T. S. MILLER.

CABLEWAY.

APPLICATION FILED FEB. 9, 1917.

1,401,271. **Patented Dec. 27, 1921.**

6 SHEETS—SHEET 1.

Fig. 1.

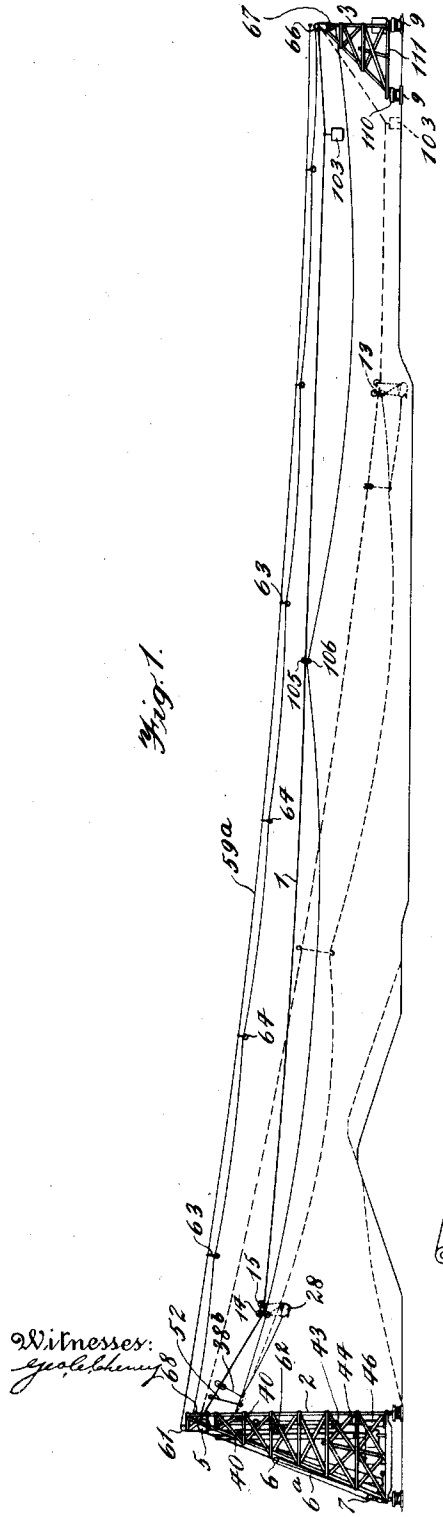
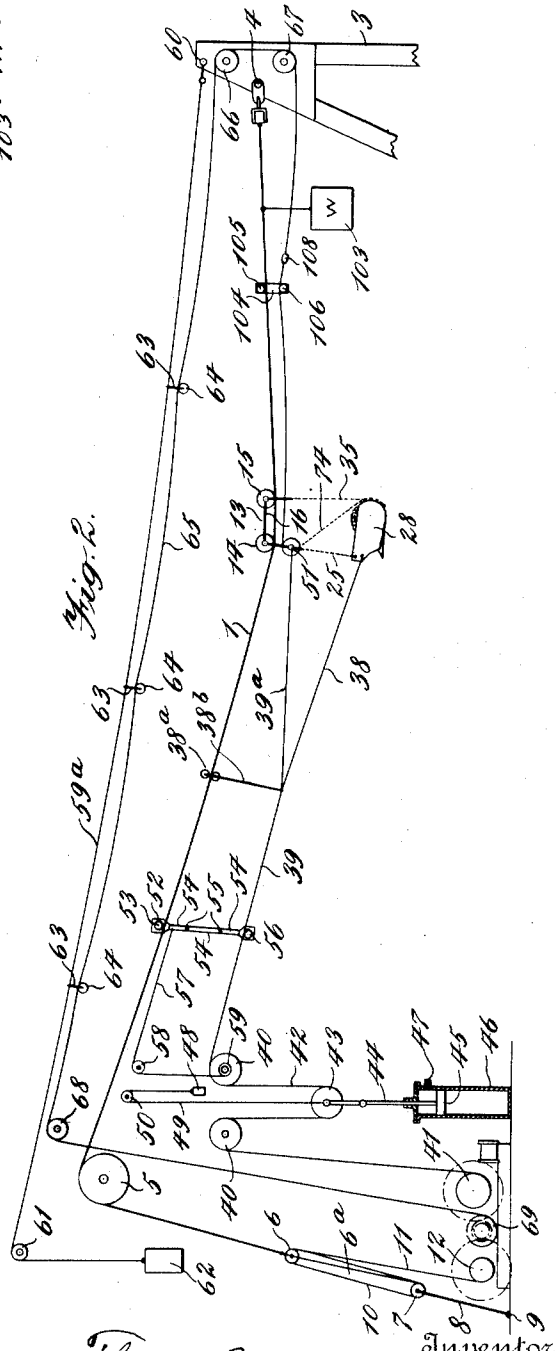


Fig. 2.



Witnesses:

Inventor

Thomas Spencer Miller

By his Attorneys

Gifford & Bull

T. S. MILLER.

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6 SHEETS—SHEET 2.

Fig. 3.

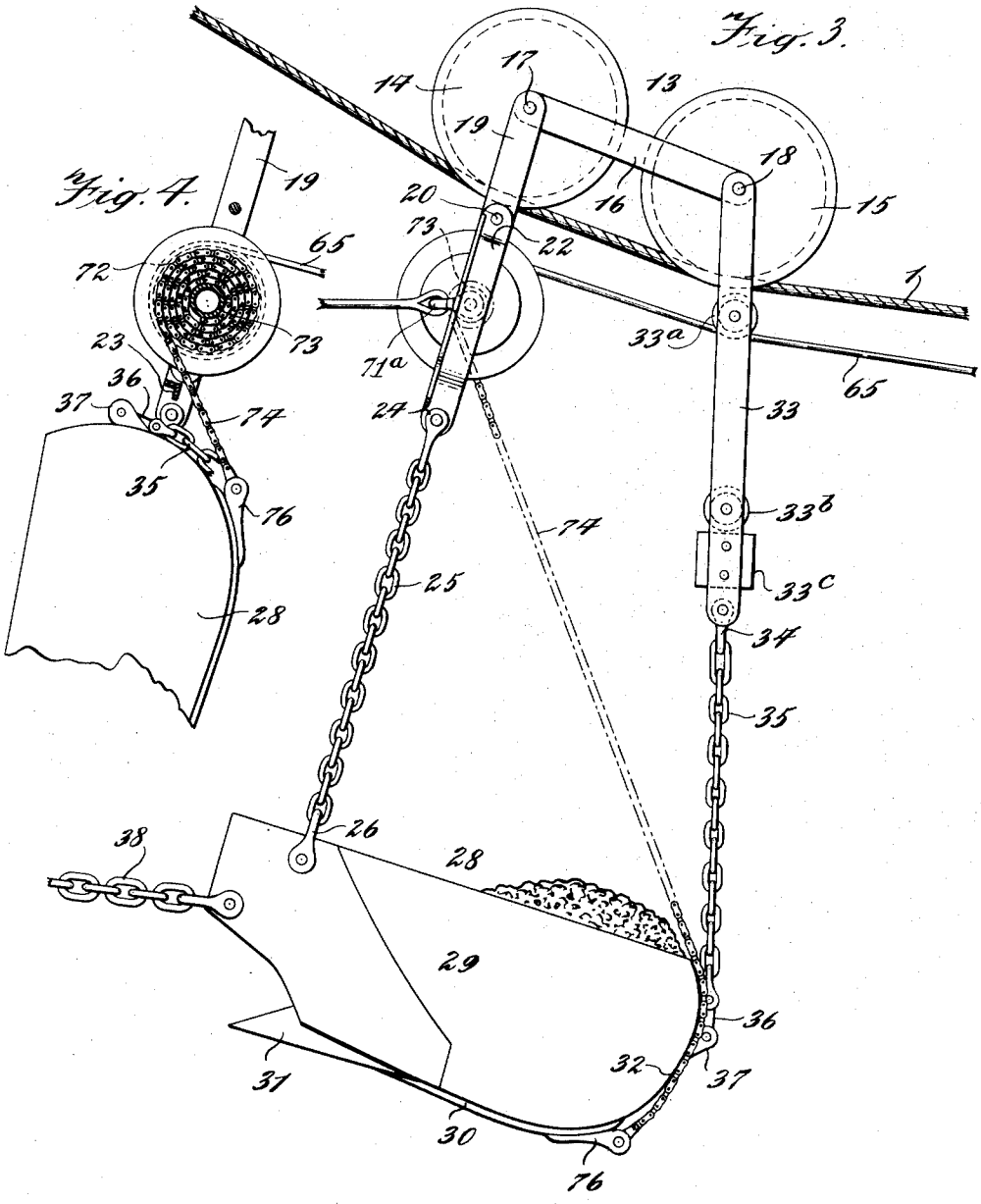


Fig. 4.

Witnesses:
Geo. Gibney.

Inventor
Thomas Spencer Miller
By his Attorneys
Gifford & Bull

T. S. MILLER.

CABLEWAY.

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6 SHEETS—SHEET 3.

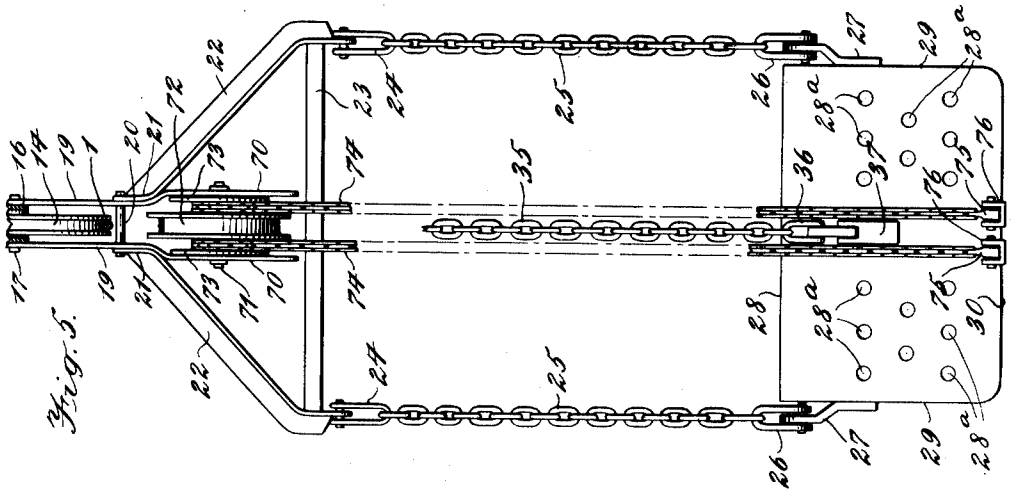


Fig. 5.

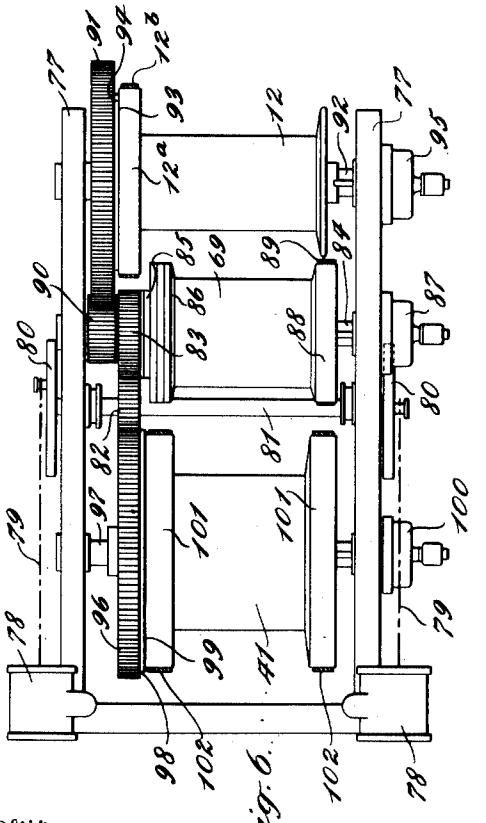


Fig. 6.

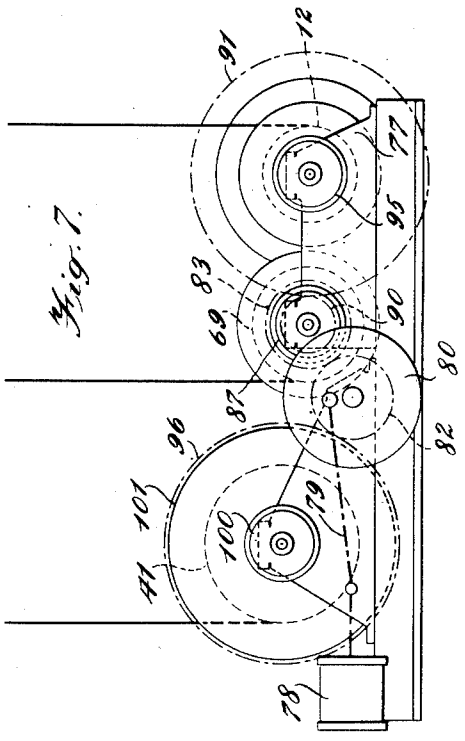


Fig. 7.

Witnesses:
Geo. E. Cheney.

Inventor
Thomas Spencer Miller
By his Attorneys
Gifford & Bull

T. S. MILLER.

CABLEWAY.

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6 SHEETS—SHEET 4.

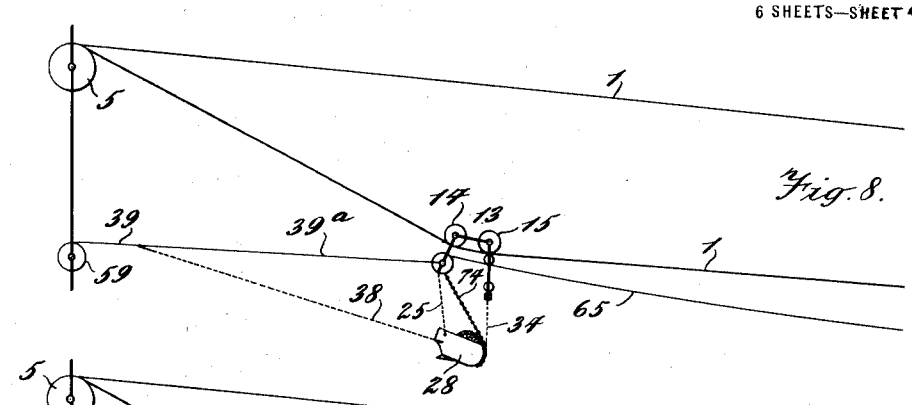


Fig. 8.

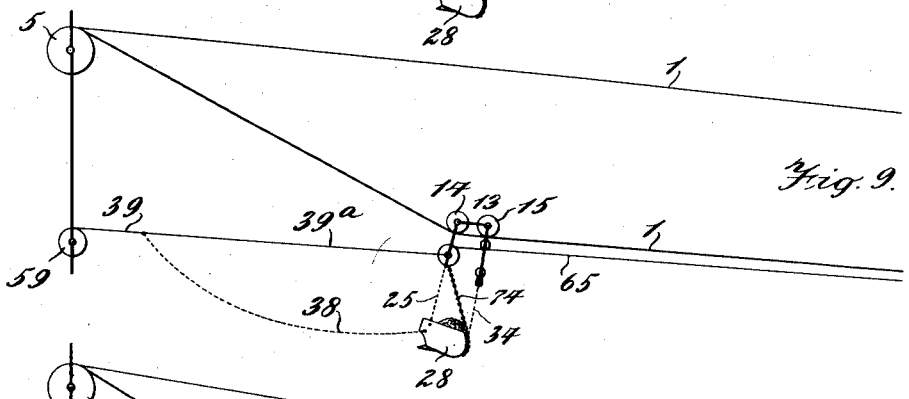


Fig. 9.

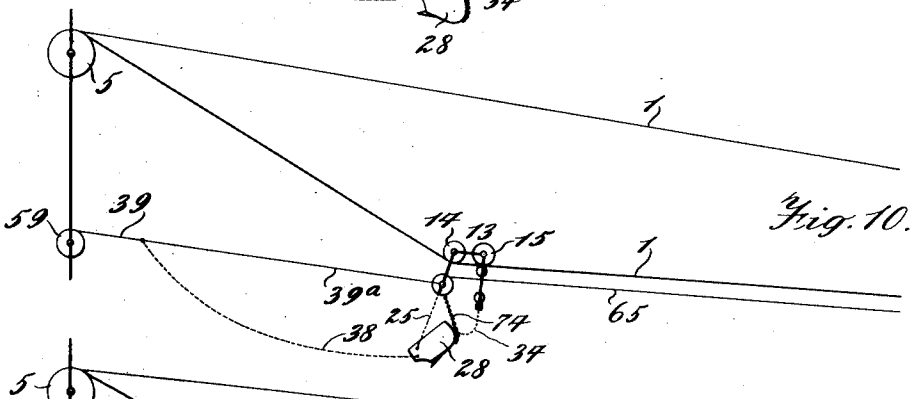


Fig. 10.

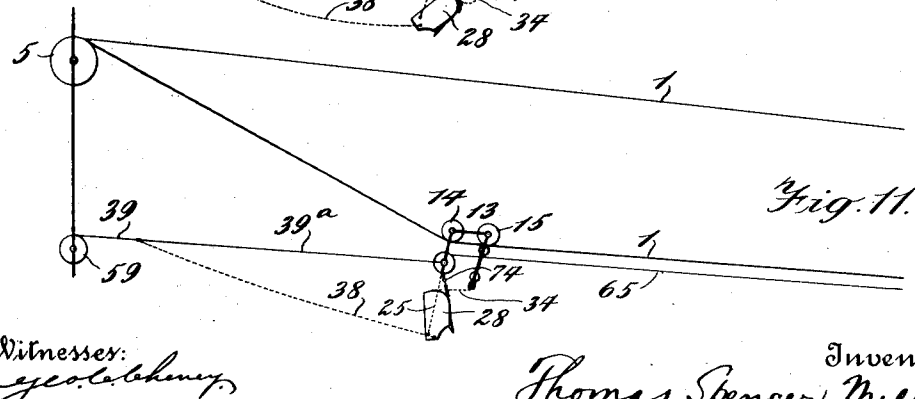


Fig. 11.

Witnesses:
Geo. Lakemey.

Inventor
Thomas Spencer Miller
By his Attorneys
Gifford & Bull

T. S. MILLER.

CABLEWAY.

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1,401,271. Patented Dec. 27, 1921.

6 SHEETS—SHEET 5.

Fig. 12.

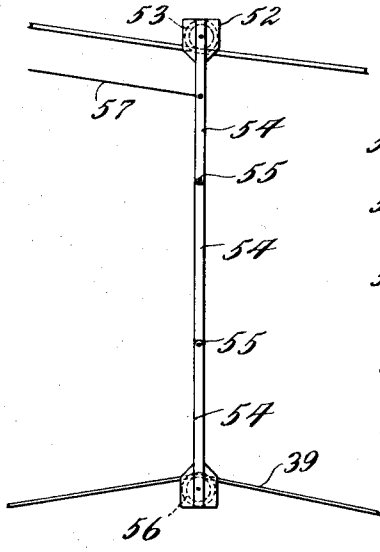


Fig. 13.

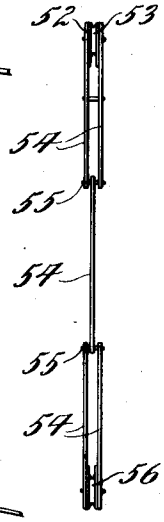


Fig. 14.

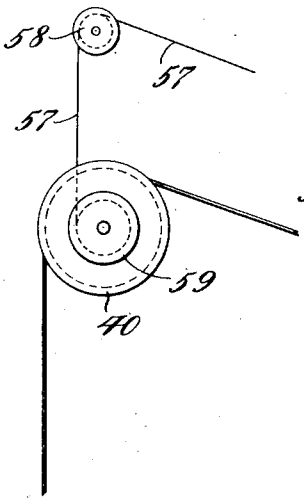
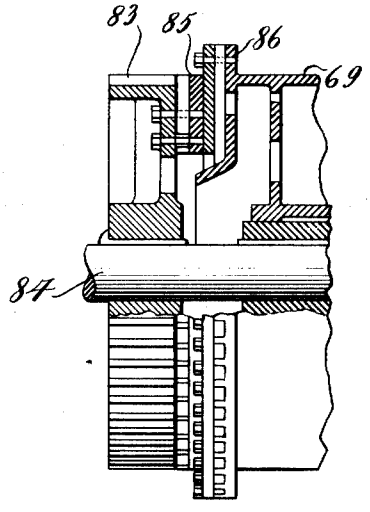


Fig. 15.



Fig. 20.



Witnesses:
Geo. E. Athey.

Inventor
Thomas Spencer Miller
By his Attorneys
Gifford & Bull

T. S. MILLER.

CABLEWAY.

APPLICATION FILED FEB. 9, 1917.

1,401,271. Patented Dec. 27, 1921.

6 SHEETS—SHEET 6.

Fig. 16.

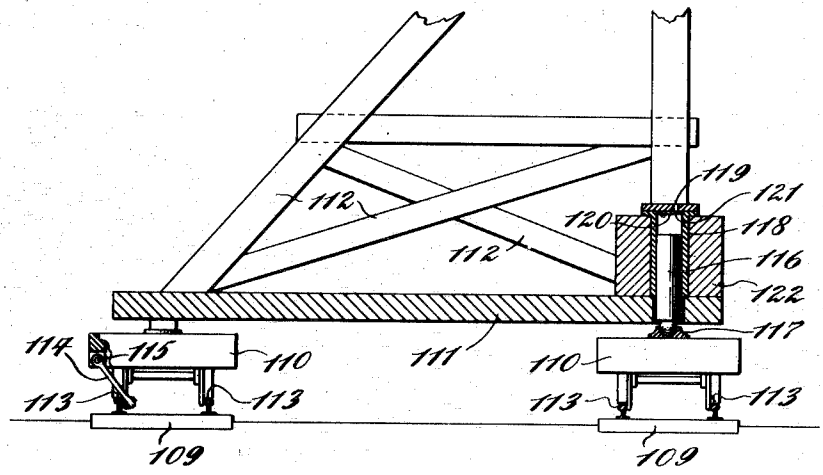


Fig. 17.

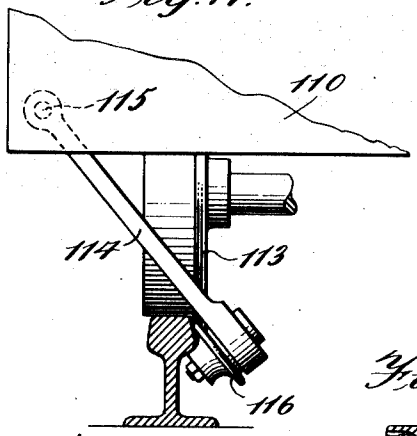


Fig. 18.

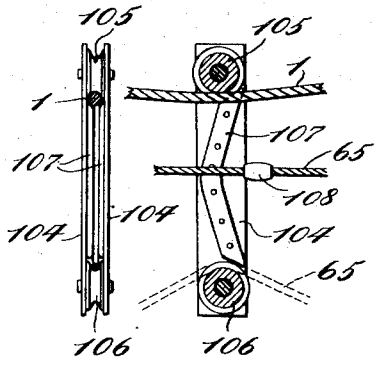
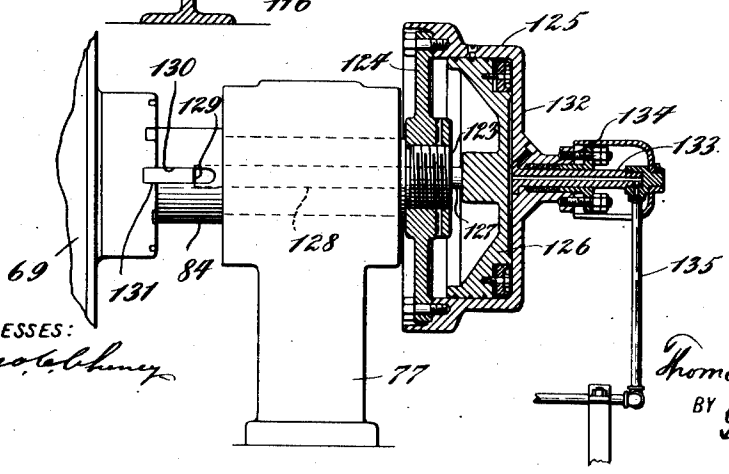


Fig. 19.



WITNESSES:

Geo. A. Gibney

INVENTOR

Thomas Spencer Miller

BY Gifford & Bull

his ATTORNEYS

UNITED STATES PATENT OFFICE.

THOMAS SPENCER MILLER, OF SOUTH ORANGE, NEW JERSEY.

CABLEWAY.

1,401,271. Specification of Letters Patent. Patented Dec. 27, 1921.

Application filed February 9, 1917. Serial No. 147,539.

To all whom it may concern:

Be it known that I, THOMAS SPENCER MILLER, a citizen of the United States, residing at South Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Cableways, of which the following is a specification.

My invention relates broadly and generally to new and useful improvements in cableways, and more particularly to cableways for performing excavating operations.

The invention consists in the novel construction of parts and their aggroupment in operative combination, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

I have fully and clearly illustrated a preferred embodiment of my invention in the accompanying drawings to be taken as a part of this specification, and wherein—

Figure 1 is a view in side elevation of a complete cableway embodying my invention;

Fig. 2 is an enlarged diagrammatic view illustrating the various rope leads;

Fig. 3 is an enlarged view in side elevation of a carriage and load carrier suspended therefrom, the same being in the form of a drag bucket, the bucket being shown in load carrying position, and also showing improved means for dumping the bucket;

Fig. 4 is a detailed view in side elevation of the rear end of the drag bucket when the latter is in load discharging position;

Fig. 5 is a view in rear elevation of the carriage and load carrier suspended therefrom;

Fig. 6 is a plan view of a winding engine for operating the various lines or ropes of the cableway;

Fig. 7 is a view in side elevation of the winding engine shown in Fig. 6;

Fig. 8 is a diagrammatic view showing the position of the bucket when carrying a load;

Fig. 9 is a diagrammatic view showing the position of the bucket at an initial stage of being dumped;

Fig. 10 is a diagrammatic view showing the position of the bucket at an intermediate stage while being dumped;

Fig. 11 is a diagrammatic view showing the bucket in the position assumed just after completion of the dumping movement, and just previous to returning to load carrying position;

Fig. 12 is a detail enlarged view of an improved rope carrier shown in Figs. 1 and 2 for supporting the bucket drag line, or inhaul line;

Fig. 13 is a detail view in front, or rear, elevation of the carrier shown in Fig. 12;

Fig. 14 is a detail view in side elevation of one means for moving the carrier of Figs. 12 and 13;

Fig. 15 is a detail view in elevation looking from the right toward Fig. 14;

Fig. 16 is a view in elevation, partly in section, of an improved supporting tower for the cableway;

Fig. 17 is an enlarged view of a track anchor shown in Fig. 16;

Fig. 18 includes views in front elevation and in longitudinal section of a support for a traversing line;

Fig. 19 is a detail view in section of a thrust operating means for the drums of the winding engine, and

Fig. 20 is a detail view of one of the slipping frictions for the outhaul drum.

Referring to the drawings by characters of reference 1 designates a main cable or trackway suspended preferably between a head tower 2 and a tail tower 3, said main cable being adapted to support a traversing element in the form of a load-carrier preferably consisting of a wheeled carriage and a load carrier proper suspended from said carriage. The head and tail towers are preferably mounted on running wheels which travel on approximately parallel trackways running transversely of the length of the main cable 1; the construction and arrangement of these towers and the trackways upon which they are supported will be further described hereinafter. This main cable is arranged so that its line of trajectory, or its elevation between the head tower and the tail tower, may be varied so that by raising and lowering the main cable the elevation of the load carrier may be adjusted to cause the load

carrier to approach or rest on the ground, or other surface, and by elevation of the main cable be lifted for transportation clear of the ground and other obstructions. Various means may be employed for accomplishing this result within the spirit and scope of my invention, but a preferable and efficient means consists in anchoring one end of the main cable, as at 4, to the tail tower 3, while the other end of the main cable is passed over a sheave or grooved wheel 5 revolubly supported on the upper part of the head tower 2. The end of the main cable which passes over the wheel 5, is connected to suitable means which by taking up and paying out the main cable will serve to raise and lower the same and consequently the load carrier. For this purpose the said end of the main cable is connected to a block 6 of a running connection takeup device 6^a, the other block 7 of which is anchored by a line 8 to any suitable point, as at 9. The running line 10 of the takeup device has one end portion 11 wound upon a drum 12 of a hoisting engine which will be presently described. The arrangement is such that when the drum 12 is operated in one direction the takeup will be shortened to pull down on the main cable to thereby raise the same between the supports, while when the takeup is paid out, or lengthened, the main cable will by gravity be permitted to lower between the supports, the elevation of the main cable depending upon the degree to which the running connection or takeup is paid out or taken up. The takeup or running connection is shown as a five-part purchase, although I contemplate omitting any block and fall where circumstances warrant.

Mounted to travel on the main cable 1 is a load carrier in the present form, being preferably shown as consisting of a carriage 13, comprising running wheels 14, 15, arranged in tandem and spaced apart by side bars or spacing members 16 connecting the bearing pins or journals 17, 18, of said running wheels respectively. Pivotally mounted on the opposite ends of the pin 17 are a pair of depending hanger bars 19, see Figs. 3 and 5, in the lower ends of which is mounted a transverse pin 20 on the opposite ends of which are pivotally supported the upper ends 21 of the opposite directed members 22 of a hanger yoke, the lower ends of said members 22 being held in spaced relation by a transverse strut or bar 23. Connected to the lower end of each of the members 22, preferably by means of a pin-and-shackle conection 24, is one end of a hanger chain 25, the lower ends of which chains are shackled as at 26, to bail ears 27 at the forward end of a load carrier, which in the present instance is shown as consisting of an open-ended digging bucket 28 constructed to dig and take its load by being dragged open-end foremost into the material to be transported. This bucket may take a number of forms without departing from my invention, but I prefer to have it consist of side walls 29, a bottom wall 30 provided at its forward endge with digging teeth 31, the rear end of the bucket being curved as at 32 from the rear of the bottom wall upward and rearward on a parabolic curve, so that the interior of the bucket is provided with a rounded surface from which the dirt will be easily discharged when the bucket is tilted or dumped. The rear wall of the bucket may be provided with openings 28^a, to prevent suction.

33 designates a pair of hanger bars, the upper ends of which are arranged on opposite sides of the wheel 15 and are pivotally suspended from the journal or bearing pin 18 for said wheel. The lower ends of these bars 33 are connected to the upper end 34 of a hanger chain 35, the lower end of which is connected in any suitable manner, as at 36, to an ear 37 on the outer face of the rear wall of the bucket by means of which hanger 33 and chain 35 the rear end of the bucket is suspended flexibly from the carriage. In order that the bucket will be carried with its open end at a higher elevation than the rear end so that the load will be safely transported, I preferably make the total length of the hanger 33 and chain 35 greater than the total length of the hanger 22 and the chains 25, so that the bottom of the bucket is inclined downward and rearward, when the main cable is elevated and the load is to be transported along the main cable.

As has been heretofore stated the load carrier 28 is adapted to take its load by having its open end dragged into the material to be transported, and for this purpose the open forward end of the bucket is connected to bridle chains 38 which unite at a point in advance of the bucket and are connected to one end of a drag line 39, which passes over a pair of elevated spaced sheaves 40 on the head tower, said sheaves being arranged to turn respectively on parallel horizontal axes, one behind the other, in the general direction of the cableway, as clearly shown in Fig. 2. The end of the drag and traversing line 39 opposite to that connected to the bucket bridle is wound upon a drum 41, whereby said line may be taken up or paid out in accordance with the direction in which said drum is operated. The arrangement is such that the drum 41 and line 39 are operable to inhaul the bucket when the main cable 1 is elevated sufficiently to lift the bucket off the ground, and for this purpose said drum is driven at high speed, but, for purposes of economy, at an

expenditure of power which would ordinarily be insufficient to perform the function of loading the bucket by dragging it into the material. It will be apparent that a portion 42 of the drag line bridges the space between the pulleys 40, and this portion 42 is made in the form of a loop within which is arranged a grooved pulley 43 journaled on the upper end of a piston rod 44 of a piston 45 mounted to reciprocate within a fluid pressure power cylinder 46 provided with a suitable fluid pressure inlet 47, which can be operated to admit pressure, for instance steam, water, or compressed air, to the cylinder on the upper side of said piston in order to drive the latter lengthwise of the cylinder to lengthen or take up the loop 42. This power cylinder is adapted to operate at relatively low speed but high power sufficient to drag the bucket into the material to be excavated. The power piston 45 and the pulley 43 are counter-balanced by a weight 48 connected by a line 49 to said piston rod 44 and passing over a pulley 50 on the head tower. This weight serves to raise the power piston and associated movable parts when the piston 45 returns to its exhaust position previous to pulling the loop to drag the bucket into the material. The line 39 is connected by a short connection 39^a to a point on the carriage as at 51, so that when the drag line is taken up by the drum 41 the power thereof will be exerted on both the carriage and the load carrier to cause them to be inhauled simultaneously. The drag line 39 and the bridle 38, as well as the connection 39^a are supported from the main cable by a running suspension, consisting of a wheeled carriage 38^a and a depending line 38^b suspended therefrom, and connected to the drag line, the bridle and said connection 39^a at the point at which they meet.

In order to prevent the drag and traversing line 39 from dropping on the ground, and to maintain it at the proper elevation during the operation of digging, and also of transporting the bucket, I provide a novel form of carrier for suspending the same from the main cable. In the present embodiment this carrier consists of a frame 52, in which is journaled a grooved wheel 53 which runs on the main cable 1, and depending from this frame are a plurality of flexibly connected sections 54, said sections being connected to each other by hinged joints 55, whereby the carrier is rendered longitudinally flexible. At the lower end of the lowermost section 54 is journaled a pulley wheel 56, over which passes, and is supported, said drag line 39. It will be seen that when the main cable 1 is lowered to permit the bucket to rest on the ground that the lower end of the carrier just described may also strike the ground, but by virtue of its flexibility the carrier will flex or bend and not become deranged in its operative relation to the cableway or drag line, or be permanently bent or broken. Connected to the carrier preferably at a point adjacent the carriage frame 52, is one end of a hauling line 57, the opposite end portion of which passes over a pulley 58 on the head tower whence said end portion is carried down and connected to means whereby said line 57 is operated to simultaneously inhaul the carrier when the bucket is inhauled. For this purpose I wind the inner end portion of the said line 57 upon a drum 59, located adjacent to the forward pulley wheel 40, and turning on an axis coincident with the latter, so that when the drag line is taken up the drum 59 will be rotated in the same direction as the pulley 40 to thereby take up the line 57 and haul the carrier toward the head tower, while, when the drag line is paid out the drum 59 will be rotated in the opposite direction to permit the line 57 to be paid out to permit the carrier to gravitate outward along the main cable. The carrier is arranged at a point intermediate the load carriage and the head tower and therefore must be inhauled at a speed less than that at which the load carriage is inhauled, and I therefore proportion the size of the drum 59 relative to that of the drum 40, so that the proper speed of inhaul will be given to the carrier. The said drum 59 is preferably of such a size as to cause the carrier to travel when inhauled at approximately half the speed of the load carriage.

I will now proceed to describe the means for outhauling the load carriage and bucket, that is, to propel it toward the tail tower. This means is shown as consisting of what may be termed an outhaul traversing line, and in this connection I will describe novel means for supporting the outhaul line, and also novel means whereby the outhaul line may be operated to tilt the bucket to cause it to discharge its load:

Suspended between the towers 2 and 3 is what I term a suspension or supporting line 59^a, one end of which is anchored to one of the towers, for instance the tail tower 3, as at 60, and the opposite end portion of which passes over a pulley 61 on the opposite tower, *i. e.*, the head tower, and depends therefrom, and connected to the depending end of said line is means to cause said line to adjust itself automatically to varying distances between the towers, and for maintaining a constant tension, and substantially constant and safe deflection on said line, said means being preferably a weight 62, which is suspended from said line off the ground or other support, so as to constantly exert its force on said line.

Fixed to the line 59^a at spaced intervals along the same is a plurality of hangers 63,

each supporting at its lower end a rope pulley or sheave 64, which operate to sustain the outhaul line in a manner which will now be described: 65 designates the outhaul line, the main portion of which is suspended between the head tower and the tail tower, and is passed over said pulleys 64, so that said main portion of the outhaul line is at all times maintained in substantially the same path or line of movement. The outhaul line at its outer end, *i. e.*, at the tail tower, is passed over a suitable guide which may consist of pulleys 66, 67, on the tail tower and is connected to the bucket-dumping means in a manner which will be presently described. The innermost end portion of the outhaul line passes over a pulley 68 on the head tower and is wound upon a drum 69, which may form part of the rope engine, heretofore mentioned, and which will be described hereinafter. The arrangement is such that when the outhaul traversing line 65 is wound upon the drum 69 said line will exert a pull on the load carriage and bucket to cause the latter to traverse the main cable toward the tail tower. It will be seen, that irrespective of the position of that section of the outhaul line between the tail tower and the load carriage due to the raising and lowering of the main cable, the portion of the outhaul line which is supported upon the pulleys 64 will be maintained in approximately the same path of movement at all times.

By suspending the outhaul traversing line 65 from the suspension or supporting rope 59ª, the tracks upon which the head tower and tail tower travel may be laid out of parallel, inasmuch as the said supporting line, by virtue of its running connection over the head tower and its counterweight, may adjust itself to different distances between the head tower and the tail tower. It will also be seen that the outhaul rope 65 during the traversing of the bucket will be held nearly straight, but at the same time the outhaul line will have the desired slack, which is important in view of the fact that it is desirable to have as much slack as possible in the outhaul line while the bucket is being inhauled.

I will now describe the bucket-tilting means which is adapted to be operated or controlled by the outhaul traversing line 65, referring particularly to Figs. 3, 4 and 5 of the drawings. Supported from the opposite ends of the pin 20, heretofore described, are the upper ends of hangers 70, which are spaced apart and are provided with bearings for a transverse bearing pin or shaft 71, upon which is journaled a flanged drum 72 upon which the carriage engaging end of the outhaul line is wound and secured in any suitable manner, the drum being of such size and width that said line will be wound helically thereon. On opposite sides of the drum 72 are arranged flanged drums 73 which are smaller in diameter than the drum 72, heretofore described, for a purpose to be presently set forth. The pin 71 forms convenient means for connecting the drag line 39 to the carriage by means of a shackle 71ª. It will be seen that these drums 73 are arranged to rotate on an axis coincident with the axis of rotation of the said drum 72, and are connected to the drum 72 for simultaneous rotation therewith. Wound upon each of these drums 73 in spiral or clock-spring form is one end portion of a flexible connection 74, the opposite ends of which connections are suitably connected as at 75 to the bucket 29, preferably to ears 76, located at a point adjacent the point where the rear curved wall 32 and the bottom wall 30 of the bucket merge. The connection 74 preferably consists of chains having flat links, the transverse width of the chain being slightly less than the width of the space between the flanges of the drums 73, so that it will be insured that said chains will wind upon the drums 73 in the clock-spring form or a spiral of superposed layers. During ordinary traversing movements of the carriage, that is, when the bucket is being inhauled or outhauled, there are, say, about thirty-five feet of the outhaul line wound upon the drum 72, and as the diameter of the drum 72 relative to the diameter of the drums 73 may be as shown, for example, substantially at the ratio of three to one, it will be seen that a pull of from about 3500 to 4000 pounds on the combined dumping and outhaul line will be sufficient to lift the bucket, in a case where the combined weight of the bucket and its load is substantially 15,000 pounds. It is contemplated, also, to deal with excavators carrying smaller or greater loads than that mentioned, which, as stated, is merely by way of example. After the bucket has been dumped the strain on the combined dumping and outhaul line will be slackened by the operator, and when this is done the weight of the bucket will be sufficient to return it to its normal carrying position, because when the bucket is in dumping position the manner of winding the chains 74 on the drums 72 provides a constantly decreasing leverage in lifting, and the chains 74 become piled up on the drums 73 to a one-to-one purchase finally, whereby the weight of the back end of the empty bucket is availed of to rewind the outhaul rope on the drum 72, so that the outhaul line will again be in position on said drum to again raise the bucket.

There are three general ways of operating the outhaul line to dump the bucket, which are as follows: (1) The operator may hold the outhaul drum 69 by a brake or other suitable means and continue to haul in on the

drag line, which will put the proper strain upon the outhaul line to cause the drums 72 and 73 and the chains 74 to dump the bucket. This mode of operation serves to spread the load inasmuch as the bucket travels some distance under the pull of the drag line before sufficient tension is put on the outhaul line to rotate the drum 72 far enough to completely dump the bucket. (2) The operator may hold the drag line drum under brake and continue to haul out on the outhaul line which will cause the load to be deposited at one point. (3) The operator may pull upon both lines and in opposite directions.

Referring particularly to Figs. 8 to 11 inclusive, wherein I have shown the different positions of the bucket during the normal operation of carrying and dumping a load, it will be seen that the initial effect of placing the outhaul line under sufficient tension to lift the rear end of the bucket, is to throw the latter forwardly on its flexible suspension and thereby slacken the bridle 38 connecting the forward end of the bucket with the drag line 39. It will also be seen from Figs. 10 and 11 that during the further dumping stages the bridle still remains slackened, so that the tension on the drag line 39 exerted on the carriage, and opposing the outhaul line, is not altered during the dumping of the bucket, and the drag line is relieved from pull which would otherwise be exerted thereon. The line 38 tightens again at the end of the dumping movement of the bucket, and thus acts as a stop means to limit movement of the bucket in the dumping direction.

The hanger bars 33 support upper and lower spaced guide pulleys 33^a, 33^b between which is guided the outhaul line 65, said hangers and said pulleys guiding said outhaul line in proper relation to the drum 72. The lower ends of the hangers 33 support a counterweight 33^c which operates, after the bucket is dumped, to return the hangers 33 to the proper bucket supporting position, shown in Fig. 3, so that the load of the bucket and its contents when suspended from the main cable will be equally distributed between the two hangers constituted by the elements 22, 25 and the elements 33, 35, respectively.

It will be noted that the carriage, and the means for suspending the bucket therefrom, is flexible in the sense that the carriage adapts itself to the various inclines which the main cable may take during the operation of the cableway, and the suspension devices, irrespective of the changes in the incline of the main cable and the position of the carriage and its members, will be maintained in a constant position of suspension due to the pivoted and flexible arrangement of the fore and rear suspension for the bucket.

Referring particularly to Figs. 6, 7 and 20 of the drawings, wherein I have shown an engine for operating the drag line drum 41, the outhaul drum 69 and the block and fall operating drum 12, 77 designates the side members of a base frame upon which are mounted steam engine cylinders 78 connected by piston rods, indicated in dot-and-dash lines at 79, to crank disks 80 on the opposite ends of a power shaft 81, the latter carrying a pinion 82 meshing with a pinion 83 on a drum shaft 84, upon which the outhaul drum 69 is mounted for longitudinal movement. The shaft 84 carries a friction clutch member 85, with which coöperates a friction member 86 on one end of the drum 69, said friction being applied and relieved by means of an air thrust 87, or other suitable means, at the opposite end of the drum in a manner which is well known. Inasmuch as the maximum strain on the combined dumping and outhaul traversing line 65, necessary to pull the empty carriage and bucket in the outhauling direction, is approximately less than half that required to dump the load, this drum may be driven at a high speed capable of driving the carriage at approximately 2500 feet per minute. In order to prevent overstrain on the outhaul line 65 when dumping, the air thrust is regulated to maintain a slipping contact between the friction members 85 and 86, so that should the outhaul line be subjected to an excessive strain the outhaul drum may slip relative to its driving connection and thereby relieve the strain on said line. The construction of the slipping friction indicated generally at 85, 86, may be that of my prior U. S. Letters Patent No. 715,111, dated December 2, 1902, by way of example. At its opposite end from the slipping friction the outhaul drum may be provided with a circumferential braking face 88, with which coöperates a band brake 89, by means of which the outhaul line may be held against rotation. Also mounted on the shaft 84 is a pinion 90 which meshes with a gear 91 fixed to a drum shaft 92, upon which the drum 12 for operating the takeup 6^a is mounted for longitudinal movement. At its end adjacent the gear the drum 12 is provided with a friction clutch member 93 adapted to engage a corresponding member 94 of any suitable form on said gear 91, by means of which said drum 12 is connected to said gear to be driven. The drum 12 is held in engagement with the gear 91 by means of an air thrust 95. The pinion 82 meshes with a gear 96 on a drum shaft 97, upon which is mounted for longitudinal movement the drum 41, heretofore described, said gear 96 having a friction clutch element 98 adapted to be engaged by a corresponding element 99 on the adjacent end of the drum whereby the latter is driven from said gear 98. The clutch members 98 and 99 are placed in op-

erative engagement by an air thrust 100 in a well known manner. The drum 41 is provided at its opposite ends with braking surfaces 101, with which coöperate band brakes 102 operable in any well-known manner to retard or stop the rotation of said drum. The drum 12, heretofore described, may be provided with a braking face 12^a, with which coöperates a band brake 12^b to hold said drum against rotation. The brakes on the drums may be manually, electrically, or fluid pressure-operated, in any well-known manner available in hoisting-engine practice.

When the main cable is slackened to bring the bucket to digging or load-taking position it is highly advantageous that the bucket be capable of operating as close to the tail tower 3 as possible, and in order to accomplish this I provide means for causing the slack provided in the main cable when lowered to be drawn toward a point adjacent the foot of the tail tower. For the purpose stated I suspend a depressor weight 103 from the main cable, adjacent the tail tower, so that when the main cable is lowered by paying out the line 11, said weight 103 will gravitate and will also move toward the tail tower, as indicated in dotted lines in Fig. 1, whereby the main cable inclines downward from the head of the head tower to a point substantially approximating the location of said weight. By this means the bucket may be outhauled to operate almost up to the point at which said weight is located, which will give a wider range of operation than were the main cable to take the normal trajectory it would assume if it were suspended free from the head tower and the tail tower.

In addition to pulling the slack in the main cable 1 when lowered toward the tail tower, the weight 103 performs the additional function of placing sufficient tension on the cable when lowered between the weight and the head tower to prevent successive sidewise movement of the cable.

I may provide a rope carrier suspended from the main cable between the tail tower and the carriage to support that portion of the outhaul lines which is between the bucket and the tail tower. The carrier for this purpose is illustrated in Fig. 18, consisting of a frame 104 having an upper pulley 105 to travel on the main cable, and a lower pulley 106 over which the outhaul line 65 passes, and by which it is supported when slack, as shown in dotted lines in Fig. 18. Between the pulleys 105 and 106 are flanges 107, secured to the side members of the frame 104 and spaced apart a sufficient distance to permit vertical play of the outhaul rope 65 there-between, but forming obstructions to the passage of a button 108 on the outhaul rope, which engages said flanges 107 to move the carrier toward the center of the cableway when the carriage and bucket are inhauled. The carrier may gravitate toward the head tower or may be positively engaged by the carriage to be moved in that direction.

I provide means whereby the main cable is relieved of over-strain, such means being adapted to yield under an over-strain. This means I associate with the tail tower, and will now be described. The tail tower is preferably arranged to travel transversely of the line of operation of the cableway on a pair of railroad tracks 109, said tower including wheeled trucks 110 upon which the base of the tower rests, for instance, a platform 111, upon which are supported the members 112 of which the tower is constructed. It will be understood that the structural features of the tower itself may vary within wide limits and form no part of my invention, and that therefore they need not be described. The rails of the parallel tracks may consist of a normally flanged and headed rails 113, and the track wheels being of the flanged form commonly employed in railway practice, as shown by way of example in Figs. 16 and 17 of the drawings. The platform 111, heretofore described, is fixed to the forward truck or trucks 110, in any suitable manner, so that if the main cable 1 is subjected to over-strain, the truck will tilt on the innermost rail of its trackway, that is, the rail which is nearest the head tower. In order to prevent this tilting movement from dismounting the wheels from said rails, I provide a holding member consisting of a bar 114 having its upper end pivoted, as at 115, to the truck at a point outside the trackway in the direction toward the head tower, said member extending to a point downward and beneath the truck, to a point adjacent the innermost flange or shoulder of the head of the inner track rail, and this inner end of said holding member I provide with a grooved roller 116, which travels on said shoulder beneath the head of the rail, and catches under said shoulder, so that should the truck be tilted the wheels would be prevented, by means of said holding device and grooved running wheels, from over-riding the same, and becoming displaced therefrom. By making the running device in the form of a grooved wheel, convenient means is provided for catching under the head of the rail, and at the same time the connection is not destroyed when the tower is transported along the trackway, as said running wheel maintains a traveling engagement with the underside of the head of the rail. The rear portion of the base of the tower is provided with an extensible connection with its truck, so that should the tower tilt, the rear truck will remain on its trackway but the tower platform may move relative to the truck. This connection may take a number of forms, but I prefer to provide a plunger 116 having a ball-and-socket connec-

tion 117 with the truck, said plunger operating in a cylinder 118 carried by the tower, said cylinder being provided with an opening 119 controlled by a check valve 120, so that when the tower is tilted air may find access to the cylinder above the head of the plunger. The check valve is provided with a small leak opening 121 to permit slow escape of the air from the cylinder when the platform descends on its truck. This cushions the descent of the tower and prevents shock. The tower platform is provided with a suitable counterweight located on its lower portion to resist the tilting movement under cable strains, and to hold the tower down on the rear truck, and for this purpose I provide a weight 122, preferably arranged over the rear truck and as a convenient construction locate the said cylinder 118 within the body of said weight 122.

In Fig. 19 I have shown one means, *i. e.*, an air thrust for maintaining the friction clutch surfaces of the drums and their driving members in driving engagement. In this figure the side frame of the engine is shown at 77, and a drum shaft 84, for instance, that of the outhaul drum, is journaled in the side frame and provided with a threaded end portion 123, upon which is secured a head 124 of a compression cylinder 125, which head and compression cylinder, by virtue of its threaded engagement with the shaft, are adapted to rotate with the latter. Reciprocably mounted in the cylinder is a piston 126 connected by a thrust rod 127 extending through a longitudinal opening 128 in a shaft 84 and engaging a cross pin 129 reciprocably mounted in a transverse slot 130 in said shaft, and seated in a transverse recess 131 in the end of the drum 69. The pin 129 rotates with the shaft and consequently the rod 128 causes the piston 126 also to rotate with the shaft. In the head 132 of the cylinder opposite to the head 124 is rotatably mounted an inlet pipe 133, suitably packed as at 134 in position in the head, said pipe 133 being connected by suitable pipe connections 135 with a suitable source of pressure. It will be seen that by regulating the degree of pressure supplied through the pipes 135, 133, into the cylinder 125 against the piston 126, and maintaining such pressure that the piston will be moved to thrust the drum 69 against the driving friction 85, the degree of engagement between the friction surfaces 85 and 86 being dependent upon the amount of pressure at which the pressure fluid is supplied and maintained.

With the parts in relative position illustrated in Figs. 2, 3, 5 and 8, the operation of the described and illustrated embodiment of the invention is as follows:

If the carriage and bucket are not at the position described for digging or taking a load, and the material to be dug or transported is located at a point between the load carriage and the tail tower, the outhaul traversing line 65 is taken up on its drum 69, and the traversing and drag line 39 is paid out until the bucket 28 is at the desired point. If the field of operation is between the load carriage and the head tower, the outhaul traversing line 65 is paid out and the inhaul traversing or drag line 39 taken up. If the bucket is at the desired location these operations will not be necessary. When the bucket is at the desired location, the drum 12 is rotated to lengthen or extend the running connection 6^a to thereby lower the main cable until the bucket rests on the ground, or in position to take a load. When the main cable is lowered, the weight 103 pulls the slack in the main cable 1 toward the tail tower as heretofore described. It will be seen that when the main cable is lowered as described, that the portion of the rope 65 which is supported by the pulleys 64 remains in its normal path of travel. During outhauling of the bucket the carrier 52 gravitates outward, pulling its line 57 after it, as said line is unwound from its pulley 59, and when the bucket is inhauled said line 57 is wound on its pulley 59 to pull the carrier 52 toward the head tower 2 at approximately half the speed at which the load carriage travels. Should the main cable be lowered so far as to cause the carrier 52 to strike or rest on the ground, the flexibility of the carrier will prevent damage to it, or derangement of its parts relative to the other members of the cableway.

In order to take a load, or dig, the operator holds the drag line 39 by maintaining the drum 41 stationary, pays out the outhaul traversing line 65 slowly, and operates the power cylinder 46 to pull the bucket into and through the material to be transported. It will be understood that the power cylinder is so proportioned, and the pressure of air or steam for operating the same supplied thereto at such pressure, as to operate the bucket to dig at high power. When the bucket 28 is filled, the operator takes up or shortens the running connection 6^a to take up sufficient slack in the main cable to lift the bucket to clear the ground and any obstructions between the bucket and the point at which it is to be dumped, and the drum 41 is then operated to take up the line 39 to traverse the carriage and bucket at relatively high speed toward the tail tower. About six feet of the main cable is pulled in or paid out in raising and lowering the same, but this may vary with machines of different sizes, or where the height of the towers or the depth of the digging varies. During this inhauling operation the line 39 operates the drum 59 to take up the line 57, and thereby inhaul the carrier 52. When

the bucket reaches the point where its load is to be dumped, sufficient strain is placed upon the outhaul line 65 to cause it to rotate the drum 72 and thereby rotate the drums 73 to take up the connections 74, and thereby lift the rear end of the bucket to cause the contents of the latter to be dumped. This can be accomplished by holding the drag line 39 and winding the outhaul line upon its own drum 69; or by exerting a pull on both the drag line and the outhaul line; or by holding the outhaul line and exerting a pull on the drag line by means of its drum 41. Irrespective of which of the three operations described is employed, the outhaul line will be placed under tension sufficient to rotate the drum 72, and the drums 73, to take up the connections 74 as described.

It will be noted that proportioning the surfaces of the drums 72 and 73 as described, and by winding the line 65 on its drum helically, while the members 74 are wound on their drums spirally, that the power of the outhaul line is multiplied onto said members 74, so that a determined pull on the outhaul is increased to exert a greater lifting force on the rear end of the bucket, which lifting force is gradually reduced as the bucket reaches its final tilted position, at which position the diameter of the chain 74, piled on the drums 73, is substantially equal to the diameter of the drum 72 upon which the outhaul line is wound. When the bucket is in dumped position, as shown in Figs. 4 and 11, the strain on the members 74 is considerably greater than the pull on the line 65 when the latter is properly slackened, and the gravitating force of the bucket is therefore sufficient to reverse the direction of rotation of the drums 73 to rotate the drum 72 in the same direction, and thereby rewind enough of the outhaul line on said drum 72 to again set the bucket-tilting means in condition to again dump or tilt the bucket, when sufficient strain is placed on the outhaul line. It will be understood that the friction contact between the clutch members 85, 86, of the outhaul drum 69 is adjusted to be slightly greater than the dumping pull, say of 4000 pounds on the outhaul line, so that should a careless operator over-run said rope in dumping, or place excessive strains thereon, the liability of the breaking or overstraining of the rope will be prevented by the slipping of the drum friction relative to the driving friction. This will prevent breaking of the outhaul rope while dumping.

The safety elements provided are important and may be recapitulated as follows:—

The tail tower yields to any over-strain on the main cable. If the outhaul traversing rope 65 should be subjected to an over-strain the drum 69 slips relative to its friction 85, and thereby prevents possible breaking of said rope. The outhaul rope supporting line 59 yields should the supporting towers spread apart, that is, should the distance between the towers be increased. The strain on the drag line 39 is limited to the pressure on the plunger or ram 45. It will thus be seen that all the elements of importance cannot be over-strained.

What I claim and desire to secure by Letters Patent of the United States is—

1. In a cable way, the combination of spaced elevated supports, a main trackway extending between and supported by said supports, a carriage on said trackway, a traversing line for the carriage, means for raising and lowering the trackway and carriage, and means between the supports and independent of the carriage and trackway for supporting the traversing line and permitting vertical movement of the carriage without varying the position of the larger portion of the traversing line.

2. In a cable way, the combination of spaced elevated supports, a main cable or trackway suspended between said supports, a carriage on said main cable, a traversing line for the carriage traveling between said supports, means for raising and lowering the main cable and carriage, and means between the supports and independent of the carriage and main cable or trackway for supporting the traversing line independent of the main cable, whereby the position of a considerable portion thereof is not affected by vertical movement of the main cable.

3. In a cable way, the combination of spaced elevated supports, a main cable or trackway suspended between said supports, a carriage on said main cable, a traversing line for the carriage traveling between said supports, means for raising and lowering the main cable and carriage, and a supporting line for the traversing line independently connected with the spaced supports and adapted to maintain a portion of said traversing line in substantially normal position independent of changes in the vertical position of the main cable and carriage.

4. In a cable way, the combination of spaced elevated supports, a main cable or trackway suspended between said supports, a carriage on the main cable, a suspension line extending between the elevated supports above the main cable, a traversing line supported by the suspension line and connected to the carriage, means for moving the main cable and carriage vertically, and means for maintaining the suspension line under tension and supporting the traversing line in substantially normal position independent of changes in the elevation of the main cable and carriage.

5. In a cable way, the combination of spaced elevated supports, a main cable or trackway suspended between said supports, a carriage on the main cable, a suspension

line extending between the elevated supports above the main cable, a traversing line extending over guides on the elevated supports and connected to the carriage, means depending from the suspension line and supporting the traversing line between said supports, means for moving the main cable and carriage vertically, and means for maintaining the suspension line and traversing line in substantially the same relation to the elevated supports independent of changes in the vertical position of the main cable and carriage.

6. In a cable way, the combination of spaced elevated supports, a main cable suspended between said supports, a carriage on the main cable, a suspension line attached to one support above the main cable and extending over a guide on the other support, a weight attached to the latter end of the suspension line, a traversing line extending over guides on the elevated supports between the main cable and suspension line and connected to the carriage, means for moving the main cable and carriage vertically, and means for supporting the traversing line from the suspension line whereby the position thereof will not be materially changed by vertical movement of the main cable and carriage.

7. In a cable way, the combination of spaced elevated supports, a main cable suspended between said supports, a carriage on the main cable, a traversing line for the carriage, means for moving the main cable and carriage vertically, and means between the supports and independent of the main cable and carriage for supporting the traversing line and causing it to maintain a substantially fixed path independent of changes in the elevation of the main cable and carriage.

8. In a cableway, in combination, spaced elevated supports, a main cable suspended between fixed points on said supports, means for raising or lowering the cable by shortening or lengthening the same between the supports, a carriage on the main cable, a digging bucket suspended from the carriage, means for traversing the carriage, and a depressor weight in fixed relationship to the main cable and acting to pull the main cable when lowered toward one of said supports to thereby permit the bucket to obtain a load near said support.

9. In a cableway, in combination, spaced elevated supports, a main cable between said supports, a load carriage on the main cable, traversing means for the carriage, means for raising and lowering the main cable, and a weight fixed on the main cable between the elevated supports to cause the latter when lowered to deflect toward one of said supports and to maintain tension in said cable.

10. In a cableway, in combination, spaced elevated supports, a cable suspended between said supports, a carriage on the main cable, means for lowering the main cable by lengthening the same, and a weight suspended from the main cable to draw the slack in the same when lowered toward one of said elevated supports, said weight being suspended in fixed relation to the main cable at a point adjacent said elevated support.

11. In a cableway, in combination, spaced supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a traversing line for traversing the carriage, a differential drum on the carriage, the said traversing line being wound on the larger portion of the drum while the bucket is in load carrying position, and a flexible connection wound on the smaller drum portion and connected to the rear portion of said drag bucket and adapted to be wound on the drum by pull exerted on the traversing line to thereby lift the rear of the bucket and dump the latter.

12. In a cableway, in combination, spaced supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage by flexible suspending devices at the front and rear portions of the bucket, said devices being substantially parallel to each other, a differential drum journaled on the carriage at a point substantially coincident with the point of connection of the forward suspending device with the carriage, a traversing line having one end portion wound on the larger portion of the drum, and a flexible connection wound on the smaller drum portion and connected to the rear portion of said drag bucket.

13. In a cableway, in combination, spaced supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a traversing line for the carriage, a drum on the carriage, the traversing line being wound on the drum, and a flexible connection also wound on said drum in a spiral of superposed layers when the bucket is in the load-dumping position, and said connection being connected to the rear portion of the drag bucket.

14. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a drag line connected to the bucket, a rope carrier adapted to travel on the main cable and supporting said drag line, a line connected to the carrier, a drum for taking up said line connected to the carrier, and means whereby the operation of said drag line operates said drum.

15. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a drag line connected to the bucket, a rope carrier adapted to travel on the main cable and supporting said drag line, a line connected to said carrier, a drum

upon which said last-named line is wound, and a wheel connected to said drum and engaged by said drag line whereby the operation of the latter operates said drum to take up the line connected to the carrier.

16. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a drag line connected to the bucket, a rope carrier adapted to travel on the main cable and supporting said drag line, a line connected to the said carrier and a take-up device operable by said drag line to take up the line connected to said carrier when the bucket is moved in the digging direction.

17. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a drag line connected to the bucket, a flexible rope carrier adapted to travel on the main cable and supporting said drag line, a line connected to said carrier, and a take-up device operable by said drag line to take up the line connected to said carrier when said drag line is operated in the digging direction of the bucket.

18. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a drag line connected to the bucket, a rope carrier adapted to travel on the main cable and supporting said drag line, said carrier being composed of a plurality of flexibly connected members, a line connected to said carrier adjacent its point of support on the main cable, and a take-up device operable by said drag line to take up the line connected to the carrier when the bucket is operated in the digging direction.

19. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a drag line connected to the bucket, a rope carrier adapted to travel on the main cable and supporting said drag line, a two-part drum having parts of large and small diameter, a line connected to said carrier and wound on the drum-part of small diameter, and the said drag line passing in driving engagement with the drum-part of larger diameter.

20. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a drag line connected to the bucket, a drum for operating said drag line, a rope carrier adapted to travel on the main cable and located between the carriage and the drag bucket drum, a line connected to the carrier, a take-up device located between said drag bucket and said bucket drum and operable by the movement of said drag line to take up the line connected to said carrier.

21. In a cableway, in combination, spaced elevated supports, a main cable suspended between the supports, a carriage on the cable, suspension devices pivotally supported from the carriage, a bucket suspended at its front and rear portions on said suspension devices, means supported on the front suspension device for tilting the bucket about its front point of suspension as a center, said rear suspension swinging toward the forward end of the bucket when the latter is tilted, and means normally tending to return the rear suspension to its load-carrying position.

22. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a combined traversing and drag line having flexible connections respectively with the carriage and said bucket, an outhaul traversing line, and means operable by the outhaul traversing line to raise the rear end of the bucket to dump its load, the connection between the bucket and said combined traversing and drag line being such that said combined traversing and drag line is relieved of strain by the bucket when the rear end of the bucket is raised during the dumping operation.

23. In a cableway, in combination, spaced elevated supports, a main cable, a carriage on the main cable, a drag bucket suspended from the carriage, a traversing line for the carriage, a differential drum on the carriage having portions of different diameters, said traversing line being wound on one of the drum portions of larger diameter, and a flexible connection between a drum portion of smaller diameter and the rear end portion of the bucket, said flexible connection being of slightly less width than the surface on which it is wound, whereby it will wind on said drum in the form of a spiral.

24. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a base on the trucks, a tower on said base and a sliding connection between said base and one of said trucks.

25. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a base on the trucks, a tower on said base, a sliding connection between said base and one of said trucks, and a track anchor carried by the other truck and adapted to engage the trackway upon which it travels.

26. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a base on the trucks, a tower on the base, a connection between one of said trucks and its trackway whereby it may tilt on its trackway, and an extensible connection between said base and the other truck.

27. In a cableway, in combination, paral-

lel trackways, wheeled trucks to travel on said trackways, a base on the trucks, a tower on the base, means whereby one of said trucks may be held to its trackway to tilt thereon, and a plunger connection between said base and the other truck.

28. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a base on the trucks, a tower on the base, means whereby one of said trucks may be held to its trackway to tilt thereon, and a plunger and cylinder connection between said base and the other truck.

29. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a base on said trucks and adapted to tilt on the outside rail of one of said trackways, a tower on said base, and a member pivoted on one of said trucks beyond the outside rail of its trackway and adapted to extend over said rail and carrying a traveler engaging the inner portion of the flange of said rail.

30. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a base on said trucks, a tower on said base, and a member pivoted on one of said trucks beyond the outside rail of its trackway and carrying a grooved wheel engaging the inner portion of the flange of said rail.

31. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a tower supported on said trucks, and an extensible connection between said tower and one of said trucks.

32. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a tower supported on said trucks, and an extensible connection between said tower and one of said trucks, said extensible connection consisting of a cylinder and plunger.

33. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a tower supported on said trucks, a weight on said tower, a cylinder in said weight, and a plunger on one of said trucks and slidable in said cylinder.

34. In a cableway, in combination, parallel trackways, wheeled trucks to travel on said trackways, a tower supported on said trucks, a weight on said tower, a cylinder in said weight, and a plunger pivoted on one of said trucks and slidable in said cylinder.

35. In a cableway, in combination, two elevated supports, a cableway suspended from said supports, parallel trackways, trucks on said trackways supporting one of said elevated supports, means whereby one of said trucks is held in tilting relation to its trackway, and an extensible connection between the said elevated support and the other of said trucks.

36. In a cableway, in combination, spaced elevated supports, a main cable, pulleys on the main cable, a frame on which the pulleys are rotatably mounted, hangers pivoted on the frame on axes coincident with the axis of rotation of said pulleys, a drag bucket, flexible suspension means connecting the front and rear portions of the bucket with said hangers respectively, a drum on the forward hanger, a flexible connection on the drum and connected to the rear portion of the bucket, a traversing line for the carriage and bucket, and means whereby said traversing line operates said drum to wind said flexible connection to lift the rear end of the bucket.

37. In a cableway, in combination, spaced elevated supports, a main cable, pulleys on the main cable, a frame on which the pulleys are rotatably mounted, hangers pivoted on the frame on axes coincident with the axis of rotation of said pulleys, a drag bucket, flexible suspension means connecting the front and rear portions of the bucket with said hangers respectively, a drum on the forward hanger, a flexible connection on the drum and connected to the rear portion of the bucket, a traversing line for the carriage and bucket, and a drum upon which the said traversing line is wound, said drums being connected and rotating on the same axis.

38. In a cableway, the combination of spaced elevated supports, a main cable or trackway suspended between said supports, a carriage on the main cable, a suspension line extending between the elevated supports and sustained at a substantially fixed elevation above the main cable, a traversing line supported by the suspension line and connected to the carriage, and means for moving the main cable and carriage vertically without changing the elevation of said suspension line.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

THOMAS SPENCER MILLER.

Witnesses:

ERNEST CULSFORD,

HERBERT THOMSON.