M. H. MILLS.

HOISTING APPARATUS.

APPLICATION FILED OCT. 16, 1916.

1,321,386.

Patented Nov. 11, 1919.

4 SHEETS—SHEET 1.

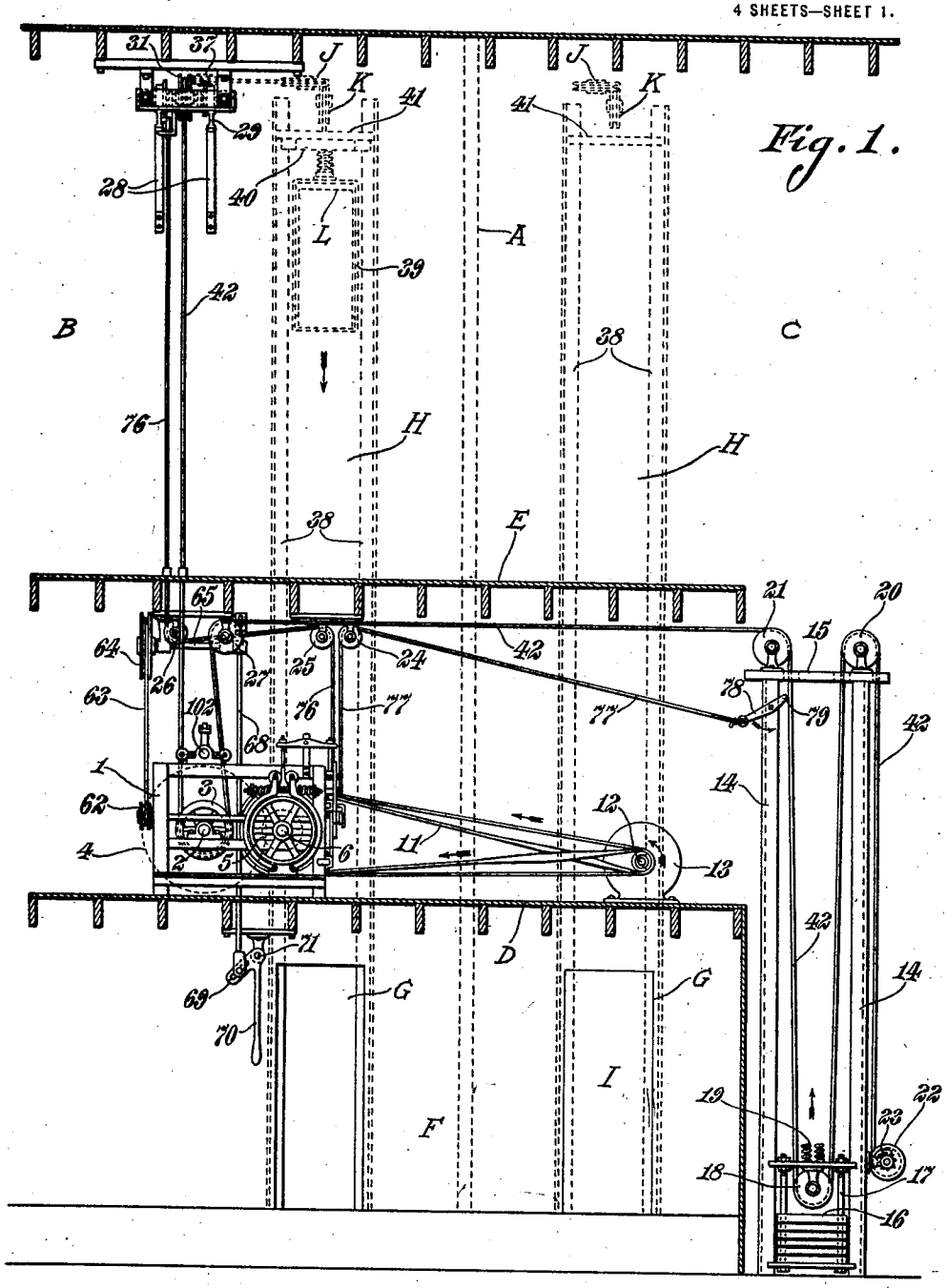


Fig. 1.

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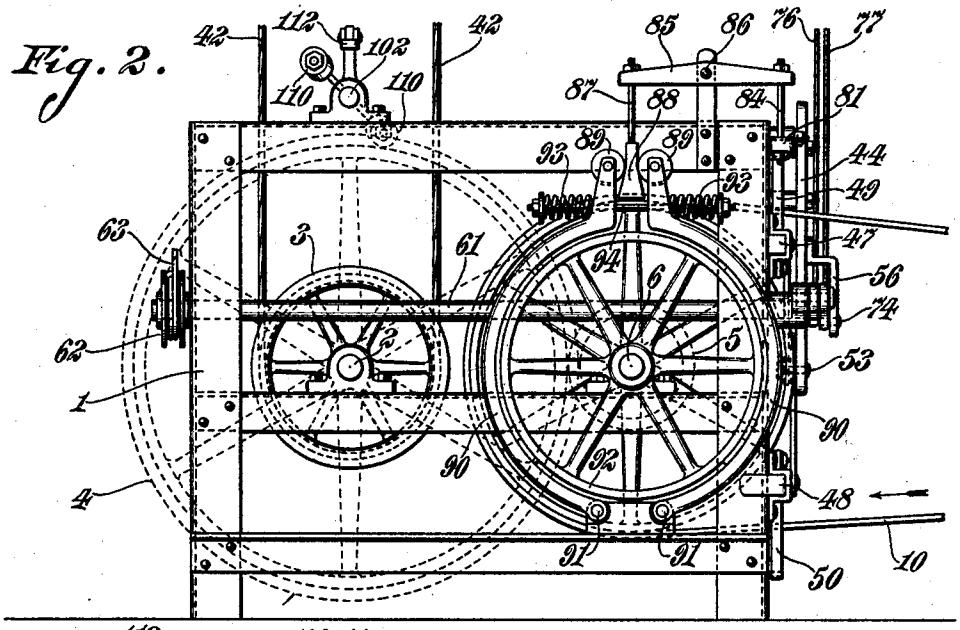
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4 SHEETS—SHEET 2.

Fig. 2.



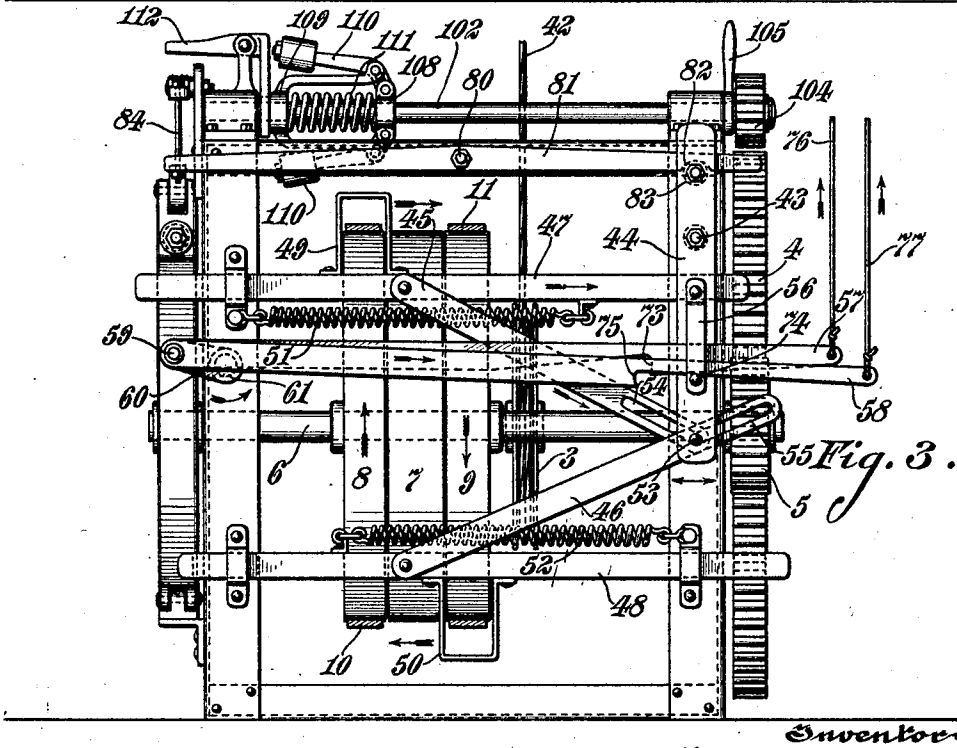


Fig. 3.

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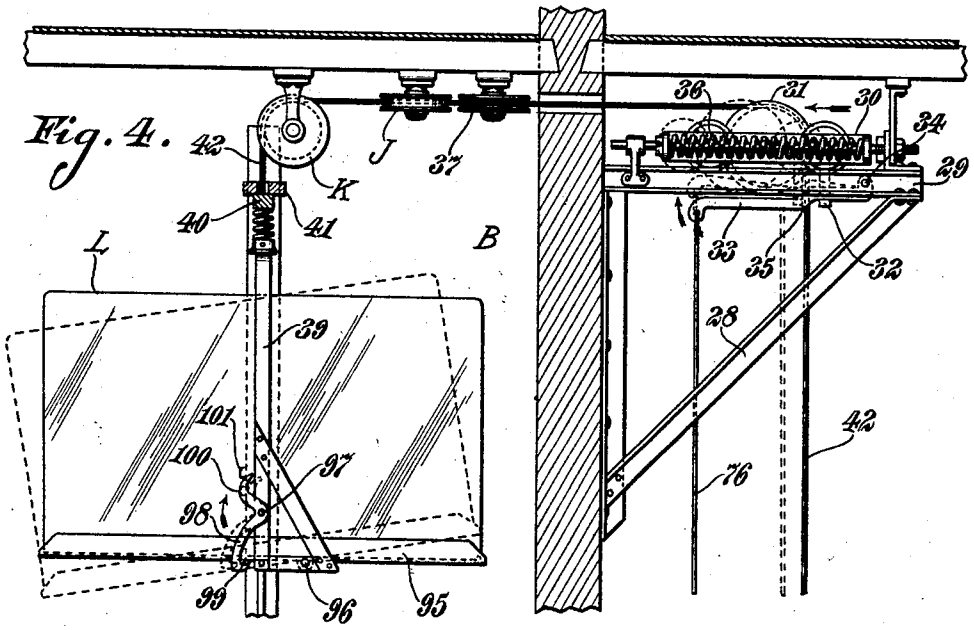
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4 SHEETS—SHEET 3.

Fig. 4.



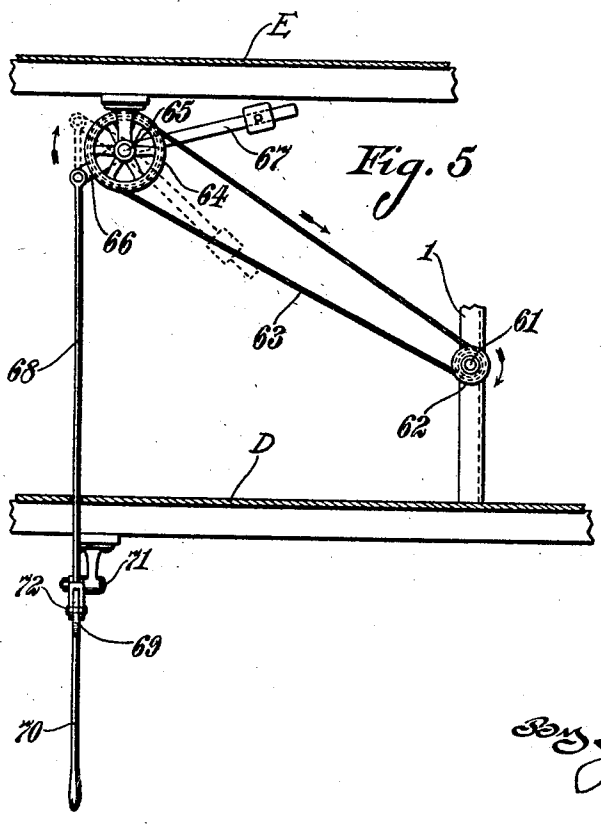


Fig. 5

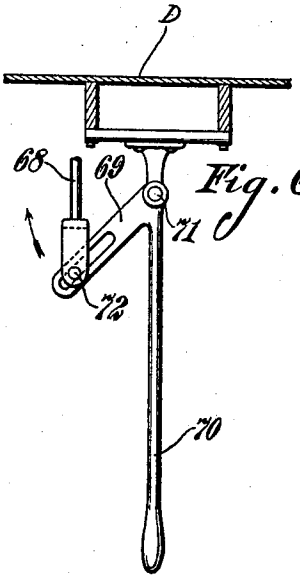


Fig. 6

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4 SHEETS—SHEET 4.

Fig. 7.

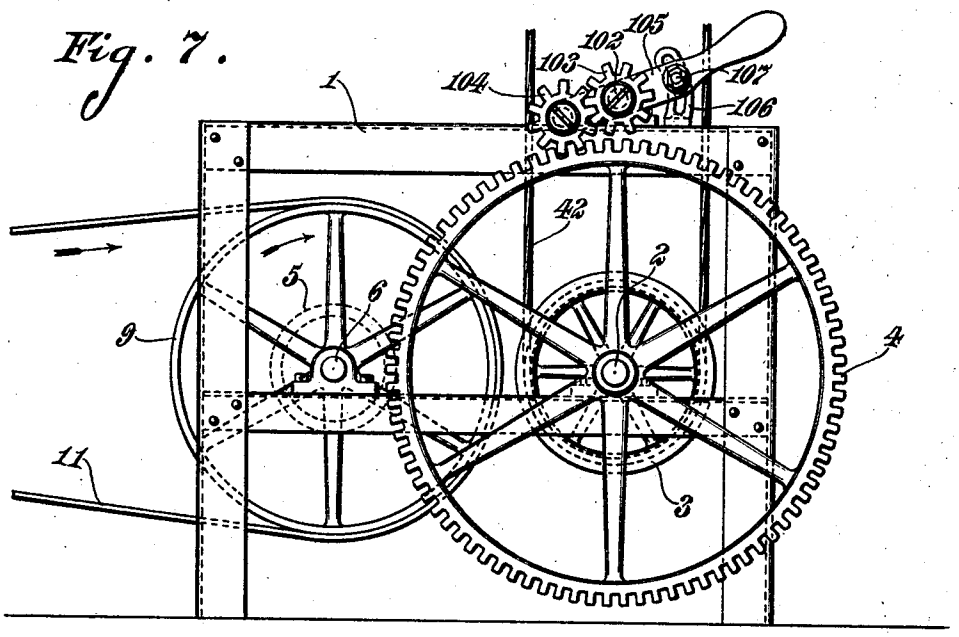
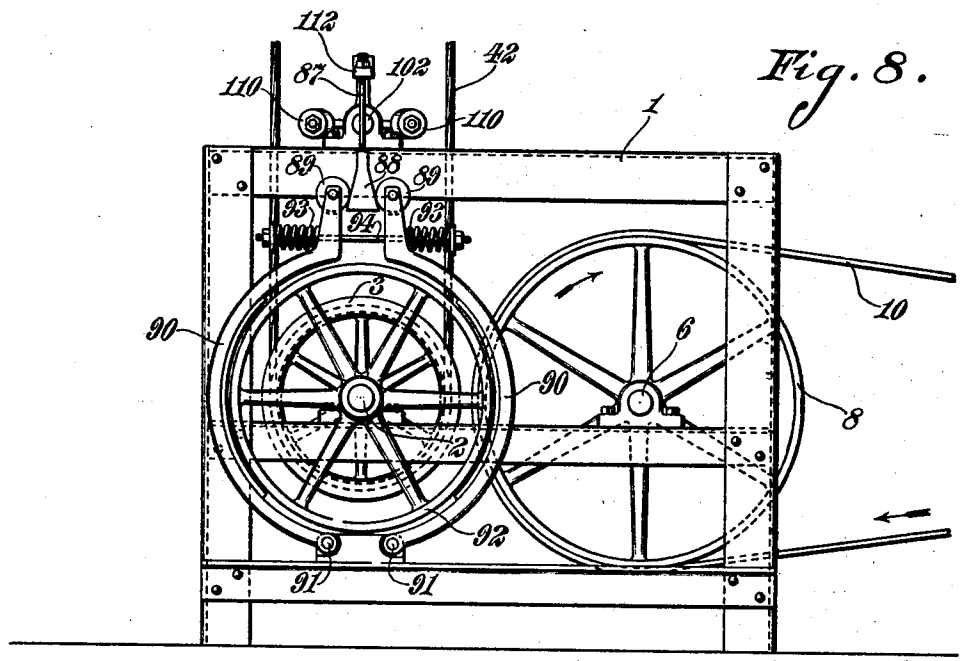


Fig. 8.



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UNITED STATES PATENT OFFICE.

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HOISTING APPARATUS.

1,321,386. Specification of Letters Patent. Patented Nov. 11, 1919.

Application filed October 16, 1916. Serial No. 126,001.

To all whom it may concern:

Be it known that I, MARK H. MILLS, a citizen of the United States, and residing at St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Hoisting Apparatus, of which the following is a specification.

This invention relates to hoisting apparatus adaptable especially for handling ice in the operations of filling and discharging the storage houses or compartments of ice plants, it being evident that the apparatus is suited to and may, therefore, be advantageously employed in many relations other than that mentioned.

In the herein disclosed embodiment of the invention, the apparatus comprises a counterweighted cage, a hoisting drum therefor, and a suitable controller included in the drum operating mechanism and operable for reversing the direction of movement of the cage.

The invention has among its objects a comparatively simple apparatus of this character which may be readily installed for use and which, aside from releasing and starting the drum, will be wholly automatic in action.

Further objects are to provide such an apparatus wherein the cage travels a predetermined distance, in either direction, before coming automatically to rest, and one in which the determined distance to be traveled by the cage, may be readily varied at will to accord with the height to which the load is to be hoisted.

Further objects are to provide an apparatus wherein the hoisting drum will be automatically locked when the cage has completed the full course of its movement in either direction, and one in which the reversing means will, when the cage comes to rest, be automatically set for the return trip.

A still further object is to provide for ready adjustment of the mechanism to adapt the cage to travel by gravity while discharging or unloading material and for connecting the mechanism to operate any one of a series of hoisting cages.

With the above and other objects in view, the invention comprises the novel features of construction and combination of parts more fully hereinafter described.

In the accompanying drawings,

Figure 1 is a view in elevation showing a hoisting apparatus embodying the invention, installed for use in an ice storage plant;

Fig. 2 is a detail side elevation on an enlarged scale, of the hoisting sheave or drum and its attendant mechanism;

Fig. 3 is a front end view of the mechanism shown in Fig. 2;

Fig. 4 is an enlarged detail view in side elevation of the cage or basket and the cable trolley;

Fig. 5 is a detail view of the controller lever showing its connection with the rock shaft;

Fig. 6 is a detail side elevation on a larger scale, of said lever;

Fig. 7 is a view similar to Fig. 2, but viewed from the opposite side and showing an arrangement of the mechanism for unloading and in which operation the cage operates by gravity; and,

Fig. 8 is a view similar to Fig. 7, but viewed from the front side as in Fig. 2.

It will be seen on reference, more particularly to Fig. 1, that the apparatus is shown installed for handling ice in the operations of filling or discharging a storage house which is subdivided by a partition A into a plurality of compartments B and C and has vertically spaced platforms D and E outside of the storage compartments and above a lobby F opening, as seen at G, into the lower ends of hoist shafts H leading upward through the storage compartments, the openings G being normally hermetically closed by means of suitable doors I, as indicated at the right in said figure, while arranged at the upper end of each shaft is a pair of idler cables guides comprising a horizontal pulley J and a vertical pulley K for a purpose which will hereinafter appear.

Mounted on the platform D is a hoisting unit frame 1 in which is suitably journaled a rotary horizontal shaft 2 carrying a hoisting sheave or drum 3 and a gear 4 in mesh with a pinion 5 carried by a horizontal drive shaft 6 also suitably journaled in said

frame, there being mounted upon the shaft 6, a tight pulley 7 and a pair of loose pulleys 8 and 9, arranged respectively on opposite sides of the pulley 7 and adapted to normally carry driving belts 10 and 11 running to and driven from the shaft 12 of a suitable motor 13.

Arranged preferably at the right of the lobby F and for travel upon suitable vertical guides 14 connected at their upper ends by a cross piece 15 is a counterweight 16 whose frame 17 carries an idler guide pulley 18 and is equipped with buffer springs 19 disposed for contact with the cross piece 15 when the weight is raised, there being mounted upon said cross piece and preferably above the respective guides 14, idler guide pulleys 20 and 21, while suitably journaled at the other side of the weight guide is a take-up drum or spool 22 normally held against rotation by means of a suitable pawl and ratchet 23 as and for a purpose which will presently appear.

Hung in suitable bearings beneath the platform E is a plurality of guide pulleys 24, 25, 26 and 27 of which the latter is positioned above the sheave 3, while sustained by a suitable overhead frame 28 for travel on ways 29, is a carriage 30 carrying a pulley 31 and having a depending arm 32 disposed to ride beneath a tripping lever 33 pivoted at 34 in said frame and having a cam portion 35 with which the arm 32 cooperates for lifting said lever in the manner and for the purpose more fully hereinafter explained, there being engaged with the sides of the carriage 30, suitable tension springs 36 tending to normally pull the carriage forward to the full line position shown in Fig. 4. The trolley 31, which stands in a plane slightly above the upper end of the hoist shafts H and to one side of the extreme left hand shaft, is in line with a horizontal guide pulley 37 idly hung in a suitable overhead bearing within the compartment B as seen more clearly in Fig. 4.

Arranged in one of the shafts or wells H for travel on suitable vertical guides 38, is a hoisting cage or basket 39 having a spring buffer 40 disposed for contact when the cage is raised, with a cross piece 41 extended between the guides 38 and adapted for vertical adjustment thereon, as and for the purpose hereinafter explained, the basket 39 being suspended from one end of a hoisting cable 42 which passes over the guide pulley K thence around pulleys J and 37, and outward over the pulley 31, and thence downward to and around the sheave or drum 3, thence upward over the pulleys 27 and 21, thence beneath pulley 18 over pulley 20 and downward and around the take-up spool or drum 22 on which latter there is wound a sufficient amount to be drawn off for carrying the basket 39 from the left hand to the right hand shaft H at such times as it may become necessary or desirable to operate the basket in said right hand shaft for filling or discharging the storage compartment C. In this connection it will be understood that the spool normally remains fixed through the pawl and ratchet connection 23, but may be released for rotation in either lengthening or shortening the active portion of the cable 42. It will also be understood that the cable is wrapped one or more times on the sheave or drum 3 adapting the latter to feed the cable back and forth in operation as usual.

Pivoted between its ends at 43 on the front end of the frame 1 is a main reversing lever 44 whose lower end is connected by links 45 and 46 respectively, with upper and lower belt shifters 47 and 48 suitably sustained for longitudinal sliding movement on said frame and having yokes 49 and 50 disposed to engage respectively, with the belts 10 and 11, and adapted through movement of the shifter bars 47 and 48 to carry said belts alternately on to the tight pulley 7, the shifters being held in normal position with the belts disposed for travel on the loose pulleys by means of springs 51 and 52, while the links 45 and 46 are connected with the lever 44 by means of a pin 53 arranged to work in a slot 54 formed in the link 45 and a corresponding slot 55 in the link 46 in order to permit of movement of one of the bars 47 or 48 without effecting the other, as will more fully hereinafter appear.

Provided on the front face of the lever 44 is a guide strap 56 affording loose bearing for a pair of longitudinally movable auxiliary reversing levers 57 and 58, fulcrumed at the rear ends upon a wrist pin 59 carried at the outer end of a crank arm 60 provided on the forward end of a rock shaft 61 having upon its rear end a sheave 62 connected by an endless band 63 with a similar, though larger sheave 64 fixed upon one end of a counter shaft 65 journaled in suitable hangers beneath the platform E and carrying a crank arm 66 and a weighted counterbalancing arm 67. The arm 66 is connected by a vertical link 68 with the arm 69 of a bell crank lever 70 fulcrumed at its elbow at 71 in a suitable bearing beneath the platform D and within convenient reach of the attendant in the lobby F. It will be noted that the arm 69 of the lever has a pin and slot connection 72 with the lower end of the link 69 adapting the lever to move the link in a true vertical line and further, that when the lever is rocked on its pivot the shaft 65 will, through the connection of link 68 with arm 66, be rocked for similarly rocking the shaft 61 through the medium of the connection 62—63—64.

The reversing lever 57 is provided with an engaging portion or tooth 73 adapted for engagement with a pin 74 on the lever 44 to rock said lever in one direction while the lever 58 is provided with a similar though reversely disposed portion or tooth 75 adapted through engagement with pin 74 to rock the lever 44 in the reverse direction. Attached to the forward end of lever 57 is a pull cord or other flexible connection 76 which extends upward from said lever, and after passing around guides 25 and 26 is carried upward and engaged at its other end with the free end of tripping lever 33, while attached to the forward end of lever 58 is a similar flexible connection 77 running upward over pulley 24 and having its other end connected with one end of a tripping lever 78 pivoted on one of the weight guides 14 near the upper end thereof, and disposed for its free end 79 to be struck by the frame 17 when the weight is raised.

Centrally pivoted at 80 on the front end of the frame 1 is a main brake actuating lever 81 provided near one end with a recess 82 adapted to normally receive a roller 83 mounted on and near the upper end of the tripping lever 44, the said lever 81 having its other end rigidly connected by a link 84 with an auxiliary lever 85 centrally pivoted at 86 on the frame and having suspended from its other end, by a rigid link 87, a brake releasing wedge 88 disposed for operation between anti-friction rollers 89 carried by the free ends of coöperating brake shoes 90 pivoted at 91 and arranged to engage a brake pulley 92 fixed upon that end of the shaft 6 opposite the pinion 5, the shoes 90 being normally pressed into frictional engagement with said pulley under the action of springs 93 carried by a rod 94 passed loosely through the free or movable ends of the brake shoes.

As seen more clearly in Fig. 4, the bottom 95 of the hoisting cage or basket is eccentrically pivoted in its supporting frame, this pivot 96 being located somewhat in rear of the vertical medial line of the cage, while pivoted at 97 on one side of the cage is a latch lever 98 whose lower end is formed to engage beneath a lug or keeper 99 provided on the bottom 95 at a suitable point in advance of the pivot 96. This lever which normally holds the bottom 95 in proper position for supporting the block of ice or other load L, has its upper end 100 formed to ride beneath a fixed lug 101, on the adjacent guide 38, for throwing the lever 98 out of engagement with the keeper 99 and allowing the bottom 95 to tilt forwardly for discharging the load as indicated by dotted lines.

In operation supposing the parts of the apparatus to be at rest, as shown by the full line positions throughout the several views, and the hoisting cage to have reached the limit of its upward movement in the shaft or well H, the bottom 95 will be released, in the manner above explained, for automatically discharging the load. The cage having arrived at the upper end of the shaft and the load having been discharged, the attendant throws the controller lever 70 to the left thereby moving arm 66 upwardly to the dotted position in Fig. 5, and causing a partial rotation of counter shaft 65 and likewise of the pulley 64 fixed thereon. This rotation of the pulley 64, which is transmitted through band 63 and pulley 62, to the shaft 61, is because of the relative sizes of the said pulleys 62—64, sufficient to turn the rock shaft 61 through a little over one half a revolution, in the direction indicated by the arrow in Fig. 3.

Through this partial rotation of the rock shaft 61 the crank arm 60 is caused to move the levers 57—58 longitudinally to the right, in Fig. 3, whereupon portion 75 of lever 58, engages pin 74 and swings the lower end of lever 44 to the right on its pivot 43, thereby actuating link 45 for moving bar 47 to the right and shifting belt 10 from loose pulley 8 onto the fast pulley 7, it being noted that during this movement of the parts, the pin 53 travels idly along the slot 55 in link 46, whereby said link and like wise the shifter-bar 48 remain, for the time being, idle, and furthermore, that when the parts come to rest after partial rotation of the rock-shaft 61, as explained, the lever 58 serves, through engagement of tooth 75 with pin 74 to hold the lever 44 in its rocked relation. When the lever 44 is moved, as explained, in the operation of shifting the belt, the roller 83 rides out of recess 82 and moves the lever 81 in a manner to properly actuate the lever 85 for drawing the wedge block 88 upward between the rollers 89 on the brake shoes, thereby causing said shoes to spread and release brake pulley 92 in order to free the shaft 6 for rotation, it being noted that this releasing of the shaft is concurrent with the shifting of the belt to impart motion to the shaft. The motion thus imparted to the shaft 6 is transmitted through the medium of gear connections 4 and 5 to the shaft 2 for causing drum or sheave 3 to feed the cable 42 in a direction suitable for lifting counterweight 16 and lowering the cage 39, it being understood, of course, that this mechanism remains active as long as the lever 58 remains active for holding the lever 44 in shifted position, as above described. By the time the cage 39 has reached the limit of its downward movement, the weight 16 will have likewise reached the limit of its upward movement,

whereupon the frame 17 strikes the end 79 of lever 78, causing the latter to pull the connection 77 in a direction for lifting lever 58 and disengaging tooth 75 from pin 74, thereby releasing lever 44. As soon as the lever 44 is thus freed from lever 58, spring 51 moves the bar 47 to the left thereby restoring all of the parts, with the exception of rock-shaft 61, levers 57—58 and controller lever 70, to their first or normal positions, with the belt 10 shifted back onto the loose pulley 8 and the brake shoes 90 in holding engaging with pulley 92, and therefore with the drive shaft 6 and the driven parts of the apparatus brought to rest.

Now as soon as the hoisting cage 39 has received another load, the attendant again moves the controller lever 70 (this to the right) thereby pulling the rod 68 and arm 66 downward, which, of course, again rotates the rock-shaft 61 in the same manner as before but in a reverse direction, causing the levers 57—58, through the medium of crank arm 60, to move longitudinally from right to left back to the position as in Fig. 3. During such movement of the parts the portion 73 of lever 57 engages pin 74 and pulls the lower end of lever 44 to the left, thus operating link 46 to push the shifter-bar 48 to the left, against the action of spring 52, and shift the belt 11 from the loose pulley 9 onto the fast pulley 7, the parts 81—85 and 88 being at the same time actauted, as before, for operating the brake shoes 90 to release the shaft 6. While the lever 44 is being moved to operate the belt shifter 48 the pin 53 travels along the slot 54, so that the link 45 and bar 47 remain idle. The belt 11 traveling on the pulley 7 serves to drive the mechanism as before but, owing to said belt being twisted, in a reverse direction or that is, for the sheave 3 to feed the cable 42 in a direction to hoist the loaded cage and allow the weight 16 to descend, it being understood that the lever 57 remains in engagement with, and for holding, the lever 44 shifted during ascent of the cage.

Upon the cage reaching the limit of its upward movement its motion is checked owing to the spring buffer 40 coming in contact with the cross-piece 41, thus causing a momentary downward pull on the cable 42 over the pulley 31, whereby the carrier 30 moves to the left against the action of springs 36. During this movement of the carrier the arm 32 rides beneath the lever 33 and in so doing coacts with cam 35 to lift said lever and exert an upward pull on the connection 76 sufficient to lift the outer end of lever 57 and disengage the tooth 73 from the pin 74 and free the lever 44. The spring 52 may now return the parts to position as before and stop the shaft 6 and the mechanism operated thereby.

It will be observed that the apparatus is wholly automatic in its operations with the single exception of shifting the belts, through manipulation of the controller, to inaugurate return movement of the cage, or that is, for starting the cage on its return trip either up or down, and furthermore that, inasmuch as the reversing mechanism is automatically set for the return trip upon the cage completing its course in either direction, the controller cannot be manipulated to start the cage in the wrong direction. It will also be noted that during installation of the apparatus, or at any time after it has been installed, it may be readily and accurately adjusted for the cage to travel to a predetermined height for discharging its load at a desired point, by moving the cross-piece 41 upward or downward, as the case may be, on the guides 38, it being understood, of course, that after the part 41 has been moved to the proper position, it will be bolted or otherwise fixedly but detachably secured in place. Likewise the active length of the cable may, owing to the provision of the spool or drum 22, be regulated at will to accord with the distance to be traveled by the cage, or for shifting the cage from one to another of the hoist shafts or wells H.

In accordance with this invention, therefore, there is provided a hoisting apparatus having a plurality of hoisting shafts each adapted to receive a cage, and the hoisting mechanism is so connected and adapted for connection with the cage as to permit a selective operation of the cage in any of the shafts. Accordingly, it is not necessary to provide a separate hoisting mechanism or even a separate cable connection for each shaft. Moreover, the provision of a single controlling device, which operates through the tension applied on the cable or cage connection through the additional strain placed on this connection when the cage is arrested, obviates the necessity of a plurality of controlling devices and, therefore, permits a single controlling device to arrest the cage when traveling in any of the shafts. Accordingly in accordance with this invention, the connection of the hoisting mechanism with a cage in any selected shaft at the same time connects the controlling device for cooperation with a connected cage thereby permitting the effective operation of a cage in any selected shaft to be accomplished with a minimum labor and expense.

In Figs. 7 and 8 there is shown an arrangement or adjustment of the mechanism in frame 1 adapting the cage to travel automatically by gravity in the operation of discharging ice from the storage compartments. In effecting this arrangement pinion 5 will be temporarily removed from drive shaft 6 thereby adapting the drum shaft 2

for free rotation, independently of the said drive shaft, the brake pulley 92 and its attendant braking mechanism, comprising the brake shoes 90, being at the same time transferred to the drum shaft 2 on which the pulley 92 will, for the time being, be fixed, as seen more clearly in Fig. 8.

Suitably journaled on the top of the frame 1 over the drum shaft 2 is a governor shaft 102 which, under the previously described normal operations of the apparatus, remains idle, there being fixed upon that end of said shaft over the gear 4, a pinion 103 in mesh with an idler connecting pinion 104 carried by a movable bearing 105 shown as being in the form of a lever loosely pivoted on the shaft 102, while fixed on the frame 1 is a slotted part or arm 106 coöperating with a clamp bolt 107 to fix the lever 105 against movement to hold the pinion 104 either in or out of engagement with the gear 4.

The shaft 102 is, as shown in Fig. 3, equipped with a ball-governor comprising a fixed head 108, a movable head 109 connected with the weighted governor arms 110 and an interposed spring 111 adapted to press the head 109 normally against the depending arm of a bell crank lever 112 suitably pivoted on the frame 1 for its horizontal arm to project above the brake pulley 92 and carry the brake controlling wedge 88 at the lower end of link 87, which in the rearrangement of the parts is transferred from lever 85 to the lever 112, as will be readily understood.

In the operation of the apparatus under this arrangement of the parts, the weight 16 in descending hauls the empty cage 39 up to the point where it is to receive the block of ice or other load L, while the loaded cage overcomes the weight and descends by gravity. While thus operating, the governor shaft 102 will, as seen in Fig. 7, be connected by the gear 4 and pinions 103—104, to be driven from the drum shaft 2, and, therefore, the governor mechanism will actuate the brake mechanism to control the speed of the drum shaft 2 which, in turn controls the speed at which the cage travels in either direction.

From the foregoing it is apparent that the invention accomplishes its stated objects in the attainment of which various minor changes may be made in the details of construction as herein set forth without departing from the spirit or scope of the invention.

Having thus described the invention, what is claimed is:

1. In a hoisting apparatus having a plurality of hoisting shafts each adapted to receive a cage, hoisting mechanism, means adapted to selectively connect said mechanism with a cage in any of the shafts, and means operating through said connecting means for automatically controlling the movement of the connected cage.

2. In a hoisting apparatus having a plurality of hoisting shafts each adapted to receive a cage, hoisting mechanism, means shiftable to any of the shafts adapted to selectively connect said mechanism with a cage in any of the shafts, and means operating through said connecting means for automatically controlling the movement of the connected cage.

3. In a hoisting apparatus having a plurality of hoisting shafts each adapted to receive a cage, hoisting mechanism, a cable connected with said mechanism, means for supporting said cable to adapt the same for connection with a cage in any of said shafts, and means operating through said cable for automatically controlling the movement of the connected cage.

4. In a hoisting apparatus having a plurality of hoisting shafts each adapted to receive a cage, hoisting mechanism, a cable connected with said mechanism, means for supporting said cable to adapt the same for connection with a cage in any of said shafts, and a controlling device for said mechanism and operated through said cable.

5. In a hoisting apparatus having a plurality of hoisting shafts each adapted to receive a cage, hoisting mechanism, a cable connected with said mechanism, means for supporting said cable to adapt the same for connection with a cage in any of said shafts, an abutment for said cage, and a yielding controlling device for said mechanism and operated through said cable.

6. In a hoisting apparatus having a shaft and a cage traveling therein, hoisting mechanism, comprising, reversing gearing, means adapted to normally move said gearing to, and retain it in neutral position, a manually operable device adapted to shift said gearing to selectively move the cage in either direction, and means operated at the limits of movements of the cage adapted to release said gearing from said shifting means in order to permit said gearing to return to neutral position.

7. In a hoisting apparatus having a shaft and a cage traveling therein, hoisting mechanism, comprising, reversing, gearing, means adapted to normally move said gearing to, and retain it in neutral position, a manually operable device, connections from said device to said gearing, adapted to shift said gearing to selectively move said cage in either direction, and elements operated at the limits of movement of the cage adapted to release said gearing from said shifting means in order to permit said gearing to return to neutral position.

8. In a hoisting apparatus having a shaft and a cage traveling therein, hoisting mecha-

nism, comprising, reversing gearing, means adapted to normally move said gearing to, and retain it in neutral position, a manually operable device, connections from said device to said gearing operable in opposite directions, adapted to shift said gearing to selectively move said cage in either direction, and means for operating said connections to release said gearing.

9. In a hoisting apparatus having a shaft and a cage traveling therein, hoisting mechanism, comprising, reversing gearing, means adapted to normally retain said gearing in neutral position, a manually operable device, independent connections from said device to said gearing adapted to selectively shift said gearing, and restoring means operable on said connections adapted to restore said gearing to neutral position.

10. In a hoisting apparatus having a shaft and a cage traveling therein, hoisting mechanism, comprising, reversing gearing, means adapted to normally retain said gearing in neutral position, a manually operable device, a pair of elements connected with and operated by said device and adapted to selectively shift said gearing, and restoring connections to said elements adapted to disconnect the same from said gearing and permitting said gearing to return to neutral position.

11. In a hoisting apparatus having a shaft and a cage traveling therein, hoisting mechanism, comprising, reversing gearing, means adapted to normally retain said gearing in neutral position, a manually operable arm, a pair of links connected with and movable by said arm and provided with oppositely directed hooks adapted to connect with said gearing, and restoring connections to said links.

12. A hoisting apparatus comprising a hoisting cage, means for operating said cage back and forth over its course, means for stopping said cage at the ends of its course, a controller for starting said operating means, a horizontally movable carriage, a cam lever operated by the movement of said carriage, and means for moving said carriage after the cage has been stopped at one end of its course, said cam lever when moved by the carriage being adapted to set the operating means for a return movement of the cage.

13. In a hoisting apparatus having a cage and hoisting means therefor, driving mechanism including a belt for said hoisting means, belt-shifting means adapted to move said belt into driving relation, controlling means for moving said belt-shifting means, means for releasing said belt-shifting means from said controlling means, and means for returning said belt-shifting means to inoperative relation.

14. In a hoisting apparatus having a cage and hoisting means therefor, driving mechanism including a belt for said hoisting means, belt-shifting means for moving said belt into driving relation, controlling means for moving said belt-shifting means, means for locking said controlling means in driving relation, means for releasing said belt-shifting means from said controlling means, and means for returning said belt-shifting means to inoperative relation.

15. In a hoisting apparatus having a cage and hoisting means therefor, driving means including a belt for said hoisting means, belt-shifting means for moving said belt into driving relation, controlling means for moving said belt-shifting means, means for locking said controlling means in driving relation, means for releasing said belt-shifting means from said controlling means, means for returning said belt-shifting means to inoperative relation, and means for locking said controlling means adapted to allow succeeding operation in the reverse direction only.

16. In a hoisting apparatus having a plurality of hoisting shafts each adapted to receive a cage, a counter-weight, hoisting and controlling mechanism, a cable adapted to connect a cage with said counter-weight and said hoisting and controlling mechanism, and means for adjusting the length of said cable to connect with a cage in any of the shafts for continued operation therein.

17. A hoisting apparatus having a cage, a hoisting connection thereto, hoisting mechanism and controlling mechanism therefor, characterized by yielding means engaging the hoisting connection and connected with said controlling mechanism, adapted through additional strain put upon the hoisting connection to arrest the movement of the cage at a predetermined point.

18. A hoisting apparatus having a cage, a hoisting connection thereto, hoisting mechanism and controlling mechanism therefor, characterized by means connected with said controlling mechanism and engaging said connection to support the strain thereof, and yielding connections to said engaging means adapted, through additional strain put upon the hoisting connection, to arrest the movement of the cage at a predetermined point.

19. In a hoisting apparatus having a cage and a hoisting connection thereto, means engaging the cage at the limit of its movement adapted to put additional strain on the hoisting connection, and means actuated upon additional strain adapted to arrest the movement of the cage.

20. In a hoisting apparatus having a cage and a hoisting connection thereto, yielding means adapted by yieldingly engaging the cage at the limit of its travel to put additional strain on the hoisting connection, and

means actuated upon additional strain adapted to arrest the movement of the cage.

21. In a hoisting apparatus having a cage and a hoisting connection thereto, adjustable means engaging the cage at a predetermined point in its travel adapted to put additional strain on the hoisting connection, and means actuated upon additional strain adapted to arrest the movement of the cage at a predetermined point.

In testimony whereof I affix my signature this 7 day of April, 1916.

MARK H. MILLS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents Washington, D. C."