however, to obtain the right of way for a straight course, and bends are made in such cases, but it should be clearly understood that such bends are only practicable by angles, and that every angle requires a station for supporting the necessary deflecting sheaves and shunt rails. With overhead grips the carriers if desired may be passed around the sheaves without detaching from the traction rope, but it is necessary in such cases to use sheaves of large diameter, requiring expensive structures. It is not always practicable, however, to use overhead grips. With underhung



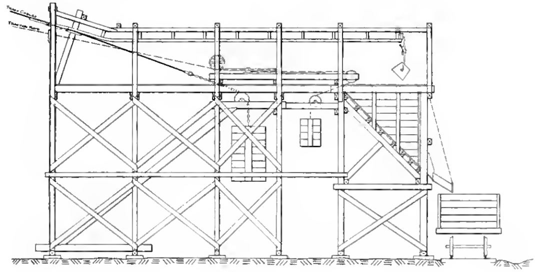
Length of line, 1,150 feet. Hourly capacity, 7½ tons.

Angle Station. Plymouth Cordage Co., Plymouth, Mass.

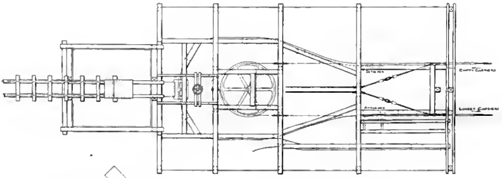
DISCHARGE TERMINAL
FOR
TRENTON-BLEICHERT TRAMWAY.



PLAN

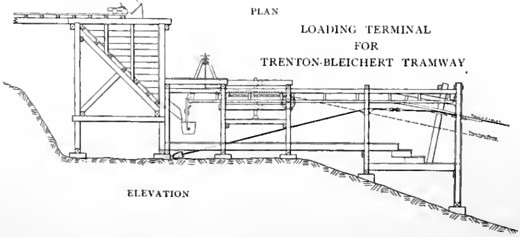


ELEVATION



PLAN

LOADING TERMINAL
FOR
TRENTON-BLEICHERT TRAMWAY



ELEVATION

grips the carriers must be detached from the traction rope upon entering the station, in order to pass the deflecting sheaves, and be re-attached in despatching them from the opposite sides. Intervening shunt rails are used for this purpose and an attendant is required to pass the carriers and grip them to the traction rope. Such stations, therefore, add not only to the first cost of the equipment, but also to the cost of operating, and should be avoided as far as possible. There is no objection, however, to angle stations in cases where these happen at points of loading or discharge, or where one section of a line connects with another section, since stations with attendants would be required at such points in any event.

Length of line, 21,000 feet. Hourly capacity, 100 tons.

1,100-foot Span on Utah Con. Tramway, Bingham Canyon, Utah.

Speed Controllers.—It usually happens, especially with ores, coal and other raw materials, that the discharge is at a lower elevation than the loading station, and that the fall is often sufficient for the gravity of the descending material to develop an amount of power in excess of that required to operate the line. In such cases brakes are provided, consisting usually of steel bands lined with hardwood blocks which are operated by levers or screws, and if the surplus power developed is not great, such brakes are sufficient to control the speed. In cases where the surplus power exceeds 15 to 20 H. P., it is not easy to control the speed by brake bands alone, and in such cases hydraulic speed controllers of our own manufacture are furnished (illustrated in Fig. 31), which are specially designed for automatically regulating the speed.

The machine consists essentially of a closed tank or receptacle for a specially prepared liquid; a valve, the position of which is determined by a governor; and a pump, the action of which causes the liquid to circulate through the valve, the same liquid being used continuously. The operation is as follows: As the tramway increases its speed the pump runs faster, the governor decreases the aperture of the valve port, which increases the pressure in the

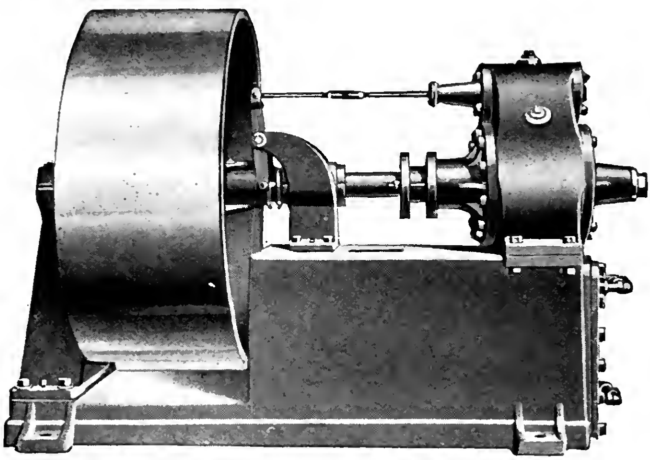


Fig. 31. Hydraulic Speed Controller.

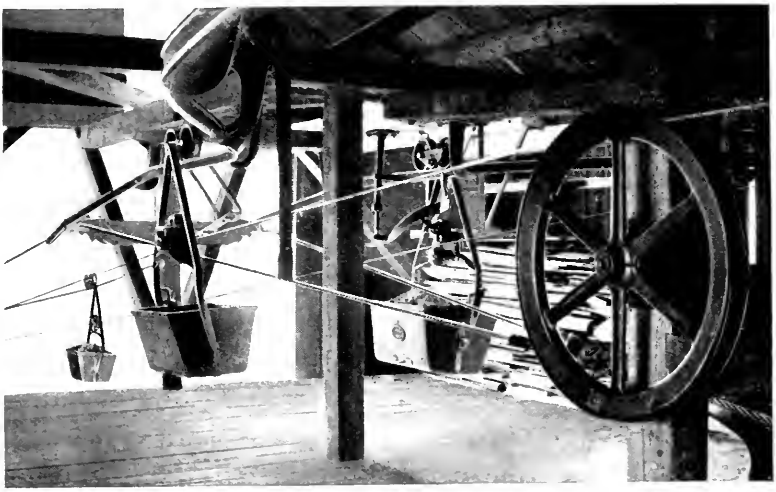
pump chamber, adding to the work of the pump, thus absorbing the surplus energy and holding the line at its normal speed. If the tramway should run too slow, the governor opens the valve wider, thus lessening the pressure in the pump chamber and the work of the pump, relieving the tramway of a certain load, and allowing it to regain its normal speed. If the liquid becomes too hot, it may be cooled by running water through a coil of pipe in the tank, provided for that purpose.

The general superintendent of a line controlled by such a machine, writes as follows:

"The controller, of 50 H. P. size, was put into use November 8, 1904, and within two hours of the time it was ready to turn over it took entire control of the line, and from that time until now, excepting during the five months that our mill was shut down, pending the completion of certain changes, it has operated to our very great satisfaction. Our tramway, as you know, was one of the most difficult to control of all the tramways in the West. Built as it is, crossing high ridges and going down into the gulch at the Curve Station, high bursts of speed were unavoidable with the old hand brakes. The result was constant breakage of standing cable and numerous runaway buckets. The controller has changed this absolutely, and the speed control is remarkable. Neither in riding the line nor in watching it is any appreciable change of speed noticeable, and it will run for hours at a time delivering exactly the rated number of buckets. This improved condition has reacted most strongly to lengthen the life of both the traction and standing cables. The former is in perfect condition, and the repair item on the latter has been reduced by 75 per cent. The labor of one man on each shift is saved. Therefore, taking all these points into consideration, it affords us pleasure to give this machine our heartiest endorsement."

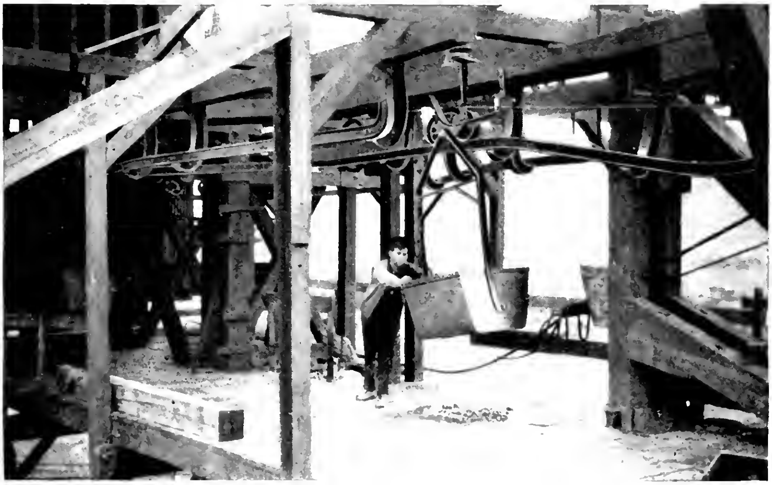
The surplus power may often be utilized for operating crushers or other machinery, or for transporting back freight. In such cases, however, owing to the variable amount of power required, it is not well to depend solely upon the surplus power developed by the tramway. If this surplus power is always in excess of the power required to run the machinery, or raise the back freight, as the case may be, a speed controller such as we have described should be attached to the operating mechanism, as otherwise it would be difficult to maintain a uniform speed, and the operation would be unsatisfactory. If the power required will exceed the surplus power developed by the tramway, always or even occasionally, an engine or motor of some kind with a suitable governor should be provided to supply the deficiency in power or absorb the excess, and serves as a controller to maintain a uniform speed.

Automatic Loaders.—Requests are frequently received to quote prices on aerial tramways equipped with automatic loaders, under a misapprehension that they are economical of labor. Such devices are necessary on lines with carriers attached permanently to the traction rope by means of clips, in order that the buckets may be loaded while in motion, and are the exigency of a condition, and not a means introduced to save operating expense. Lines equipped with automatic loaders have to be run at slow speed, or at least the speed has to be slackened while the buckets are being loaded, and in some instances it has been found necessary to stop the line altogether at such times. Such a device can only be used on lines of relatively small capacity. A man is invariably required to attend to the brake or driving machinery, and the same man has also to attend to filling the automatic loading chute from the main bin, to say nothing of having to clean up the material spilled, whereas in our design, the carrier with empty bucket automatically detaches itself from the traction rope upon entering the terminal, and by its own momentum runs to the loading point. Here the operator has only to raise the gate of the loading chute, keeping it open for a



Length of line, 3,000 feet. Hourly capacity, 10 tons.

Loading Terminal, showing Carriers with Underhung Grips, one in position for attaching, and the other about to be detached from the Traction Rope. Bagdad Chase Gold Mining Co., Atlanta, Idaho.



Length of line, 1,300 feet. Hourly capacity, 30 tons.

Loading Terminal, showing Carrier with Overhead Grip about to be attached to the Traction Rope. St. Louis, Rocky Mountain & Pacific Co., Koehler, New Mexico.

few seconds until the bucket is full, and then quickly closing the gate, he pushes the carrier along the shunt rail into the mechanical attacher, shown in Fig. 9, which grips it again to the traction rope. This whole operation can be effected in less time than is required with an automatic loader, it does not require any more labor, and the line can be run at a constant speed, double that of a line with automatic loader, thus proportionately reducing the number of car-

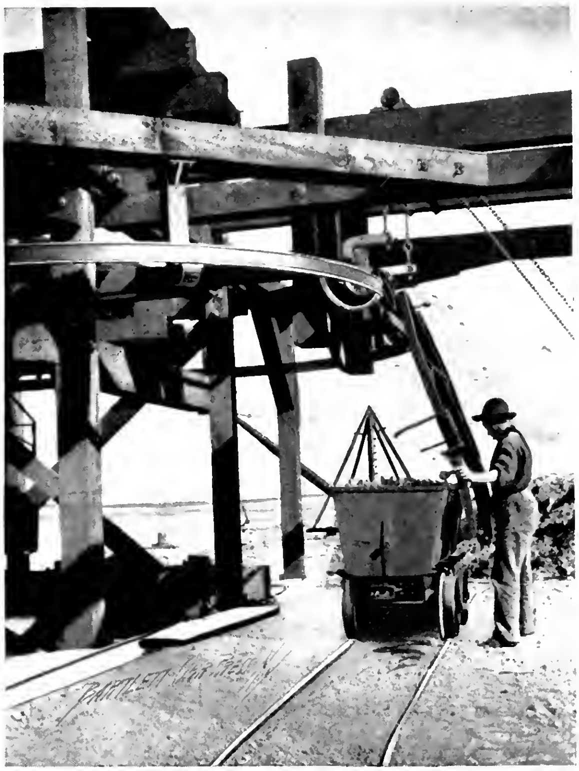


Fig. 32. Transferring Buckets to and from Surface Cars by Mechanism.

riers and the wear and tear. There is nothing to get out of order, and no material to be cleaned up at intervals from the floor of the loading station. Our method of operating furthermore admits of loading from, or discharging into, a number of bins, which is often desirable, as, for instance, in the case of ores that have to be graded, or where the output of several mines has to be kept separate. It also admits of the transportation of back freight, such as coal for operating, timber and supplies, which cannot be done on lines with automatic loaders without stopping the line.

Length of line, 12,270 feet. Hourly capacity, 60 tons.

Line of Yampa Smelting Co., Bingham, Utah, showing portion of 750-foot span, and 90-foot support.

Length of line, 12,650 feet. Hourly capacity, 40 tons.

Along the line of the Gold Prince Tramway, Animas Forks, Col.

Transfer of Buckets to and from Surface Cars.—Ordinarily the buckets are loaded from bins by means of chutes, such as shown in the view of the loading station on page 12. In the case, however, of materials that will not readily flow through a chute, such as rock in large lumps, sticky clay, or materials like soft coal that would suffer from breakage if handled in this way, the buckets, if desired, may be transferred to surface cars, conveyed directly to the working faces of the quarry or mine, as the case may be, and after loading, returned to the tramway station, transferred back to the carrier hangers, and thus without rehandling of the material despatched over the line.

The transferring of the buckets may be effected by mechanical means, as illustrated in Fig. 32, or it may be done without such apparatus, by laying the surface track in a circuit under the station shunt rails upon a rising inclination on one side, just sufficient to lift the empty buckets from the hangers as the carriers and surface cars are moved along together, and upon a like falling inclination on the opposite side, whereby the loaded buckets in a similar manner are dropped into the hangers, as illustrated in Fig. 33. The latter method of operating requires more space, and on this account is not always practicable, but it has been found quite as satisfactory a way of working.

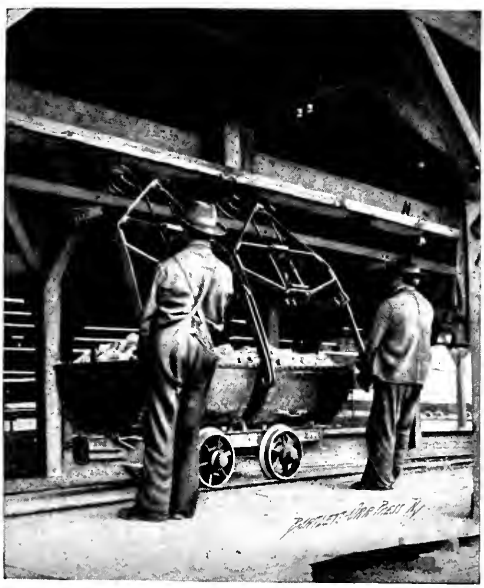


Fig. 33. Transferring Buckets to and from Surface Cars by Inclined Tracks.

Dock Hoists.—Trenton-Bleichert tramways are used advantageously in many places for conveying materials from vessels or boats alongside docks, to warehouses or factories, and in such cases it is generally found most convenient to use hoists operated by separate power for taking the materials out of the holds of the vessels, since the work of a dock hoist is more or less intermittent. Conditions sometimes occur, how-

Length of line, 525 feet. Hourly capacity, 30 tons.

Dock Hoist and Loading Terminal. American Agricultural Chemical Co., Searsport, Maine.

Length of line, 1,050 feet. Hourly capacity, 30 tons.

Dock Hoist and Loading Terminal, Maine Insane Hospital, Augusta, Maine.

ever, where it may be practicable to operate both hoist and tramway from the same power. Coal, ore, and like materials are handled in this way by elevating them to bins from which the tramway buckets are loaded by chutes in the usual way. Two views of such stations are shown on page 42.

It is generally desired in such cases to unload quickly, and bins of ample size therefore should be provided, with hoists exceeding the capacities of the tramways, so that the work of the latter may be regular and not intermittent.

ELEVATORS, SCALES AND COUNTERS.—The carriers, if desired, may be raised or lowered at any terminal or intermediate station by means of elevators or hoists specially designed for the purpose. If the loaded carriers are raised, such elevators are operated in the usual way by belts or a suitable motor. If, however, the loaded carriers are lowered, it is customary in this case to use two cages, so that the power developed by the gravity of the loaded carrier may be used to raise the empty carrier, the motion of the cages being controlled by means of brakes.

The cage of such a hoist in either case is usually provided with a short section of rail having a slight depression cut in the upper edge, just long enough to accommodate the carriage, and serving to hold it in place while raising or lowering.

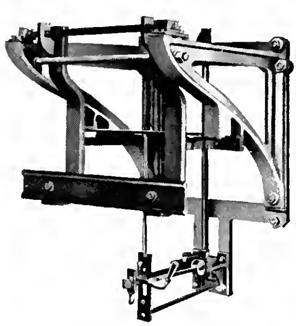


Fig. 34. Trenton-Bleichert Tramway Scale.

Upon arriving at the desired elevation, as, for instance, in passing from one floor to another in a warehouse or factory, the carriers, if necessary, can be transferred to lines of overhead rails, the same as the station shunt rails, and thus conveyed to the desired points of loading or discharge at the various elevations.

Scales are also furnished of special design, illustrated in Fig. 34, for weighing the loaded receptacles, or counters, which will automatically register the number transported.

Advantages of the Trenton-Bleichert System

1. *It is adapted to the heaviest traffic.* Capacities up to 200 tons per hour can be transported, which is not possible with any other system of aerial tramway.

2. *The carriers are moved under ordinary conditions at speeds varying from five to six miles per hour.* This is about double the speed possible with a single-rope line, or any kind of aerial tramway with carriers permanently attached to the traction rope, or with receptacles that have to be loaded in motion. It follows that

3. *The number of carriers required for a given service is less than with other lines.*

4. *The loading and discharge of the receptacles at either terminal or intermediate station can be effected at any point or any number of points.* This is not practicable with other lines having carriers permanently attached to the traction rope or receptacles that have to be loaded in motion.

5. *The steepest grades can be surmounted without difficulty.*

6. *Less power is required, or more developed, as the case may be, than with any other system.* This is due to the smooth surface of the track cables, and their greater strength than ordinary cables of the same size, admitting of tensions such as to make the path of the carriers more nearly along a direct line between the terminals than is practicable with other lines using ordinary cables.

7. *The carriers, if necessary, can be run around angles without requiring the services of an attendant.* (See page 34.)

8. *The carriers can also be run about either terminal, where no loading or discharge of the receptacles occurs, without requiring the services of an attendant.*

9. *Low cost of operation and maintenance.* The economy of a Trenton-Bleichert tramway is apparent in the longer life of track cables, and the less wear and tear of the operating parts, due to the fact that the workmanship is first-class in every respect. Only the best materials are used in the construction of the various parts, which are made to standard gauges, so that renewals or repairs can be made promptly and cheaply.

Cost of Operation and Maintenance

THE following extracts from testimonial letters will best convey some idea of what it costs to operate and maintain a Trenton-Bleichert tramway:

From The Solvay Process Co., Syracuse, N. Y.:

"With reference to the statement of the cost of operating as determined from actual records, we have to say that with greater traffic, we are enabled to considerably reduce the expense, and while we have not kept the accounts separate for the main line, we can say that the cost, including general expenses and taxes for the main line (three and one-quarter miles long), and the quarry lines (aggregating one and one-quarter miles in length), at which we can transport the stone, is approximately the following:

No. of buckets per month	110,000
Gross tons per month	55,000
Cost per bucket, holding one-half ton	$0.04
Cost per gross ton	$0.09
Cost per net ton	$0.08
Cost per ton—mile	$0.02

"The cost of transportation over the short branch lines is less than 3 cents per bucket, which, however, is more than 2 cents per mile because the main expense is at the terminals. In the main line costs, about one-quarter has to be transferred from the pockets to the line. These expenses do not include the cost of transferring the buckets from the cars to the rails, but includes only the cost of despatching and receiving the buckets."

From The Eureka Slate Co., Slatington, Cal.:

"The tramway is operated directly by water power, requiring a maximum of about 20 H. P. The cost of transportation when the tramway is run to full capacity is about five cents per square (about 700 lbs.). The tramway has been in constant operation for a little more than four years. It has never been out of commission, has cost not to exceed $25 per year for maintenance, and I am pleased to advise you that it is one of the most satisfactory pieces of machinery that it has ever been my pleasure to install."

The length of this line is 13,300 feet, and the capacity 300 squares of slate in nine hours.

From The Colorado Fuel & Iron Co., Denver, Col.:

"Replying to yours of the 28th in regard to the operation of the tramway at Sopris, the amount of material handled on this line is approximately 100 tons per day, and the cost of operation and maintenance for the past year has been between three and four cents per ton of material handled. For the past two years it has cost little or nothing for repairs and has been very satisfactory in operation."

This line is 2,370 feet long, and is used for disposing of waste from a coal washery. Self-dumping buckets are used, and the capacity is 20 tons per hour.

From The Cia. Manufacturera de Ladrillos Areniscos, Coah, Mexico:

"The overhead tram has given excellent results, handling 500 tons of sand every nine hours with the greatest facility, at a cost of four cents U. S. currency per ton, and considering the difficult manual labor in filling the cars from the river bottom, I think that the cost is very reasonable."

This line is 1,950 feet long, and has a capacity of 22½ tons hourly.

From The Mond Nickel Co., Ltd., Victoria Mines, Ontario, Canada:

"Regarding the tramway built by you which we have operated, would say that it is satisfactory in every way and the repairs have been very light. The ropes are still in good condition and show very little sign of wear. The cost of operation has been about six cents per ton mile on a basis of 150 tons per day, including loading and unloading."

This line is 11,400 feet long, and is used for transporting ore. The capacity is 25 tons per hour.

From The Curwensville Fire Brick Co., Bolivar, Pa.:

"We are pleased to state that the tramway you erected at our plant in 1903 has been in successful operation ever since that time without interruption and we have experienced no trouble whatever with it, but have found it entirely satisfactory in every respect. The only expense that has been necessary in maintaining it is the price of the oil that we have used on the cables, and the only cost of operation is the expense of a man at each terminal.

"We may add that we are transporting at the present time about fifty tons of clay per day at an actual cost of $3.50 to $4 per day, while previously we were obliged to haul our clay on wagons at a cost of 45 cents per ton, which would represent $22.50 for the quantity we are now using, or a saving to us at the present rate of operation of $15 to $20 per day. Of course, during a good part of the time that we have had this in operation we have only handled about one-half the material we are now transporting."

This line is 2,337 feet long, and the capacity 20 tons per hour.

From The Catskill Cement Co., Smith's Landing, N. Y.:

"Replying to your favor of March 16th, we beg to say that our experience with your tramway has been very satisfactory. It has proved to be a very efficient and economical means of transportation, and cost of repairs has been comparatively small taking all things into consideration. This tramway has been in operation now nearly six years, the last four years of which it has been carrying about 300 tons of stone per day of ten hours."

This line is 4,170 feet long, and capacity 20 tons hourly of stone.

From The Cayuga Lake Cement Co., Ithaca, N. Y.:

"Replying to your chief engineer's request regarding the success which we are having with the tramway which you installed for us in 1901, would state that the best evidence we can give possibly is to give you the expense for repairs during the past year, owing to the fact that we keep an account of each department in our works for all repairs made during the year, and we find that the tramway in question has carried on an average about 350 tons daily and the total cost for repairs on the tramway has been $34.57 for the past year.

"We wish to further state that the tramway is a perfect success, and we think it is the finest system of any in use."

This line is 2,340 feet long, and capacity 20 tons hourly of stone.

From The Vermont Marble Co., Proctor, Vt.:

"In reply to your letter of recent date, will say that in 1894 we installed the first tramway furnished by your people, which was about 1,600 feet in length. We operated this tramway continuously for about eight hours a day until 1900, then we extended the line for about two miles, using all of the ropes and apparatus that we installed originally in 1894. Since installing the longer line, we have been operating it continuously for ten hours a day, and about half the time have been running it half the night. This makes more than twelve years of continuous day service, and it was not until last year that we began to replace the standing ropes. During this time we have put in one new transmission (traction) rope. We now have in operation a large part of the apparatus that was originally installed in 1894. It seems impossible that any machine could do better work or give better satisfaction than this has done."

This line is 11,000 feet long, and capacity 15 tons hourly of sand.

From The Kittanning Coal & Coke Co., Kittanning, Pa.:

"We have gotten from you all the supplies necessary to keep this tramway in order, and I think your books will scarcely show more than $50 or $60 expenses on the entire system since we first installed it.

"There is no question in our mind whatsoever that your tramway will take all the coal we can dump into the loading bunk. We have moved over 400 tons of coal a day and we average likely 300 tons daily, and I am certain that the system is not in operation more than 50 per cent. of the time.

"As a means of transportation, we consider it perfect. It costs us about $15 daily to run it, and, of course, the cost of the coal per ton depends entirely upon the amount of coal moved. It has averaged, I presume, five cents per ton, which seems high compared with loading directly from the mines onto the cars, but as we transport our coal almost a mile, we consider the cost very reasonable."

This line is 4,140 feet long.

From Washington Portland Cement Co., Concrete, Wash.:

"The costs per ton for transporting material over our tramway are as follows:

During year 1909, 78,734 tons carried @ .03991 cent per ton.
During year 1910, 79,767 tons carried @ .02939 cent per ton.
During year 1911, 111,097 tons carried @ .03602 cent per ton.
During year 1912, 118,396 tons carried @ .06385 cent per ton.
During year 1913, 172,413 tons carried @ .02877 cent per ton.

"The costs for the first six months in 1912 were high, due to the purchase of new track cables and additional rolling stock, required to increase the capacity of the line."

This tramway is 3,750 feet long, with an hourly capacity of 60 tons of limestone. Initial installation was for 45 tons per hour.

From Tintic Mining and Development Co., Bingham:

"We have operated a Trenton-Bleichert Tramway, built by the Trenton Iron Works, for the last six years. It was running continuously for five years. The other year we were closed down on account of strikes.

"We have transported on an average of 600 tons per day of nine hours, a distance of 2½ miles, at a cost of 8¼ cents per ton.

"The upkeep has been very slight and the tram has given perfect satisfaction, and is still running smoothly."

Reversible Aerial Tramways

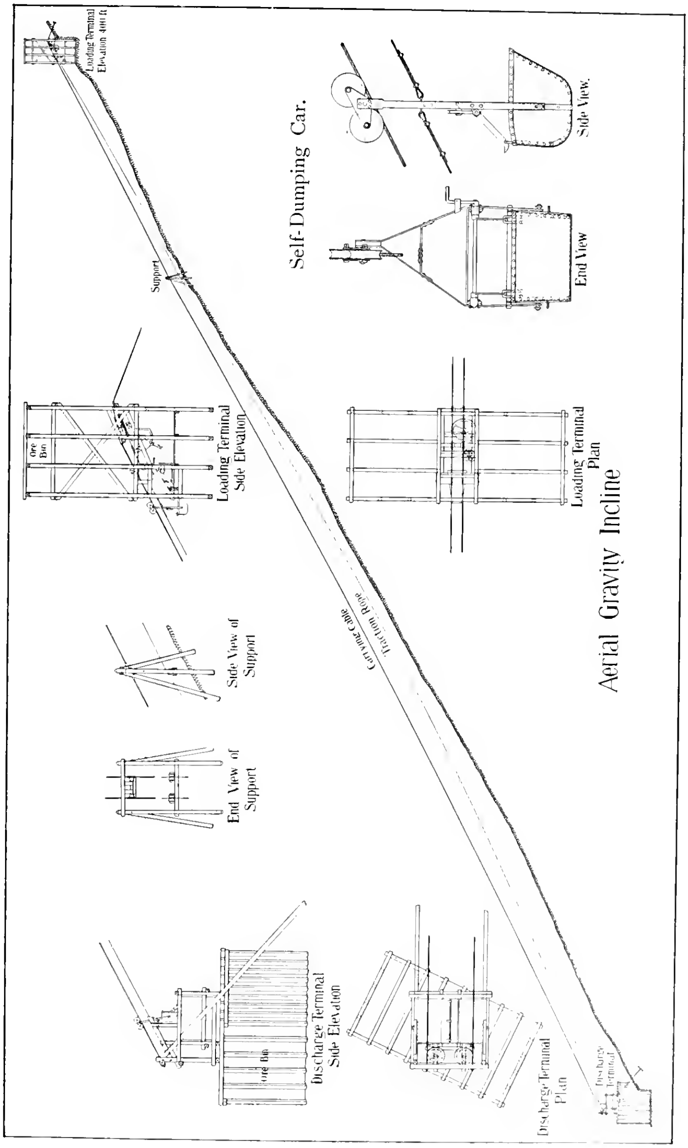
LINES of comparatively short length or of light capacity are often operated most advantageously by reversing the motion of the traction rope at each trip of the carriers, and are known as reversible aerial tramways. We offer these where a cheap equipment is desired, and where the conditions are adapted to such a line, it may be operated quite as satisfactorily as a Trenton-Bleichert tramway. Lines of this kind are built with a pair of carriers, one on each of two parallel track cables, or with one carrier on a single track cable, and are designated respectively as double-cable and single-cable reversible tramways.

The carriers are usually provided with self-dumping receptacles, and loads are carried up to a ton in weight. Hand-dumping receptacles, however, are sometimes used, especially in cases where the carriers have to be detached from the traction rope at either or both of the terminal stations, and are conveyed to the points of loading and discharge by means of shunt rails. A sufficient number of carriers are provided with such lines, so that some may be loading or discharging while others are in transit. Since the lines are stopped at each trip of the carriers, the average speed may be considerably beyond what is practicable with a Trenton-Bleichert tramway. The usual speed is about 600 feet per minute, but in cases where there are no intervening supports, speeds are attained as high as 1,000 feet per minute. Where lines are run at these very high speeds, however, the wear of the track cables and carriage wheels is proportionately greater, and these cannot, therefore, be expected to last as long as those in lines running at more moderate speeds.

The capacity of a reversible aerial tramway, either of the double-cable or single-cable type, is directly proportional to the load and inversely proportional to the distance, and will rarely exceed 25 tons per hour. Such a line is generally designed at the outset for its maximum capacity, and is not, therefore, recommended in cases where a subsequent increase in the capacity is contemplated.

DOUBLE-CABLE REVERSIBLE TRAMWAYS.—Reversible aerial tramways with two parallel track cables, as ordinarily constructed are equipped with two carriers, one loaded and one empty, which travel alternately in opposite directions, and are sometimes known as "two-bucket" or "twin-cable" tramways.

These lines may be operated by power or by gravity, according to the relative elevations of the terminal stations. Lines operated by gravity are commonly known throughout the western states as "jig-back" tramways.


Loading Terminal
Elevation 400 ft.
Support
Self-Dumping Car.
Side View.
End View
Ore Bin
Loading Terminal
Side Elevation
Loading Terminal
Plan
Traction Rope
Carrying Cable
Side View of
Support
End View of
Support
Aerial Gravity Incline
Ore Bin
Discharge Terminal
Side Elevation
Discharge Terminal
Plan

On the preceding page is illustrated in detail the general features of such a line equipped with self-dumping and self-righting buckets. (See Fig. 21, page 21.) The two carriages each travel on parallel steel track cables of the locked-coil or smooth-coil constructions, and are attached to a light traction rope, usually ½-inch diameter, the movement of which is controlled by brakes at the upper terminal station.

A view is shown on page 51 of the discharge terminal of such a line, built for The Ross Mining and Milling Co., Silverton, Col. The line is 1,400 feet long, with a fall of 524 feet, and has a capacity of 10 tons per hour. The track cables are 1¼-inch diameter, of the locked-coil construction (see Fig. 1, page 7), and the traction rope is ⅝-inch diameter. The buckets are self-dumping, but not self-righting like those illustrated in Figs. 13 and 14, page 19.

A similar line of 5 tons hourly capacity built for the Old Hundred Mining Co., Howardsville, Col., is 1,850 feet long with a fall of 1,050 feet, and another line operated in conjunction with this is 760 feet long with a fall of 515 feet; these two lines serving as feeders to a Trenton-Bleichert tramway of 25 tons hourly capacity, 1,610 feet in length.

A line built for Thomas & Spillane, San Luis, Potosi, Mexico, 825 feet long and 425 feet fall, is equipped with self-dumping and self-righting receptacles specially designed for transporting railroad ties.

Many other lines have been built, among which may be mentioned one for the Pulaski Iron Co., near Buchanan, Va., which is 960 feet long with a fall of 494 feet.

A line operated by power, built for the Victor Fuel Co., Hastings, Col., is used for disposing of refuse rock from a coal washery. The line is 1,850 feet long with a rise of 57 feet, and has a capacity of 15 tons per hour.

Single-Cable Reversible Tramways.—Reversible tramways with a single-track cable are applicable generally to lines operated by power, in which one carrier traveling back and forth, is sufficient to carry the desired capacity.

The receptacles are designed to suit the material to be carried, and may be self-dumping or not, according to the conditions of loading and discharge.

The carriers may also be detached at either terminal if desired, in order to reach points of loading or discharge not directly accessible by the cable line. The requisite number of carriers are provided in such cases, so that as one is in transit the others may be loading or dumping. The carriers are conveyed to the points of loading or discharge, as the case may be, by means of shunt rails as in other

Length of line, 1,400 feet. Hourly capacity, 10 tons.

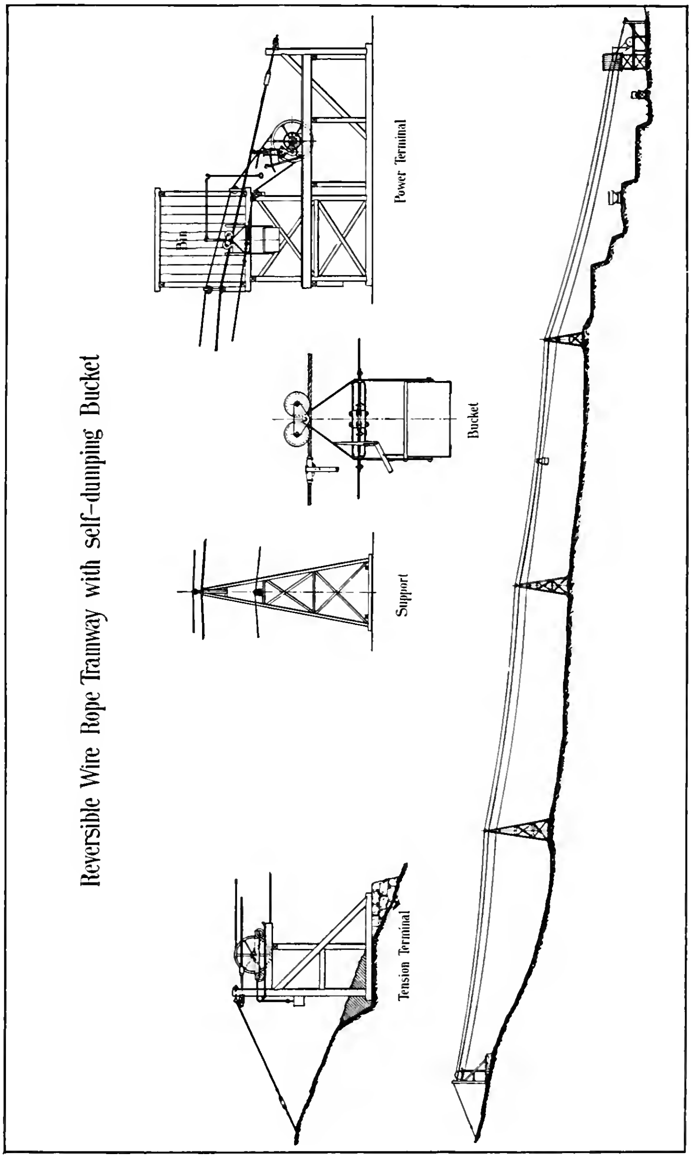
Double-Cable Reversible Tramway of The Ross Mining and Milling Co., Silverton, Col. View of Discharge Terminal.

aerial tramways, and switches are provided so that the carrier coming in may pass the one going out.

The receptacles or buckets may also be transferred to and from surface cars if desired, where it is not practicable to reach the points of loading or discharge by means of shunt rails, on account of the supporting structures which would be cumbersome, or liable to injury from blasts, as, for instance, in quarry work.

On page 52 is illustrated in detail a line of this kind built many years ago for the St. Bernard Coal Co., at Earlington, Ky., for carrying refuse from their coal washer, which is still in operation.

A single bucket holding half a ton, suspended from a carriage running on a 1½-inch track cable of the smooth-coil construction (see Fig. 4, page 8), is moved by a 7-16-inch endless traction rope driven by a small reversing engine. Trippers clamped to the track



Reversible Wire Rope Tramway with self-dumping Bucket cable at the dumping points disengage a latch on the bucket hanger, releasing the bucket, which is so balanced as to discharge automatically. The construction of the latch in this particular case is such that the loaded bucket passes the trippers going out without lifting the latch. In coming back, however, the latch is disengaged and the bucket dumps, thus permitting of the use of a number of trippers, and the discharge of the bucket at various points without having to shift any of the trippers. One man operates the line.

The carrier is permanently attached to the traction rope, and the bucket after dumping, returns to the loading terminal upside down, which gives it a chance to thoroughly clear itself of the refuse material before reloading.

The line at Earlington is about 600 feet long and has a capacity of 10 tons per hour. The ground immediately under the line having been filled in, the buckets are now discharged into side-dump cars, and the material in this way is conveyed by means of portable tracks to the dump banks on either side of the cable line, and a large area of ground is thus covered.

Materials may be transported by such lines in either direction, and where the power can be taken from some convenient shaft, the traction rope may be operated from either end by double-friction clutch pulleys, driven by straight and crossed belts.

The view on page 54 shows a line of this kind built for the Philadelphia & Reading Coal & Iron Co. for conveying ashes from the boiler house at the West Shenandoah Colliery to the dump, and affords a good illustration of what can be done with such a line—the pile of ashes in the picture representing the accumulation of four years.

This line is 1,485 feet long, and has a capacity of 7 tons per hour. The carriers, three in number, are provided with overhead grips, and the buckets, 35 cubic feet capacity, hold each 1,400 pounds of ashes. A single line of shunt rail connects the boiler house with the terminal station, where the carriers pass each other by means of an automatic switch. The carriers are illustrated in Figs. 13 and 14, page 19, the former showing a loaded carrier about to be attached to the traction rope, and the latter showing an empty carrier passing a support on the return trip. In Fig. 13 is also shown the mechanism for closing the jaws of the grip on the traction rope in dispatching a carrier, and also the inclined plate for releasing the grip when the empty carrier returns, known respectively as the attacher and detacher, which are placed close together.

Length of line, 1,485 feet. Hourly capacity, 7 tons.

Single-Cable Reversible Tramway of The Philadelphia & Reading Coal and Iron Co., at the West Shenandoah Colliery, Pa., showing dump.

The Philadelphia & Reading Coal & Iron Co. now have four of our tramways operating as shown on opposite page.

Among other lines of this description may be mentioned one 600 feet long built for the Megargee Paper Mills, Modena, Pa., which serves to carry paper and the various materials used in its manufacture.

A line 800 feet long, built for the Peart, Nields & McCormick Co., of Belfield, Va., is used for carrying sawmill refuse.

A line 1,060 feet long, of 7½ tons hourly capacity, built for B. Laughon, of Pulaski, Va., is used for conveying sand from an island in a river to railroad cars.

A line 800 feet long, built for the New York Juvenile Asylum, Chauncey, N. Y., is used for conveying coal; and a line 135 feet long, built for the Hamilton Manufacturing Co., of Lowell, Mass., is used for conveying rolls of cloth.

A line 640 feet long built for the Nevada United Mines Co., Ely, Nev., used to carry ore at the rate of 30 tons hourly.

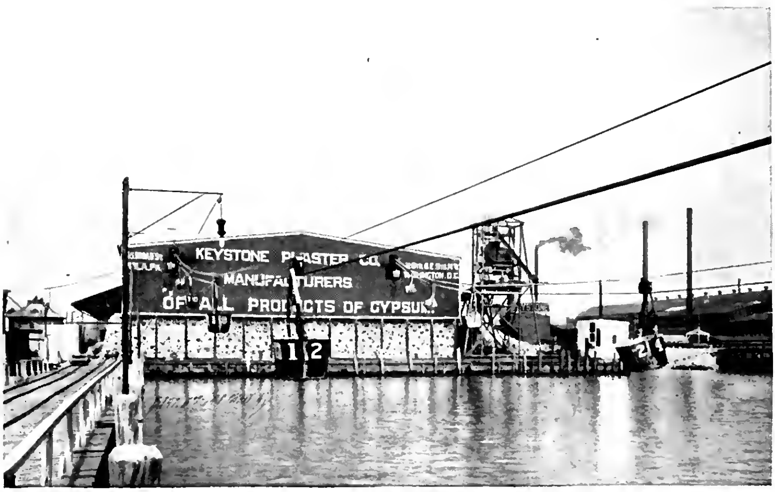
A line for the American Optical Co., Southbridge, Mass., 500 feet long, to carry spectacle lenses.

From this list, picked at random, it will be seen that there are many uses for aerial tramways, and every installation has been a factor in reducing the cost of transportation.

Mechanism for transferring Buckets to and from Surface Cars at Loading Terminal of line built for The Farnam-Cheshire Lime Co., Cheshire, Mass.

Trenton-Bleichert
Aerial Tramways of Special Design

CONDITIONS sometimes occur when an aerial tramway can be used to advantage for conveying materials to and from points in a triangular, quadrilateral, or irregular shaped circuit. This can readily be done by means of angle stations and other structures specially designed to meet the conditions of loading and discharge.



Length of line, 1,500 feet in circuit. Hourly capacity, 70 tons.

Tramway, with Self-Dumping Buckets, used for Stocking Warehouse, Keystone Plaster Co., Chester, Pa.

In a line at Chester, Pa., built for the Keystone Plaster Co., for stocking gypsum, illustrated on this page, the track cables diverge at an angle from the loading terminal on the dock, spanning a basin between this and the warehouse, close under the roof of which the carriers, equipped with self-dumping buckets, move continuously in four parallel lines above the stock piles, and can be discharged automatically at any desired point. The carriages in the warehouse travel on rails suspended from the roof bents, passing around seven angles without detaching from the traction rope. The sheaves at the angles about which the traction rope runs are 12 feet in diameter, and the total length of the circuit, including the cable lines, is about 1,500 feet. Overhead grips are used as in other lines with angle stations.

The following letter was received in response to an inquiry as to the service rendered by this line:

"In reply to your favor of the 16th, would say that the Trenton-Bleichert tramway you installed for us is highly satisfactory. We handled 65,000 tons of rock over it last season with practically no cost for repairs. As it does not require more than 6 H. P. to handle from 60 to 70 tons per hour, its operation is very economical. It is a great labor saver, and situated as we are, we could not do business without it."

SUSPENDED RAIL TRAMWAYS are used with economy for transporting materials in factories, warehouses and other locations, where a perfectly straight track is desired. These are so named from the fact that the entire track is composed of suspended rails, along which the carriers are moved as in other lines by means of a light endless traction rope to which they are gripped.

A line of this kind, 5,700 feet in circuit, having a capacity of 100 tons hourly, with 4 angle stations, was used at Aspinwall, Pa., for transporting materials in the construction of the filter beds there, from which the water supply of Pittsburg is drawn.

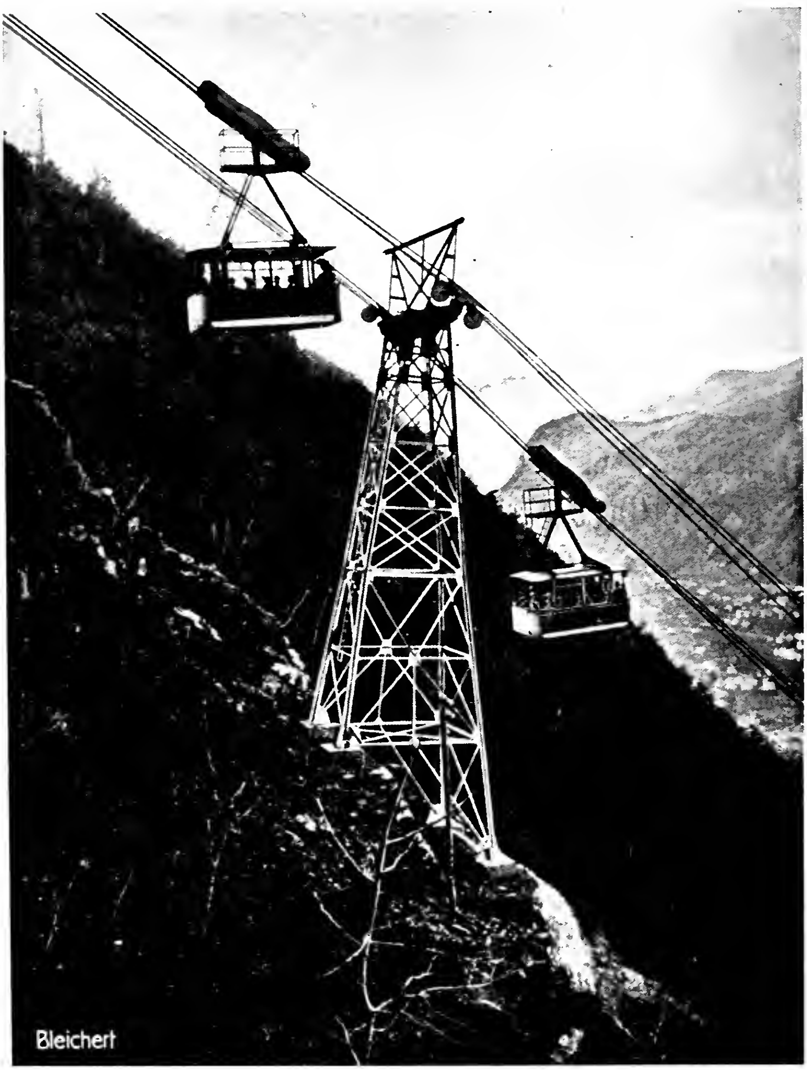
Short lines of this kind without angles, are operated very satisfactorily for moving materials in the manufacture of explosives at powder works—one at Ashburn, Mo., built for the Du Pont Company being used for carrying "dope."

We have also furnished a number of special design tramways, with automatic turnout stations, at various points along the line, for the transportation of explosives, and these are all giving very satisfactory service, which is proven by the repeat orders we receive for duplicate plants for other works.

Fifteen different installations for one company is a good criterion as to the satisfaction our tramway equipments give our customers.

Passenger Tramways

We are prepared to make estimates and furnish equipments for aerial tramways for the transportation of passengers. In our passenger equipments we have reached the acme of perfection in tramway design. Our passenger tramways are equipped with special patented safety devices, and the materials used in manufacture are of the highest grade only, the designs providing for a very large factor of safety, thereby reducing the possibilities of accident to a minimum. There are a number of Bleichert passenger tramways in operation, one notable installation being that pictured on the following page.



Passenger tramway in the Alps from the Eisack Valley to the summit of the Kohlererberg, in the Tyrol. Length, 5,420 feet. Difference in elevation between lower and upper terminal is 2,736 feet.

Stacking Tramways

While transportation has an important bearing on valuable products, it also is quite an item in connection with the disposal of such matter as cannot be sold, such as waste products.

Of course, where the waste product is only a very small percentage of the output, it is not very seriously considered. But when the percentage of waste approaches or exceeds the main product, the means of disposal should be very carefully considered. Such is the case in mining, metallurgy, etc.

In many cases a regular wire rope tramway will answer the requirements of disposing of waste product, provided there is sufficient ground room to distribute the material.

It sometimes develops, however, that the available space for piling this waste product is somewhat limited as to its area, and to provide for this contingency we have developed the stacking tramway, which can be arranged to transport the material any distance

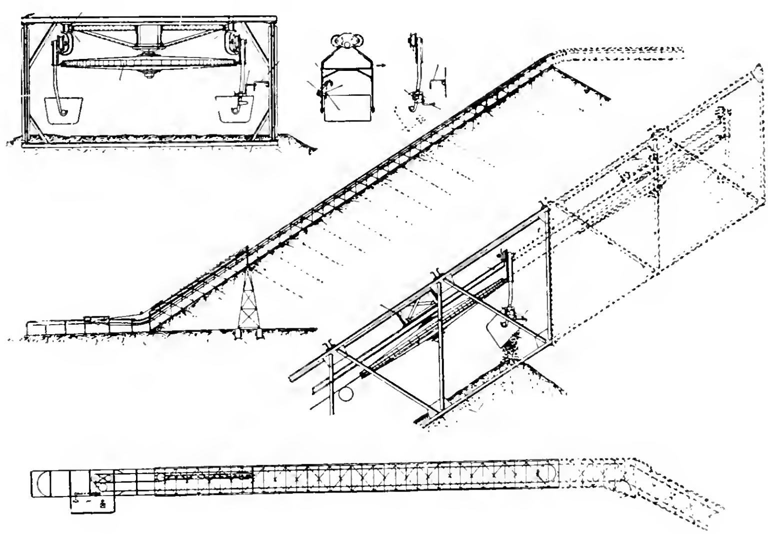


Fig. 35 Details of Stacking Tramways

and stack it in piles as high as 250 to 300 feet, and higher if occasion requires.

As seen from Fig. 35, this installation consists mainly of a bridge installed at an inclination adapted as closely as possible to the natural gradient of the heap. This bridge consists of two lateral latticed trusses with connected upper and lower ties (so as to leave the inner space free), and is provided with an endless wire-rope railway, the charging station of which lies at the foot of the heap or at any distance from the same. The bridge itself is made from a number of short sections, so as to be capable of continuous extension as the waste heap grows. After the upper end of the last section is covered and is thus furnished with sufficient support, a new link, freely suspended, is fitted according to the cantilever principle, as seen from the diagram, while the terminal pulley is shifted to this link and tipping started from the extension. As the main connections are made by bolts, dismounting can be carried out readily and cheaply. In order to simplify the extension work and to accelerate the mounting, the final pulley, together with the corresponding suspension rail section, is located in a frame suspended from rollers. As the latter run in guides, rigidly connected to the longitudinal girder, the whole frame can, after the addition of a new section, be

Fig. 36. Slag Heap and Railway at Marchienne au Pont, Belgium

advanced bodily as far as the new terminal of the bridge. With this arrangement, the tightening device of the hauling rope will obviously have to be given a corresponding increase in stroke, so as to render the addition of a further bridge section possible without inserting a further wire-rope section.

An automatic tripping device enables buckets to be unloaded without the aid of a workman, and to return empty to the loading station.

The economical advantages of the new system are self-evident. In fact, the consumption of power is extremely low, the superintendence or lighting-up of the plant on the waste-heap is entirely avoided and extension work will only be found necessary at comparatively long intervals. The following calculation illustrates the advantage of the new type of railway:

Supposing the waste heap to be stowed at an angle of 35 degrees, and in the shape of a cone, the following table will give the volume of the waste heap and the time at which extensions are to be added if 200 cu. yds. as an average be stowed per day.

Let h be the height of the heap and a the tipping angle, the volume of the cone will be:

$$J = (h \cot a)^2 \pi \times \frac{h}{3}$$

(d is the maximum breadth at the foot of the waste heap.)

h in Yards	d in Yards	J in Cubic Yards	Time Required for Stowing	
			Days=Years	Months
30	86	58,100	290= 1	—
35	100	91,630	460= 1	5½
40	115	138,500	700= 2	3½
45	129	197,000	1,000= 3	3½
50	143	267,700	1,350= 4	5
55	158	359,500	1,800= 6	—
60	172	464,700	2,350= 7	9½
65	186	588,730	2,950=10	—
70	200	733,100	3,700=12	3½
75	215	907,625	4,550=15	2
100	286	2,150,000	10,800=36	—
125	358	4,200,000	21,000=70	—

Information for Estimating

The following information is necessary to enable us to make estimates on tramway equipments:

1.—What is the length of the proposed tramway between loading and discharge points?

The line should be perfectly straight if possible. Steep grades do not add to the expense, but angles render stations necessary, with attendants to pass the carriers around the deflecting sheaves, which adds to the cost of construction and operation. If angles cannot be avoided, state the number. Curves are impracticable.

2.—Describe the ground over which the proposed tramway will be erected.

Also give difference of level between loading and discharge points, and state if loads go up or down grade, so that the amount of power required or developed may be determined, and all data, as to rivers, roads, railroads or buildings over which the line passes, stating width and necessary clearance in height. If possible, send a profile of the ground.

3.—At what elevation above ground must material be delivered to or discharged from the carriers at the terminal stations?

Information desired as to height of bins, or other means of loading or discharge.

4.—If power is required to operate the tramway, at which end can it be obtained?

5.—What is the material to be carried? About how much does it weigh per cubic foot in the form that it will be carried in the buckets, or other receptacles?

6.—At how many hours do you reckon the day's work?

7.—What quantity do you require to transport per hour?

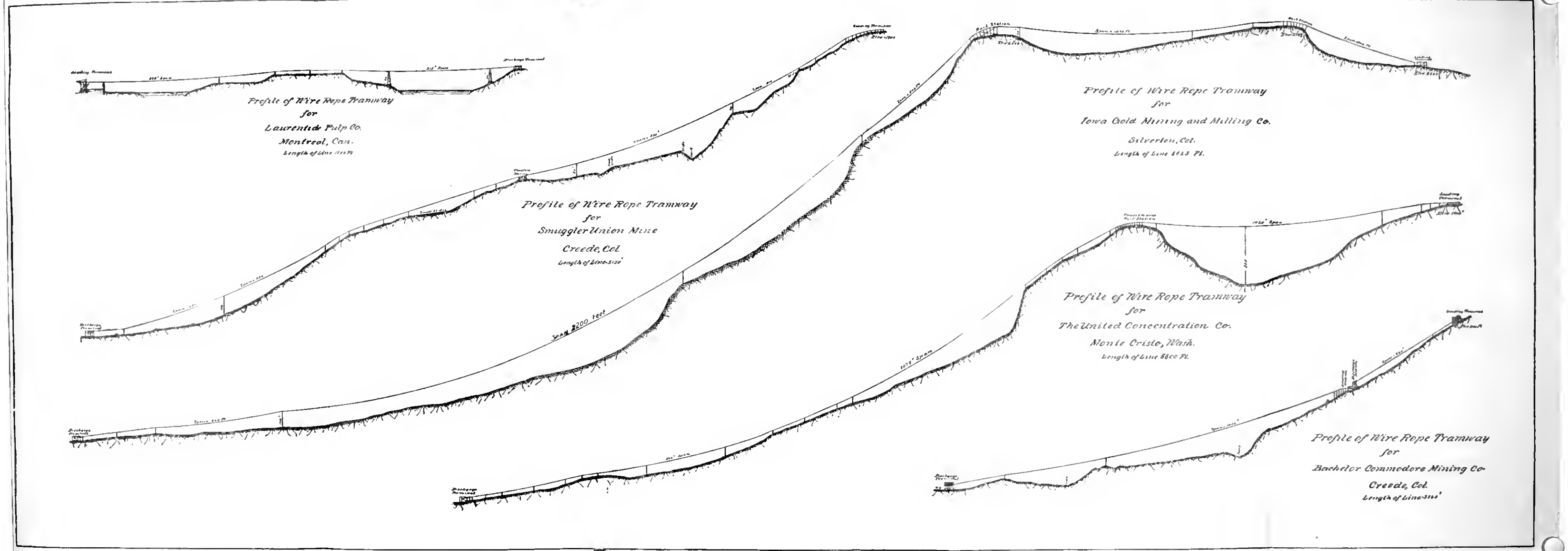
8.—In what manner is the transportation now carried on, and at what cost per ton?

This information is necessary if estimates are required showing economy of tramway transportation over existing methods.

Preliminary estimates of cost will be furnished in response to applications made out on question sheet to be found in the back of this catalog, or upon receipt of information as outlined above. Definite estimates can be furnished only after laying out the line on a profile of the ground made from an actual survey. If preferred, we will have these surveys and profiles made by our own engineers, who are acquainted with the special requirements of our methods.

Contents

The Read Printing Co., New York


Profile of Wire Rope Tramway
for
Laurentide Pulp Co.
Montreal, Can.
Profile of Wire Rope Tramway
for
Smuggler Union Mine
Creede, Col.
Length of Line-5150'
Span 2200 feet
Profile of Wire Rope Tramway
for
Iowa Gold Mining and Milling Co.
Silverton, Col.
Profile of Wire Rope Tramway
for
The United Concentration Co.
Monte Cristo, Wash.
Length of Line 5600 Ft.
Profile of Wire Rope Tramway
for
Bachelor Commodore Mining Co.
Creede, Col.

AMERICAN STEEL & WIRE COMPANY

Cable Address
"STEELMAKER NEWYORK."

30 CHURCH ST., NEW YORK

Information desired to obtain an approximate Estimate for

P. O. Address,

1.—What is the length of the proposed tramway between loading and discharge points?

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