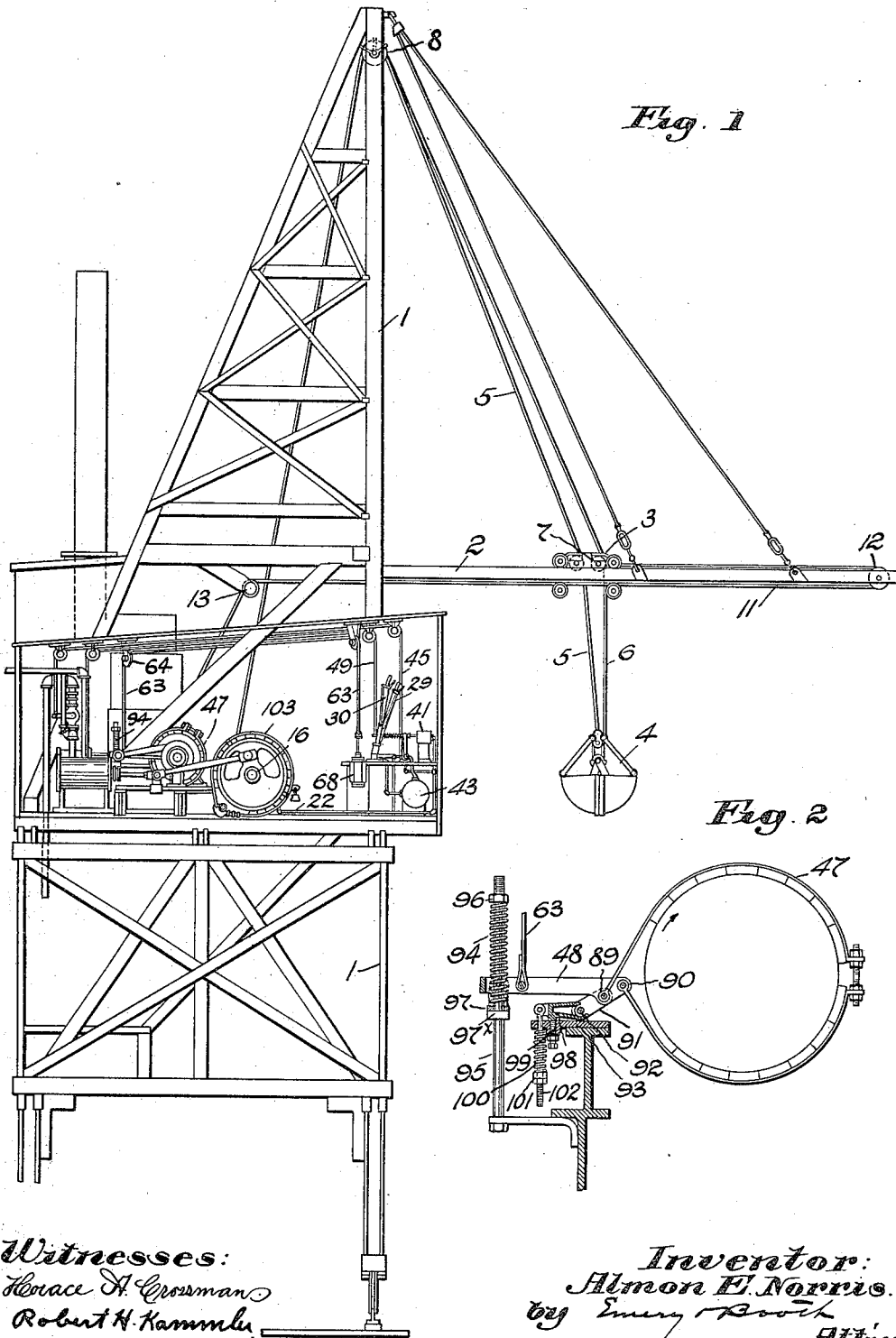


A. E. NORRIS.
 HOISTING APPARATUS.
 APPLICATION FILED FEB. 26, 1908.

1,008,361.

Patented Nov. 14, 1911.

4 SHEETS-SHEET 1.



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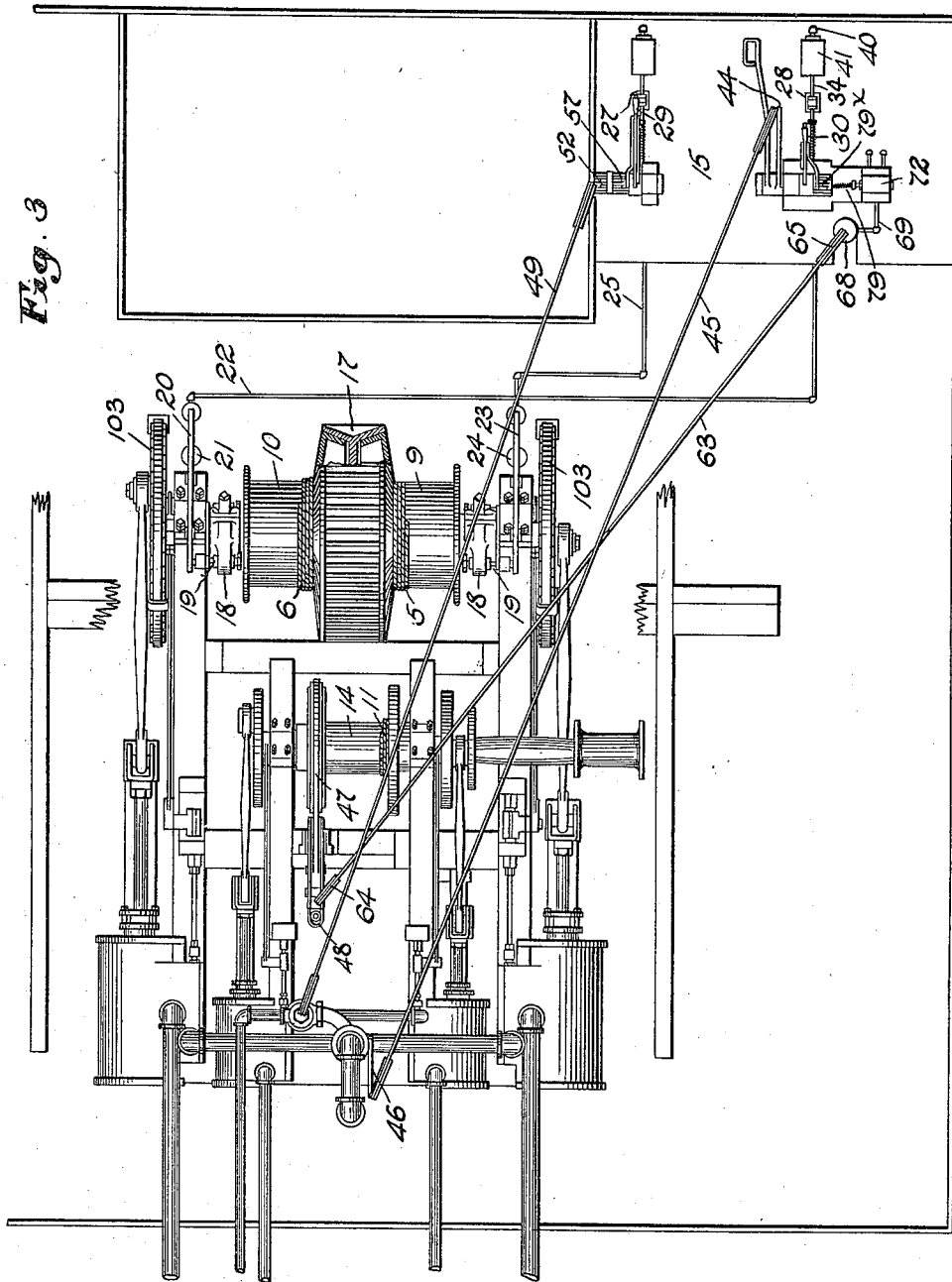
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4 SHEETS—SHEET 2.



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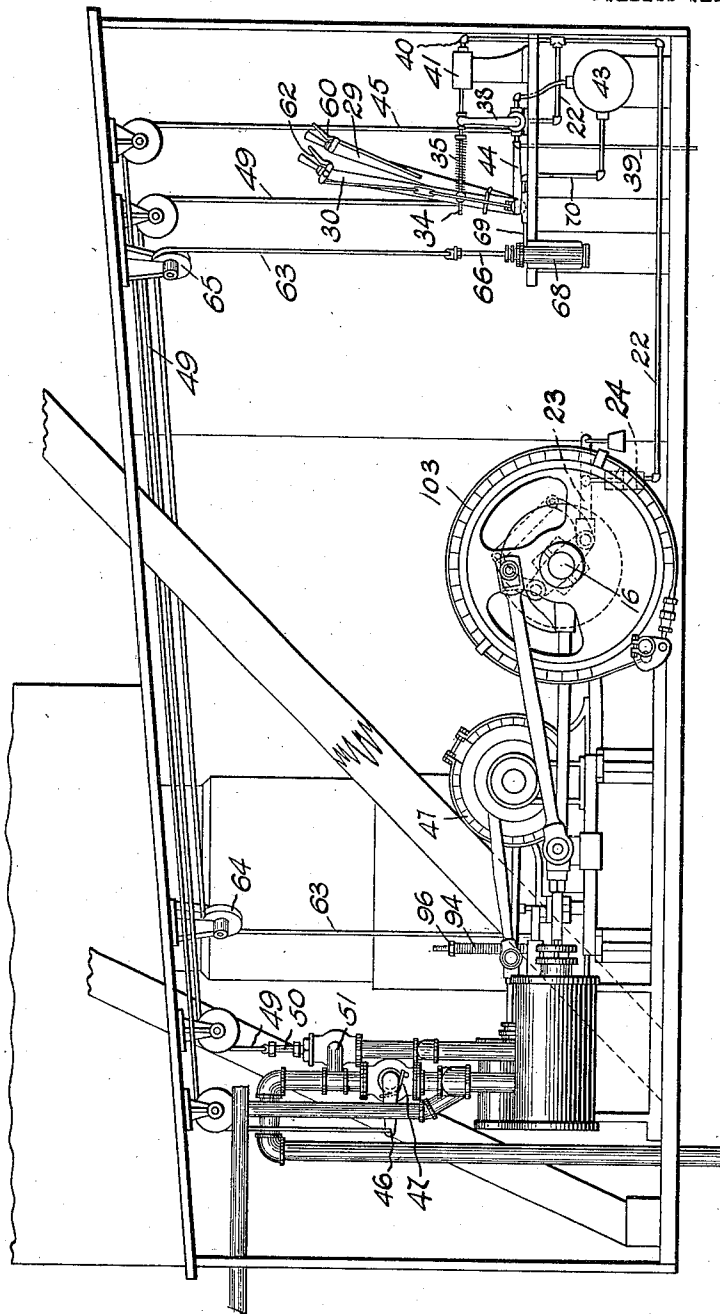
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4 SHEETS—SHEET 3.

Fig. 4



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4 SHEETS-SHEET 4.

Fig. 5

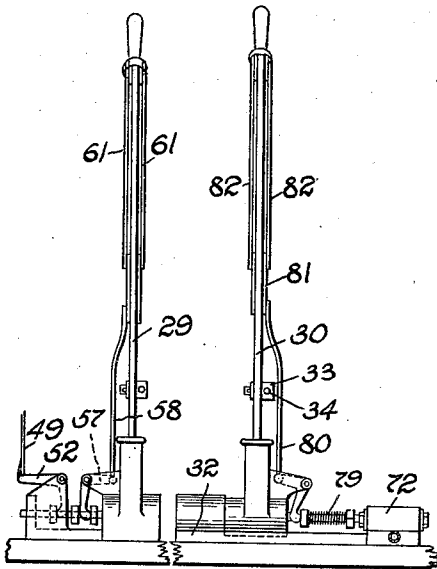


Fig. 6

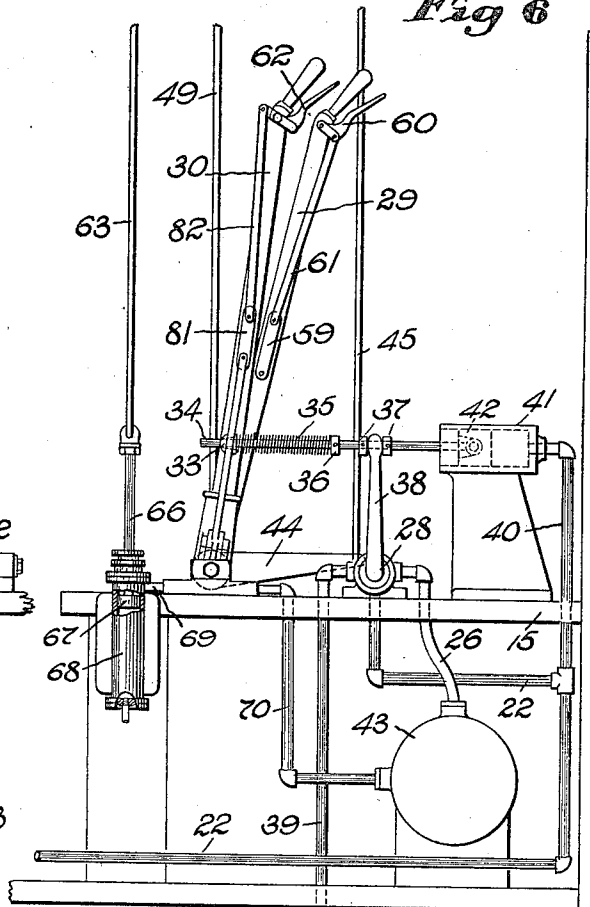


Fig. 10

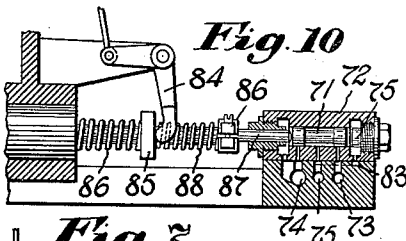


Fig. 7

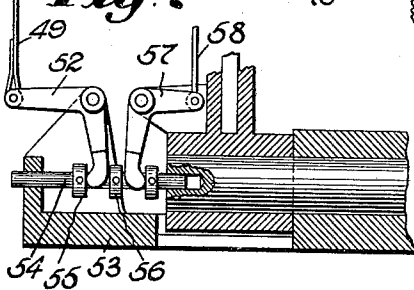


Fig. 8

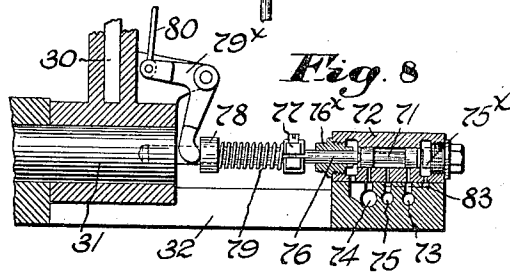
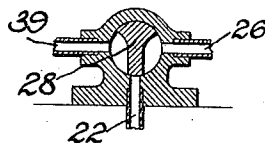


Fig. 9



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UNITED STATES PATENT OFFICE.

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HOISTING APPARATUS.

1,008,361.

Specification of Letters Patent. Patented Nov. 14, 1911.

Application filed February 26, 1908. Serial No. 417,947.

To all whom it may concern:

Be it known that I, ALMON E. NORRIS, a resident of Cambridge, county of Middlesex, and State of Massachusetts, have invented an Improvement in Hoisting Apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to apparatus for hoisting or hauling heavy loads, being more particularly concerned with means for rendering such apparatus more readily controllable by the operator through the employment of some auxiliary source of power such, for example, as compressed air or other pressure fluid.

In the control of hoisting or hauling devices such, for example, as the clutch for a rope-winding drum, it is quite desirable that the auxiliary power employed should be applied by the operator through the levers or other controlling devices with substantially the same graduated or delicate effect as where hand power alone is relied upon to operate such devices. For example, where a grab is raised or lowered through a rope-winding drum, the clutch for such drum, when operated by manual power is not only completely released or tightly thrown in at times, but also at other times partly thrown in so that the operator has the graduated control of such clutch constantly at his command. During the lowering of the load he can thereby maintain at any desired rate the speed at which it drops through the resultant retarding friction. The same is true of the traversing of the trolley which sustains the grab and which it may be desired to run at different speeds at different times. In other words, in the practical operation of devices of this class not only must the operator have the auxiliary power at his command to throw the clutch or other controlling device entirely off or completely on, but it is also necessary that he should be able to apply the auxiliary power to secure and maintain intermediate conditions and cause the controlling device to respond proportionately either to the manual movement or to the pressure manually exerted as in the case of directly applied manual control. Where compressed air is employed for this purpose, and a simple controlling valve only is used, the opening of such valve tends to throw the clutch

or other device completely on. The only way a condition can be secured between an inoperative and a completely operative or effective one is to reduce or build up the pressure in the system by intermittently opening or closing the valve. To do this the valve lever must be quickly oscillated from an open to a closed position, since in neither position does it give the required effect. This neither simulates the conditions of hand control, since the operator is called upon to jerk back and forth the hand lever which offers no resistance to movement as contrasted with moving the usual clutch controlling lever part way against a constantly increasing pressure, nor is the effect the same since the clutch or other controlling device is alternately thrown in and out, exerting a series of jerks upon the rope instead of an even pull.

One object of the present invention is to provide an economical and practical system of auxiliary power control for devices of this class which is practically applicable to such devices as hoisting and conveying systems, and where substantially the same delicacy of control may be attained as with direct hand control.

In the following described embodiment of the invention the same is shown as employing compressed air and as applied to a hoisting tower the latter using the ordinary grab or bucket, but it is to be understood that the particular medium of power employed and the particular form of apparatus to which the same is shown applied form no essential part of my invention.

My invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof while its scope will be more particularly pointed out in the appended claims.

In the drawings,—Figure 1 shows in side elevation a hoisting tower embodying one form of my invention; Fig. 2 is a sectional elevation of the band brake and brake controlling levers for the trolley drum; Fig. 3 is a sectional plan on an enlarged scale showing the principal controlling and motive parts for controlling the movements of the trolley and the bucket; Fig. 4 is a side elevation of the parts shown in Fig. 3; Fig. 5 is a rear elevation of the two clutch controlling levers; Fig. 6 is a side elevation of the same; Fig. 7 is a sectional elevation

taken through the axis of one of the controlling levers shown in Fig. 5; Fig. 8 is a similar section taken through the remaining clutch controlling lever and the air valve controlled thereby; Fig. 9 is a transverse section taken through one of the clutch controlling valves, and Fig. 10 is a section similar to the section shown in Fig. 8 but disclosing a modified form of valve control.

To illustrate my invention I have shown the same applied to a usual form of hoisting tower employing well-known mechanisms. It is to be understood, however, that the application of the invention is not limited to this particular type of hoisting apparatus or to a hoisting apparatus employing the elements which are herein set forth, but that numerous other applications and embodiments of the herein described invention may be had. The general arrangement of the operating parts of the hoisting apparatus, which will be apparent to those skilled in the art, may be briefly described as follows.

Referring to Fig. 1, the hoisting tower 1 is provided with the laterally extending boom 2, which latter provides the track-way for the trolley carriage 3 by which the hoisting element, herein represented as a usual grab or bucket 4, is carried. The latter may be of any suitable construction such, for example, as that set forth in U. S. Patent No. 699,000, dated April 29, 1902. The bucket is provided with operating ropes through which the raising or lowering of the same and the opening and closing of its jaws may be controlled. In the present instance two operating ropes are utilized, the same comprising the hoisting rope 5 by which the bucket is suspended and raised or lowered, and the opening and closing rope 6 by which the jaws are opened or closed. These pass upward over and about suitable guide sheaves 7 upon the trolley, thence obliquely upward over the guide sheaves 8 near the top of the tower 1 and thence downward to the operating room near the base of the tower where they pass over and about and are secured to suitable rope-winding drums 9 and 10 (Fig. 3), the former, or the hoisting drum, serving to control the hoisting rope 5, and the latter, or the opening and closing drum, serving to control the opening and closing rope 6. The trolley with its suspended bucket is traversed outwardly along the boom by means of the trolley rope 11 fixed to the outer end of the trolley carriage, whence it passes to the end of the boom over the guide sheave 12, over and about the guide sheave 13 and thence to the trolley drum 14 (Fig. 3) upon which it is wound and unwound under the control of the operator. When the bucket is hoisted the inward pull of the oblique hoisting rope 5 tends to traverse the trolley inwardly along the boom toward the

tower, so that the trolley may be traversed at will in either direction by merely winding in the trolley rope on the trolley drum or releasing the trolley drum to permit the rope to unwind. With the system herein described the three rope-winding drums and all movements thereof are placed entirely within the control of a single operator stationed upon the platform 15 in one corner of the operating room.

Any suitable device for driving the rope-winding drum may be employed, but, referring to the details of the driving connections for the drums, which are here shown for the purpose of illustrating the invention, the hoisting drum 9 and the opening and closing drum 10 are loosely journaled side by side upon the main driving shaft 16, but may be clutched thereto either separately or together by being forced into engagement with the centrally located clutch member 17 (see broken away portion Fig. 3). The drum shaft is connected at opposite ends through a crank and connecting rod connection to a two-cylinder horizontal engine, for which, however, may be substituted any suitable motor.

Any suitable clutch operating devices may be employed for the drums 9 and 10, and I have here indicated sliding collars 18 and clutch-operating screws 19 of the type described in the prior Reissue Patent No. 12,085 for forcing the drums either separately or together into clutching engagement with the shaft. For this purpose the clutch screws for the drum 10 are connected through suitable connections to the operating lever 20, the latter being controlled directly by an auxiliary source of power, herein pressure fluid preferably compressed air, and indirectly through suitable controlling levers at the operating platform.

While the compressed air may be applied to move the operating lever 20 in any desired way, in the present instance the lever is connected to a piston within the underlying upright cylinder 21 to the bottom of which compressed air may be admitted through the supply pipe 22, thereby acting to lift the piston and turn the clutch-operating lever 20 for clutching the drum 10 to the shaft 16 with a greater or less frictional effect according to the pressure in the operating cylinder 21. In a like manner the clutch-operating screws for the hoisting drum 9 are connected to an operating lever 23, which is under the control of the operating cylinder 24 connected to the air supply pipe 25. The supply pipes 22 and 25 have connection with the main supply pipe 26 (Fig. 6) through valves 27 and 28, respectively, under the control of the operator by connections about to be described.

The air valve 27 for the hoisting drum clutch is controlled by the hand lever 29, 130

while the air valve 28 for the opening and closing drum is controlled by the hand lever 30. As shown, these levers may be and preferably are of a construction similar to that ordinarily employed in connection with the direct hand control of clutches of this description. Since they are of substantially the same construction, and each effects the control of its respective valve, in substantially the same way, the connections only of the lever 30 need be described. The latter (Figs. 5 and 6) is pivoted upon a stud 31 (Fig. 8) secured to a bracket 32 upon the platform 15, so that the lever can be thrown forward or backward by the operator over a considerable range of movement, in the same fashion as if directly connected to the clutch-operating screws. Connections between the lever 30 and the air valve 28 are provided such that the valve will be moved to regulate the pressure supply and the effective pressure at the clutch-operating cylinder, in accordance with the position to which the lever is moved and the force applied to move it. For this purpose the lever 30 is provided with a laterally extending stud 33 which has sliding engagement with the valve-controlling rod 34, the stud being swiveled upon the lever so that the rod can slide freely through the same in any position of the lever. The stud bears directly against a spring 35 coiled about the rod 34, the forward end of the stud abutting against a collar 36 fixed upon the rod, so that as the lever is moved forward it slides over the rod but compresses the spring and the latter forces the rod forward with a pressure represented by the compression of the spring. The rod is also provided with other fixed collars 37 between which the forked end of the valve-controlling lever 38 lies, so that the valve lever is moved forward or backward as the valve controlling rod is moved forward or backward. In the neutral or off position of the controlling lever 30 all substantial pressure is withdrawn from the spring 35 and the lever 38 assumes a substantially upright position, holding the valve 28 in the position represented in Fig. 9 where the supply pipe 22 for the clutch cylinder is cut off from the supply pipe 26, as well as from the exhaust pipe 39, which latter leads to any suitable point.

When the lever 30 is thrown forward with the intent of applying the clutch to the opening and closing drum, the spring 35 is compressed and this, in turn, throws forward the valve-controlling rod 34, turning the valve so as to admit pressure from the pipe 26 to the pipe 22, thereby applying the clutch. The pipe 22, however, has connection through a branch pipe 40 with the back of the regulating piston 42 connected to the end of the valve-operating rod 34, so that pressure fluid admitted to the regulating

cylinder tends to oppose the pressure of the spring 35, and if such pressure is sufficient, to overcome the force of the spring and move the valve back to a closed position.

The proportions of the valve-controlling spring 35 and the regulating cylinder are preferably so selected that when the lever 30 is moved part way over, thereby exerting pressure against the spring and opening the valve to admit pressure to the pipe 22, the valve will be closed by the pressure simultaneously admitted to the regulating cylinder 41 as soon as that pressure is built up to a point proportional to the hand pressure exerted against the lever. On the other hand the valve will again be immediately opened to admit more pressure fluid if the pressure drops below the point which is called for by the position of the lever and the degree of compression of the spring. The result is that the regulating cylinder on the one side and the spring 35 on the other control the valve to maintain the pressure of the pipe 22 at the predetermined point, the spring acting to open the valve when the pressure in the pipe for any reason drops below the predetermined point, and the regulating cylinder acting to close the valve or to move it beyond that point and to a position of exhaust if the pressure for any reason rises above that predetermined point. The various parts may be so proportioned that the valve will respond delicately to the position of the controlling lever and admit and maintain a predetermined pressure supply in the pipe. Such pressure will be proportionate to the pressure exerted against the spring 35 and the operator will, therefore, exert his strength against the lever with a force which, at all times will be substantially proportionate to, although it may be considerably less than, the real pressure in the operating cylinder 21 at the clutch. In other words his control over the clutch is exercised in simulation of the conditions which would obtain if the latter were connected directly by mechanical connections to the clutch lever 30. The supply pipe 26 may be connected to any suitable source of supply, either a compressor or tank, the same being herein represented by a reservoir tank 43.

The clutch-operating lever 29 may be and preferably is connected to operate the clutch for the hoisting drum through connections which are substantially the same as those described in connection with the clutch lever 30, so that no further description of these need be given. By the side of the hand lever 30 (Fig. 3) is a substantially horizontal foot lever 44 fulcrumed upon the adjacent supporting bracket with the hand lever 30. The foot lever, which is arranged to be conveniently operated by the tower operator, is connected by means of a flexible

member, such as the rope 45, which, passing up and over suitable sheaves, leads across the tower and extends down to the arm 46 of the throttle valve for the main hoisting engine.

5 To the throttle valve arm is also connected the spring 47* tending normally to close said throttle. The latter, however, may be readily opened to a greater or less extent through the upward pull of the throttle

10 rope 45 caused by the downward pressure upon the foot treadle 44. By means of the two hand levers 29 and 30 which control the clutches for the opening and closing and hoisting drums, and also foot lever 44

15 which controls the engine throttle, the operator has entire control over the movements of the opening and closing and the hoisting ropes. In the present embodiment of my invention I have also associated with

20 the clutch-controlling levers other controlling devices by which the movements of the trolley can be regulated so that the entire control of all movements of the bucket may be exercised by a single operator without

25 altering his position upon the operating platform.

While other means may be employed for taking in or letting out the trolley rope 11, there is here shown for that purpose an additional but smaller double-cylinder, horizontal, trolley-engine connected by means of a crank and connecting rod to drive the trolley drum 14. While the latter may be loosely mounted upon its driving shaft and

30 operatively connected therewith through suitable clutching devices, in the illustrated form of the invention the drum is fixed to the driving shaft so that it moves with the engine at all times. One end of the drum

40 is formed into a friction surface encircled by the brake band 47, the latter acting to permit the winding-in movement of the drum and the outward movement of the trolley, but automatically preventing the reverse or unwinding movement of the drum, necessary to the running-in movement of the trolley, except when suitably controlled or released. The brake band is provided

45 with a brake releasing lever 48 connected with suitable controlling devices at the operating platform, whereby the operator has it at his command to release the brake and permit the trolley carriage to run inward, the engine being permitted to run backward

50 during this movement.

The starting or stopping of the trolley engine is preferably controlled from the operating platform by means of another controlling rope or cable 49, which, passing

60 over appropriate sheaves, is connected to a valve-operating rod 50 of the throttle valve 51.

At the operating platform the trolley throttle rope 49 (Fig. 7) is connected to

65 one arm of a bell-crank lever 52 pivoted

upon the bracket 53, the other arm of said lever being forked to embrace the slide rod 54 between the fixed collars 55 and 56. Reversely arranged with reference to said rod is a second bell-crank lever 57 connected to

70 a link 58, the latter jointed (Fig. 6) to a sliding block 59 upon the hand lever 29. The hand latch 60 is pivoted closely adjacent the handle of the lever 29 and has connections with the sliding block through the

75 links 61, whereby the operator without removing his hand from the lever 29 may also open and close or partially close the trolley engine throttle by pressing or releasing the hand latch.

When the hand latch 60 is pressed the bell-crank lever 59 is moved to slide the rod 54 inwardly and draw down the rope 49, thereby opening or partially opening the throttle. The slide rod 54 being arranged

85 substantially in line with the axis about which the hand lever 29 is moved, movement of the latter does not tend to draw down the trolley rope or otherwise affect the same. In order that the engine may be free to run

90 reversely when the trolley drum is released for unwinding movement of the rope, to allow the trolley to run inwardly the throttle valve 51 for the trolley engine is preferably provided with means which, when the

95 throttle is closed, will also act to relieve the pressure of the steam or other pressure fluid trapped in the cylinder, and which otherwise would prevent the free reverse movement of the engine. Such a form of relief

100 throttle valve is shown in my co-pending application, Serial No. 411,466, filed January 18, 1908.

In the illustrated form of my invention the releasing lever for the trolley drum

105 brake 47 is also controlled from the operating platform and herein by auxiliary power, preferably compressed air, from the same source as the air which is caused to operate the clutches for the grab operating ropes.

110 Also, since it is desirable to place it within the control of the operator to regulate the degree of application of the trolley drum brake, automatic regulating means are provided for the auxiliary power similar to

115 those already described, so that a graduated application of the brake may be secured and automatically maintained at any predetermined point.

To control the trolley drum I have provided a hand latch 62 pivoted adjacent the handle of the clutching lever 30 and this latch controls a valve at the base of the lever which controls the application of compressed air to the brake-releasing lever. Referring to Figs. 2 and 4 the brake releasing

125 lever 48 is connected to a releasing rope or cable 63, the latter passing upward over a sheave 64 and thence forward to a sheave 65 over the operating platform and thence

130

downward where it is connected to a piston rod 66 adapted to be operated or drawn downward by a piston 67 (Fig. 6) working within a pressure cylinder 68. When the piston is forced down it draws down the operating rope 63 lifting the brake-operating lever 48 and releasing the band 47 to permit the more or less free unwinding movement of the trolley drum.

The lower part of the cylinder is connected to the atmosphere through a suitable vent pipe, but the upper part has connection to the pipe 69 adapted to be placed in communication with the pipe 70 and the air reservoir 43 through the control of the piston-controlling valve 71. The latter (Fig. 8) is mounted in a valve casing 72 at the base of the lever 30 and arranged at one side of the same and co-axially therewith. The valve casing has a live pressure port 73 connected with the pressure pipe 70, an exhaust port 74 connected with the exhaust pipe 39 and an intermediate port 75 connected with the pipe 69 leading to the working cylinder 68.

The valve is adapted to be moved longitudinally to place the cylinder port in communication with either the live pressure port or the exhaust port, excessive movement in one direction being limited by the abutment 75*, and in the other direction by the abutting plug 76*. The valve is moved in one direction by the actuating pin 76 slidably mounted at one end in the plug 76*, the latter threaded into the end of the valve chamber, the opposite end of the pin being slidably supported in the stud 31. As will be more fully described, the pin-actuated movement of the valve takes place against a pressure acting upon the opposite end of the valve, such pressure being so proportional to the working pressure admitted to the working cylinder.

Fixed upon the pin 76 is clamped the collar 77 between which and the sliding collar 78 is provided the spring 79. The collar 78 is adapted to be engaged by the forked end of the bell-crank lever 79*, the opposite arm of which is attached to the link 80, the latter (Fig. 6) secured to the sliding block 81. The block 81 has attachment to the pivoted hand grip 62 through the links 82, so that when the hand grip is compressed the connections are moved to slide the collar 78 along the pin and compress the spring 79. The compression of the spring 79 in turn moves the pin 76 against the piston valve and moves the latter to open the working cylinder port to the live pressure port 73, thereby admitting pressure to the cylinder and moving the piston therein to raise the brake-releasing lever.

If the hand grip is squeezed tightly against the handle the spring 79 may be compressed under such a pressure that the valve will move against the abutment 75*

and open and maintain open the working cylinder so that it attains the full pressure of air supply. The working cylinder port 75, however, is connected with the space at the outer end of the valve chamber by a runaround port 83, shown in dotted lines in Fig. 8, so that the outer end of the piston valve is exposed to the same pressure as is admitted to the working cylinder. This pressure, if sufficient to overcome the pressure exerted by the spring 79, will move the valve to a closed position, or even beyond that to a position of exhaust, and reduce the pressure in the working cylinder. If, therefore, the hand grip is moved only partly to a closed position, the spring 79 will be only partly compressed and the pressure exerted upon the opposite end of the valve will move to close the same before the full pressure of the air supply has been attained in the working cylinder. This will act in substantially the same way as in the case of the air valve 28 to automatically regulate the pressure in the working cylinder in accordance with the graduated movement of the controlling lever, herein the hand grip 62.

In Fig. 10 I have shown a modified form of controlling and regulating device of the same general type as that illustrated in Fig. 8, but applicable to cases where the auxiliary power is normally maintained applied to hold the clutch or other controlling element in one position and then withdrawn at times through manual movement of the controlling lever to release the controlling element and permit its movement to another position under the influence of some medium such as a spring. Such would be the case were the spring 94 employed to release instead of apply the brake band 47, and the cylinder 68 maintained open to pressure fluid and employed to apply instead of release the band, the exhaustion of the pressure fluid from the cylinder under control of the operator acting to permit the spring actuated release of the brake. Under such circumstances a bell-crank lever 84 (Fig. 10) may be employed of the same type as the lever 57 in Fig. 7. This acts against the sliding collar 85 and the spring 86, the latter between such collar and the end of the stud 31. Between the sliding collar 85 and the collar 86 fixed upon the operating pin 87 is a second and preferably weaker spring 88. Substantially the same construction of valve and valve chamber is shown as in the case of the first described modification of Fig. 8, but in the modified form of Fig. 10, the normal condition which accompanies the release or inactive position of the hand latch 62, being that of pressure within the cylinder 68 and runaround port 83, the spring 88 is normally or initially compressed so that with the hand grip released it balances the pressure which is exerted against the oppo-

site end of the valve when the full working pressure of the supply source is attained in the working cylinder. With the hand grip released therefore the valve is balanced as shown with both exhaust and supply ports closed, but adapted to be moved to open one or the other the instant the fluid-exerted pressure upon the valve falls below that of the spring or vice versa. The pressure in the working cylinder is exhausted or reduced by allowing the spring 88 to expand and thereby reducing the spring-exerted pressure upon the valve. The expansion of the spring 88 follows the compression of the hand grip since the latter act compresses the spring 86 and slides the abutting collar 85 farther away from the fixed collar 86. The spring 86 may be initially compressed to the same degree as the spring 88 or it may be compressed to a greater degree if a stop or like provision is employed to limit its compressive effect upon the spring 88 to the required amount when the hand grip is full open.

It will be seen that the principle of pressure regulation is substantially the same in the last described modification although the parts operate in a somewhat reversed relation. In other words, the valve being constantly pressed to an open position by spring pressure, the latter is relieved more or less by the movement of the hand grip, and pressure in the cylinder more or less reduced by the automatic regulation according to the pressure exerted upon the hand grip. In each case, however, whether controlling the opening or closing drum, clutch 10 through the air valve 28, or the hoisting drum clutch, or the brake-releasing lever 48 through the valve 71, or the brake-releasing lever through the modified form shown in Fig. 10, the auxiliary power may be applied to the controlled parts gradually and delicately responsive to the graduated control exercised by the operator over his immediate controlling lever. In each case, too, the controlled part is moved under a force or pressure which is proportionate to the pressure exerted by the operator against his immediate controlling lever and also proportionate to the movement of that immediate controlling lever.

While the principles of my invention may be carried out in a great variety of ways and combinations, the adjustments for both the valves 71 and 28 are preferably such that the valve normally remains in a balanced state closing both the supply and exhaust ports and opening only for an instant as the spring-exerted pressure exceeds the fluid-exerted pressure or vice versa. In the one case it opens the supply port and moves back to close the same, quickly at first and then slowly, as the admitted pressure approaches the point determined by the pressure manu-

ally applied to the controlling lever. When that pressure is reached both ports are again closed, and the valve again finds its balanced condition. In the other case, where the fluid-exerted pressure exceeds the spring-exerted pressure owing to a manually caused reduction in the latter at the hand controlling lever, the valve moves to open the exhaust and then is gradually restored to its balanced condition as the pressure drops to the point determined by the hand control. In practice, the valve responds almost instantaneously to the movement of the hand grip and is almost instantaneously restored to its balanced condition so that the working pressure is quickly and delicately responsive to rapid successive movements of the hand controlling lever.

In the drawings a conventional showing only is made as to actual and relative dimensions and proportions of the valves, pipes, springs, levers, etc., these details obviously being a matter of design well understood by those skilled in the art and a matter of special consideration for any given installation dependent upon the pressure employed and numerous other considerations with which an explanation of the broad principles of my invention need not be encumbered.

Referring to Fig. 2 and the trolley drum brake there shown, the upper and lower halves of the brake band are secured at their ends at the points 89 and 90, respectively, to the brake lever 48, these points being so selected with reference to the pivotal attachment of the lever to a link 91, and a center line passing from the pivotal center or attachment 92 of the link to a fixed support 93, to the axis of the trolley drum, that the band tends to open or release the drum on tripping movement of the lever about its pivotal attachment 89, or, on the downward tipping movement of the link 91. The pull of the trolley rope normally tends to turn the drum in the direction of the arrow shown in Fig. 2. This places a frictional pull on the band, tending to draw the link 91 to the position shown. This position of the lever and link draws the band about the drum, preventing movement of the latter in the direction of the arrow and, therefore, preventing unwinding of the rope. The pull of the drum is resisted by the spring 94 which encircles the upright rod 95, the spring lying between the adjustable nut 96 and the cross piece 97, the latter carried by a stirrup attached to the lever 48. This spring presses down the outer end of the lever bringing the cross piece 97 against a fixed abutment 97* and maintains a predetermined but adjustable tension of the band. The link 91 has a rearwardly extending arm 98 having a lug which rests upon the adjustable stop screw 99, the latter serving as a means for limiting the upward

swing of the forward arm of the link. The link is normally drawn to its uppermost position shown by means of a spring 100 located between the lower side of the adjacent supporting part 93 and an adjustable nut 101 secured to the threaded rod 102, the latter jointed to the rearward arm 98. If the direction of the drum movement is reversed friction on the lower half of the band 47 pulls the link 91 down far enough to release the band and permit free rotation of the drum. Although normally held against unwinding movement, the drum may be released by the upward pull of the releasing rope 63 which raises the outer end of the brake band lever against the spring 94, thereby swinging down the point of attachment 90 of the brake band to the lever, this acting to loosen the band.

From the description of the operating lever it will be seen that the operator has within the control of his right hand the clutching and unclutching of the grab opening and closing rope, and, at the same time, through the hand latch 62, the control of the inward movement of the trolley. Subject to the control of his left hand is the clutching or unclutching of the hoisting rope drum and the throttle control of the trolley engine, the throttle control of the hoisting engine being at its command through the medium of the foot lever 44. The clutches for the opening and closing and hoisting drums may be normally kept in an open or ineffective position by any suitable means such as the weight shown attached to the operating levers and shown in Fig. 4. Automatic brakes 103 are preferably employed for the crank disks of these drums to prevent reverse or unwinding movement while the clutches are thrown in.

In the use of the term rope herein it is to be understood that I include other flexible power transmission devices such as wire cables, chains, etc., as well as devices which are capable of performing like or equivalent functions.

While I have shown and described one form of my invention, it is to be understood that the same is not limited to the details of parts herein shown, or to the specific application of the invention herein described, but that extensive modifications may be made herein without departing from the spirit of the invention.

Claims.

1. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for applying said controlling element, a source of pressure fluid supply, movable controlling means within the control of the operator for regulating communication between the pressure fluid means and the source of supply, and

means for further regulating communication between the fluid pressure means and the source of supply automatically to maintain the pressure at a point determined by the controlling means.

2. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for applying said controlling element, a source of pressure fluid supply, movable controlling means within the control of the operator for regulating communication between the pressure fluid means and the source of supply, and means automatically to restrict such communication on rise of the effective pressure to a point determined by the controlling means.

3. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for applying said controlling element, a source of pressure fluid supply, movable controlling means within the control of the operator for regulating communication between the pressure fluid means and the source of supply, and means automatically to restrict such communication on rise of the effective pressure to a point determined by the controlling means, and to enlarge such communication on the lowering of effective pressure below said point.

4. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for moving said controlling element, a source of pressure fluid supply, a valve for controlling communication between said source and said pressure fluid means, controlling means adapted to be moved by the operator, means for controlling said valve in response to the movement of said controlling means, and means for subjecting said valve to an opposite controlling effect through the pressure fluid supplied to the pressure fluid means.

5. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for actuating the same, a source of pressure fluid supply, a valve controlling communication between the said source and the pressure fluid means, means for admitting pressure fluid to the valve to move the same in one direction, said admitted fluid pressure being proportional to the pressure supplied to the pressure fluid means, means acting to move the valve in the opposite direction and controlling means within the control of the operator for varying more or less the effective action of said last named moving means.

6. The combination with a hoisting and conveying device, of a trolley carriage and

its load-carrying device, a controlling element, pressure fluid means for actuating the same, a source of pressure fluid supply, a valve controlling communication between the said source and the pressure fluid means, means for admitting pressure fluid to the valve to move the same in one direction, said admitted fluid pressure being proportional to the pressure supplied to the pressure fluid means, a spring acting to move the valve in the opposite direction, and controlling means within the control of the operator for varying more or less the moving effect of said spring.

7. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for applying said controlling element, a pressure fluid supply valve, controlling means within the control of the operator for moving said valve to apply said controlling element, and means automatically to regulate said valve to maintain the pressure at a point determined by the controlling means.

8. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for applying said controlling element, a pressure fluid supply valve, controlling means within the control of the operator for moving said valve to apply said controlling element, and means automatically to regulate said valve to cut off or reduce the supply when the effective pressure rises to the point predetermined by the controlling means.

9. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid means for applying said controlling element, a pressure fluid supply valve, controlling means within the control of the operator for moving said valve to apply said controlling element, and means automatically to regulate said valve to cut off or reduce the supply and also to exhaust the pressure fluid when the effective pressure rises to the point predetermined by the controlling means.

10. The combination with a hoisting and conveying device, of a trolley carriage and its load-carrying device, a controlling element, pressure fluid-actuated means for actuating said controlling element, a valve for controlling the pressure fluid supplied to said pressure fluid means, and a controlling device within the control of the operator, said valve being adapted to be moved by said controlling means, but having also a movement independent thereof.

11. In a hoisting and conveying apparatus, the combination with a traversing carriage, of a hoisting device carried thereby, a controlling lever for said hoisting de-

vice, auxiliary power supply means through which said lever is adapted to act to control said hoisting device, and auxiliary controlling means upon said lever for controlling the traversing movement of said carriage.

12. In a hoisting apparatus, the combination with a traversing carriage, of a grab carried thereby, controlling ropes and rope-winding drums for controlling said grab, clutching devices for each of said drums, an independent controlling lever for each clutching device, and auxiliary power-actuated means subject to the control of each of said levers for operating its respective clutch.

13. In a hoisting apparatus, the combination with a traversing carriage, of a grab carried thereby, a rope-winding drum with its rope for controlling said grab, a drum clutch, pressure fluid means for controlling said clutch, a clutch lever for controlling said pressure fluid means, and auxiliary means upon said clutch lever for controlling the traverse of said traversing carriage.

14. A hoisting apparatus having a grab, a trolley, a hand-operated controlling device for the grab, an auxiliary controlling device for the trolley adapted to be grasped by the operator, while still holding the grab controlling device, pressure-fluid means through which said trolley-controlling device is adapted to act, and means automatically to maintain the pressure of said pressure-fluid means at a point determined by the pressure upon said trolley-controlling means.

15. A hoisting apparatus having a grab, a trolley, a hand-operated controlling device for the grab, an auxiliary controlling device for the trolley associated with said grab controlling device, so that the operator can grasp the same while still exercising control over the said grab controlling device, pressure-fluid means through which said grab controlling device is adapted to act, and means automatically to maintain the pressure thereof at the point determined by the pressure exerted against the said grab controlling device.

16. A hoisting apparatus having a controlling element, pressure fluid means through which said controlling element acts, an auxiliary controlling element, and pressure fluid means through which said auxiliary controlling element acts, said auxiliary element being accessible to the operator without losing his control over the main controlling element.

17. A hoisting apparatus having a trolley, a bucket, a device for controlling the bucket, a controlling member therefor, pressure-fluid means through which said controlling member acts upon the controlling device, and means for applying and varying the pressure exerted upon said controlling de-

vice in substantial proportion to the application and variation of the effort exerted by the operator at the controlling member.

18. A hoisting apparatus having a trolley, a bucket, a controlling rope for the bucket, a clutch for said controlling rope, pressure fluid means for controlling said clutch, and controlling means for applying said pressure fluid means with an effort substantially proportionate to the effort exerted by the operator.

19. A hoisting apparatus having a trolley, a bucket, bucket controlling friction clutches, pressure fluid means for controlling said clutches and a pair of hand operated devices for controlling the pressure fluid means said clutches being responsive through said pressure-fluid means and hand operated devices to the degree of effort exerted by the operator.

20. In a hoisting apparatus, the combination of a trolley, a bucket, a trolley winding drum, a brake controlling the same, pressure fluid means for controlling the brake and controlling means for said pressure fluid means for applying to the brake an effort proportionate to the effort exerted by the operator upon the controlling member.

21. In a hoisting apparatus, a trolley, a bucket, operating ropes connected to the bucket, winding drums for said ropes, a pair of clutch levers, pressure fluid means controlled by said levers for controlling the operation of the winding drums responsive to the degree of effort exerted by the operator at the levers, and means for controlling the movement of the trolley, said means being within the manual control of the operator while still retaining his grasp upon the clutch levers.

22. In a hoisting apparatus, the combination with a trolley of a bucket, an operating rope for the bucket, a rope winding drum, a hand lever connected to control the drum,

pressure fluid means for controlling the same responsive to the degree of effort exerted by the operator at the hand lever, and trolley controlling means located to be controlled by the operator while holding the said bucket controlling lever.

23. In a hoisting apparatus, a trolley, a bucket, an operating rope for the bucket, a rope winding drum, a friction device therefor, a controlling lever for the friction device, a trolley controlling means within the manual control of the operator while still retaining his grasp upon the said hand lever, and pressure fluid means for controlling said trolley with an effort proportionate to the effort exerted by the operator upon said trolley controlling means.

24. In a hoisting apparatus a trolley, a bucket, a pair of operating levers, trolley controlling means within the manual control of the operator while still retaining his grasp upon said levers, and variable effort pressure fluid means through which said levers and trolley controlling means act, the effort of said pressure fluid means being variable in response to the variable effort exerted by the operator.

25. In a hoisting apparatus, a trolley, a bucket, an operating rope for the bucket, a rope winding drum, a drum controlling lever, a grasping device upon said controlling lever, and pressure fluid means governed thereby for controlling the trolley and acting with an effort proportionate to the effort exerted by the operator upon said grasping device.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

ALMON E. NORRIS.

Witnesses:

THOMAS B. BOOTH,
EVERETT S. EMERY.