April 23, 1929. N. WARSHAW 1,710,442

FOUR-POST HOISTING MACHINE

Filed April 27, 1927 3 Sheets-Sheet 1

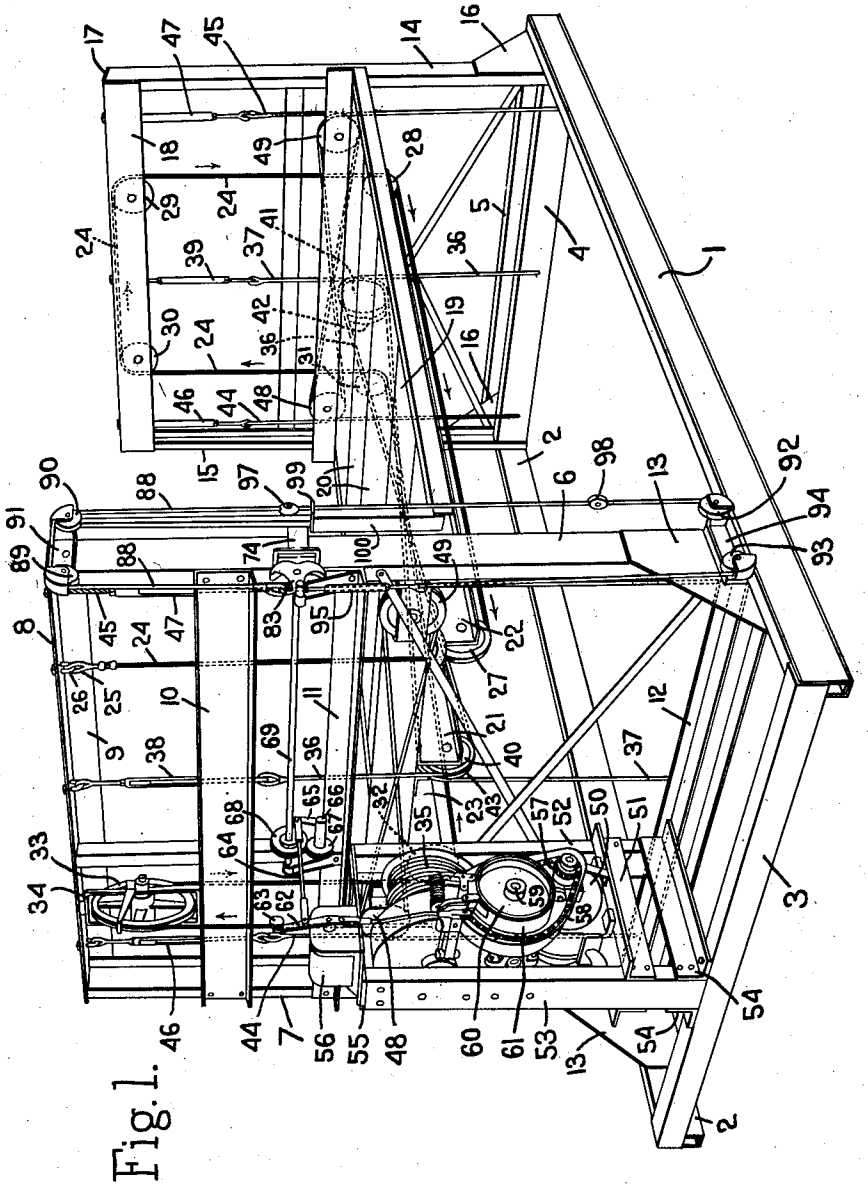


Fig. 1.

Inventor.
Nathaniel Warshaw
by Heard Smith & Tennant.
Attys.

April 23, 1929. N. WARSHAW 1,710,442

FOUR-POST HOISTING MACHINE

Filed April 27, 1927 3 Sheets-Sheet 2

Fig.2.

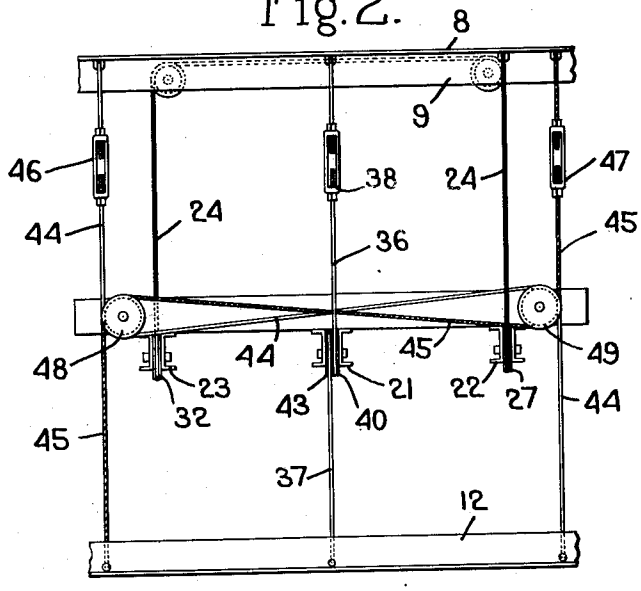
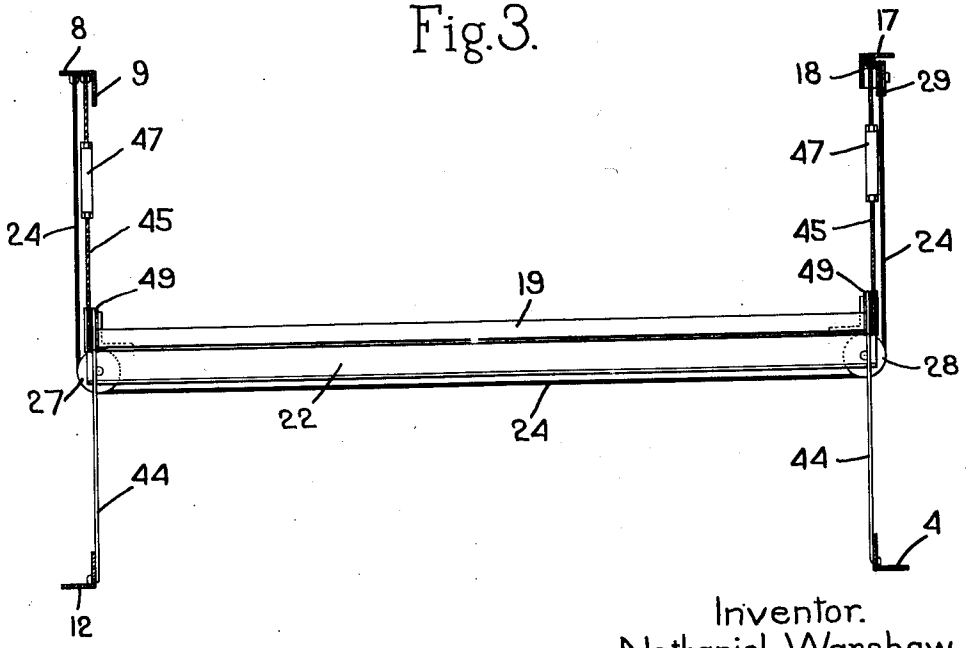


Fig.3.



Inventor.
Nathaniel Warshaw
by Heard Smith & Tennant.
Attys.

April 23, 1929. N. WARSHAW 1,710,442

FOUR-POST HOISTING MACHINE

Filed April 27, 1927 3 Sheets-Sheet 3

Fig. 4.

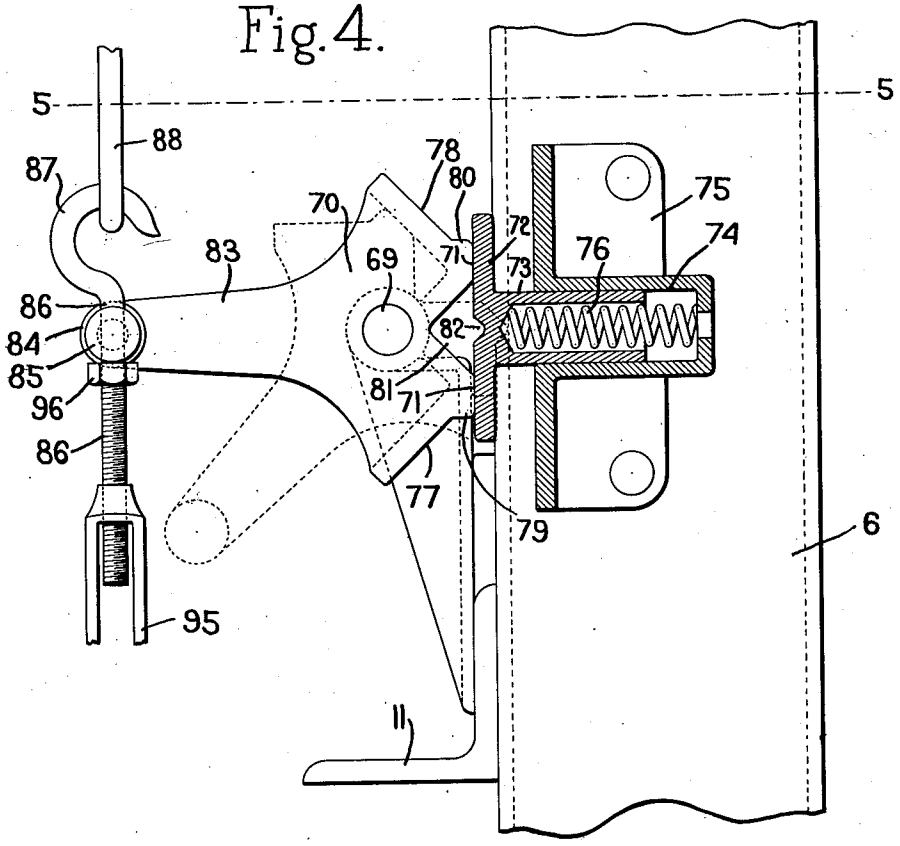
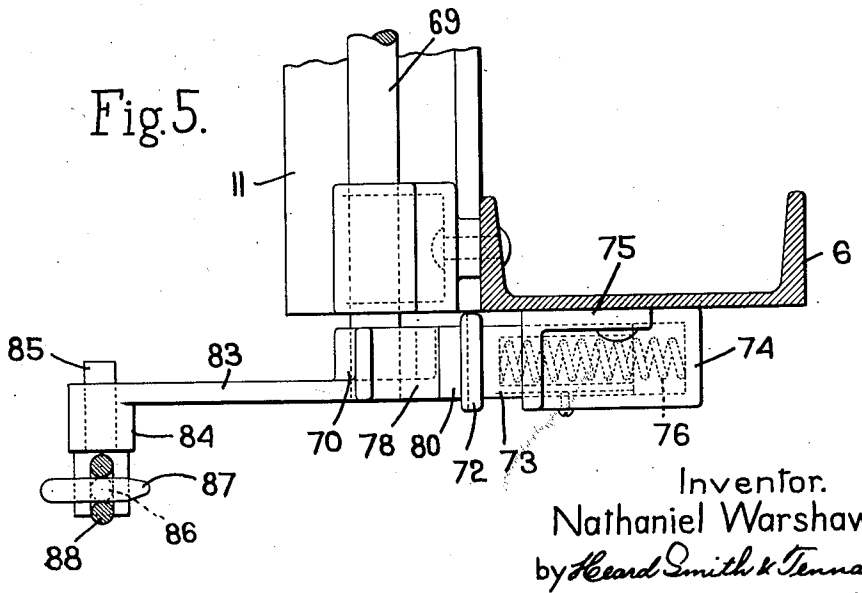


Fig. 5.



Inventor.
Nathaniel Warshaw
by Heard Smith & Tennant.
Attys.

Patented Apr. 23, 1929. 1,710,442

UNITED STATES PATENT OFFICE.

NATHANIEL WARSHAW, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO LEWIS-SHEPARD COMPANY, OF WATERTOWN, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

FOUR-POST HOISTING MACHINE.

Application filed April 27, 1927. Serial No. 187,061.

This invention relates to improvements in hoisting machines which, to distinguish from other types of hoisting machines, may be termed a "four-post hoisting machine". Machines of this type are usually designed for heavy work and particularly for hoisting large objects.

The principal object of the invention is to provide a hoisting machine of this type with flexible means for guiding the platform vertically operable to maintain the platform in a horizontal position during the raising and lowering movements thereof.

One of the features of the invention relates to means for preventing longitudinal tilting of the platform during the raising and lowering thereof.

Another feature of the invention relates to means for preventing lateral tilting of the platform during the raising and lowering thereof.

Another object of the invention is to provide flexible means wholly supporting the platform and operable by winding mechanism to raise and lower the platform in such a manner that substantially equal lifting forces are applied to the corner portions thereof.

Another object of the invention is to provide electrically operated means for actuating the winding mechanism with novel means for retaining the controlling means selectively in neutral inoperative position, or in position to cause a winding-up or unwinding movement of the winding mechanism.

Other objects and features of the invention will more fully appear from the following description and the accompanying drawings and will be particularly pointed out in the claims.

A preferred embodiment of the invention is illustrated in the accompanying drawings, in which,

Fig. 1 is a perspective view of a four-post stacker embodying the improvements above mentioned;

Fig. 2 is a detail view illustrating the upper and lower girders of the end frame and illustrating the platform, the means for supporting the platform and the flexible guiding means for preventing longitudinal and lateral tilting thereof during its raising and lowering movements, the winding mechanism being omitted;

Fig. 3 is a similar vertical sectional view taken at right angles to that shown in Fig. 2 and showing the upper and lower members of the end frames in vertical section;

Fig. 4 is a detail view illustrating the portion of one of the vertical posts of the end frame adjacent the winding mechanism, showing the shoe forming part of the controlling mechanism in full lines in neutral position and in dotted lines in position to cause the winding-up of the flexible platform-supporting means; and,

Fig. 5 is a detail plan view of the mechanism illustrated in Fig. 4 on line 5—5 Fig. 4.

The hoisting machine illustrated in the accompanying drawings comprises generally a base of rectangular form having at or adjacent its ends vertical end frames free from connections at their upper ends, a platform supported wholly by a cable carried by said end frames and extending beneath the platform in parallelism with and adjacent to the side edges of the platform, an electrically operated winding mechanism for said cable and controlling means for the winding mechanism manually operable to cause said winding mechanism to raise or to lower the platform with automatically operable means for restoring the controlling mechanism to neutral position when the platform has reached a predetermined upper or lower limit of movement.

The platform, which is thus wholly supported by the cable, is guided during its raising and lowering movements wholly by flexible means adapted respectively to prevent both longitudinal and lateral tilting of the platform. These flexible guiding mechanisms are means for producing a movement of the platform parallel to the plane of the base of the hoisting machine and are applied respectively to one, or preferably both ends of the platform to prevent lateral tilting and longitudinally of the platform to prevent longitudinal tilting thereof.

The base of the hoisting machine, as illustrated herein, comprises a pair of bottom side girders 1 and 2, which preferably are of box-like construction and may be made of oppositely disposed channel bars, the flanges of one being fitted within the flanges of the other and welded together. These side girders are connected by suitable end girders 3, 4 and 5, preferably of angle iron. A front end frame is secured to the side girders 1 and 2 at a short distance from the front end of the frame and comprises vertical posts or

standards 6 and 7, preferably in the form of wide channel bars which are welded, or otherwise secured, to the inner faces of the side girders 1 and 2 and are connected at their upper ends by a top girder 8 which desirably is of angle iron, the horizontal member of which rests upon the top of the posts 6 and 7 and the vertical member 9 of which is secured to the rear flanges of said standards.

The end frame also desirably comprises other cross girders including a wide channel bar girder 10 which is located at a distance below the upper girder 8. Another cross girder 11, preferably of angle iron, is located at a distance below the girder 10 and is connected to the upper end of the frame of the hoisting mechanism, as will hereinafter more fully appear, and a lower cross girder 12, preferably of angle iron, is connected to the forward flanges of the posts 6 and 7 and forms a support for the lower end of the frame of the hoisting mechanism. In order to strengthen the construction gusset plates 13 desirably are secured to the outer faces of the posts 6 and 7 and the inner faces of the side girders 1 and 2 respectively and are so formed that their upper ends are substantially the same width as the posts, while the lower ends have much wider surfaces engaging the inner faces of the base members 1 and 2. These gusset plates may be interposed between the vertical posts and the side girders and all welded, or otherwise secured, rigidly together, the gusset plates serving to brace the posts against forward or rearward movement which might be caused by the weight of the platform and the action of the hoisting mechanism.

The rear end frame comprises vertical posts or standards 14 and 15 having at their lower ends gusset plates 16 which are similarly secured to the standards and base girders 1 and 2, the cross girder 4 being secured to the forward vertical flanges of the posts 14 and 15. The rear frame has a top girder of angle iron in which the horizontal member 17 thereof rests upon the top of the posts 14 and 15 and the vertical flange 18 thereof engages and is rigidly welded to the front channels of the posts 14 and 15.

The platform 19 comprises a series of floor members or planks 20 which are secured to and supported by a series of girders preferably in the form of pairs of channel irons which are spaced apart and have their upper flanges secured to the floor members. In the present construction three of such supporting girders are shown comprising a central girder 21, and side girders 22 and 23 which are located at equal distances from the longitudinal center or axis of the platform and preferably in proximity to the side edges of the platform. The channel bars of these girders are spaced apart a sufficient distance to permit sheaves to be mounted between the channel bar members of the girders to provide guides for the suspending cable and for complementary flexible guiding members which prevent the longitudinal tilting of the platform as will more fully appear.

The platform is supported wholly upon a flexible suspending member, such as a cable 24, which is illustrated herein in solid black to distinguish it from other flexible members and is provided at one end with an eye 25 which engages a U-bolt 26 in the horizontal flange of the upper girder 8 of the front end frame. The cable 24 extends vertically downward from its support beneath a sheave 27 which is mounted between the channel members of the girder 22, thence beneath a sheave 28 at the opposite end of said girder, thence upwardly around a sheave 29 which is mounted in the horizontal flange 18 of the top girder of the rear frame. The cable passes from this girder horizontally over a sheave 30 also mounted in the horizontal flange 18 of said top girder, thence vertically downwardly beneath a sheave 31 which is mounted between the channel members of the girder 23, thence longitudinally of the girder beneath a sheave 32 which is mounted between the front ends of the channel member of said girder 23, thence upwardly over a sheave 33 which is mounted in a suitable frame 34 which rests upon the transverse girder 10 and engages at its upper end the top girder 8 of the front frame, and from this sheave the cable extends to and around the winding drum 35 of a suitable winch mechanism.

In this construction, therefore, the cable runs first beneath the sheaves of one side girder, thence over the sheaves at the top of the remote end frame, thence downwardly and beneath the sheaves of the other side girder, and upwardly to its anchored end in the upper portion of the frame which is adjacent to the winding mechanism. As the cable is wound it exerts an equal lifting force upon all of the corner portions of the platform.

Flexible guiding means are provided respectively to prevent longitudinal tilting of the platform and to prevent lateral tilting of the platform. The flexible mechanism for preventing longitudinal tilting of the platform comprises complementary flexible guiding means which are fixedly secured at their respective ends to diagonally opposite upper and lower portions of opposite end frames and extend downwardly beneath the platform and longitudinally thereof with means, such as sheaves on the platform engaging the guiding members in such a manner as to equalize the vertical movements of the ends of the platform when raised or lowered.

In the particular construction disclosed herein the flexible guiding means comprises cables 36 and 37, the upper ends of which are connected by adjustable means, such as turn-

buckles 38 and 39 respectively to the upper girders 8 and 17 of the front and rear end frames. The flexible guiding member 36 extends vertically from its support downwardly beneath a sheave 40 at the proximate end of the girder 21, thence longitudinally of the girder and over a sheave 41 at the remote end of the girder 21, thence downwardly and is anchored at its lower end below the lower limit of movement of the platform preferably to the cross girder 4 of the base frame.

The complementary guiding member 37 extends downwardly beneath a sheave 42 at the remote end of the girder 21, thence longitudinally of the girder and over a sheave 43 at the end of the girder, adjacent the front end frame, thence vertically downwardly and is anchored at its lower end below the lower limit of movement of the platform, preferably to the transverse girder 12. By reason of the fact that the guiding members 36 and 37 pass vertically downwardly beneath the sheaves adjacent the front and rear end frames, and thence pass longitudinally of the girder over sheaves at the remote ends of the girder and from such sheaves to the anchored end, the complementary members exert counterbalancing influences upon the ends of the platform which prevent the longitudinal tilting of the platform as the platform is raised irrespective of the position of the weight which is imposed upon the platform.

The mechanism for preventing lateral movement of the platform is of like character and may be applied to one end of the platform, but preferably is applied to both ends. A description of one of these complementary pairs of guiding mechanisms will, therefore, be sufficient. For convenience in reading of the drawings one of the complementary guiding cables is illustrated in parallel lines with an open space therebetween, while the other complementary member is provided with diagonal lines crossing the spaces between the parallel lines thereof similar to the illustration of a section.

The complementary guiding members 44 and 45 are secured at their upper ends by suitable adjustable means, such as turnbuckles 46 and 47 to the upper girder of the same end frame in proximity to the ends of said upper girder. The ends of the platform have secured to them by suitable means pairs of sheaves 48 and 49 located respectively directly beneath the upper supports of the guiding members 44 and 45 respectively. The guiding member 44 extends vertically downwardly from its support beneath a sheave 48, thence transversely of the end of the platform over one of the sheaves 49, thence vertically downwardly and is anchored at its lower end below the lower limit of movement of the platform preferably to one of the transverse girders of the base frame. The complementary guiding member 45 likewise extends vertically downwardly from its supportc beneath the sheave 49 at the proximate side of the platform, thence transversely of the end of the platform, over a sheave 48, thence downwardly, and is anchored at its lower end below the lower limit of movement of the platform preferably to the same transverse girder of the base frame. By reason of this construction lateral tilting of the platform is prevented in the same manner as heretofore described. Desirably a similar flexible guiding mechanism is provided at the other end of the platform.

The flexible guiding means for preventing longitudinal tilting of the platform, together with the means for preventing lateral tilting of the platform, insures the vertical movement of the platform in parallelism to the base of the machine. Thus the platform is wholly suspended upon the cable 24 and is prevented from longitudinal or lateral tilting movements by the pairs of flexible guiding means above described. As all of these flexible members are guided upon sheaves the resistance to the movement of the platform is reduced to a minimum. The construction is relatively simple requiring no machined parts. The hoisting cable and the guiding cables can be of any desired strength so that a hoisting machine capable of handling very heavy loads can be conveniently and economically constructed.

It will be noted that the upper ends of the platform are free from connection and, therefore, no obstruction presented which would engage the load upon the platform or prevent its removal from either end thereof when the platform is elevated to its highest position. Furthermore, the flexible means for guiding and equalizing the movements of the platform are all located within the inner planes of the ends of the platform or beneath the platform so that the full width of the platform is available and the maximum possible floor surface provided.

Another feature of the invention relates to novel mechanism for controlling the hoisting mechanism. The hoisting mechanism may be any suitable winch or winding mechanism and preferably is of the type disclosed in application Serial Number 106,365, Frederick J. Shepard, Jr. and Nathaniel Warshaw, filed May 3, 1926. The power actuated winding mechanism may be briefly described as comprising an electric motor 50 mounted upon a suitable base 51 upon a rectangular winch frame comprising posts 52 and 53 which are connected together at the bottoms by angle iron girders 54 which are detachably bolted to the base girders 3 and 12 respectively and a top plate 55 resting upon the upper ends of the posts 52 and 53 which support the controller box 56 for the electric motor. The shaft of the motor is provided with a gear 57

which through the chain 58 drives a shaft 59 having a worm which engages a suitable worm gear (not shown) which is mounted upon the winding drum 35 or the shaft thereof. A suitable brake drum 60, which is fixedly secured to the shaft, is engaged by a brake 61 which is operated through suitable mechanism connected to the controller lever as disclosed in the prior application aforesaid. The controller lever 62 is connected to the usual controller shaft which is journalled in the controller box and is provided with a handle 63 by which it may be conveniently operated. When the controller lever is in neutral position no current is supplied to the motor. When, however, it is moved to forward position, that is to the left as illustrated in Fig. 1, current is transmitted to the motor to cause a winding-up movement of the winding drum. When the controller lever is moved in the other direction from neutral position it reverses the direction of current of the motor and causes an unwinding rotation of the winding drum.

The present invention comprises novel means for actuating the controller lever to arrest the movement of the platform when the platform has reached a predetermined upper limit, or a predetermined lower limit, of movement. In the construction disclosed herein the controller lever is connected by a link 64 to an arm 65 of a shaft 66 which is provided with a gear 67 which meshes with a complementary gear 68, preferably of larger diameter, fixedly secured to a shaft 69 journalled in suitable brackets in the main frame. The end of the shaft 69 has fixedly secured to it a shoe 70 which presents a central, preferably flat, face 71 which, when the controller lever is in neutral position, is engaged by a flat plate 72 having a hollow central post 73 which is slidably mounted in a hollow boss 74 of a bracket 75 carried by the post 6 of the front end frame. The locking plate 72 is held yieldably in engagement with the shoe by a helical spring 76 located within the boss and within the chamber of the post 73 of the locking plate which abuts at its ends upon the end wall of the chamber of the locking plate post and the end of the boss 74 respectively. The shoe 70 is also provided with flat side faces 77 and 78 which extend in angular relation to the flat central face of the shoe. Desirably convex ribs 79 and 80 are provided on the side faces adjacent the intersections thereof with the flat central face and the central flat face has a re-entrant recess 81.

The locking plate 72 is provided with a central groove 82 preferably having a curvature complementary to that of the ribs 79 and 80. The ribs and groove, which present complementary curved faces, provide means for more easily forcing the locking plate rearwardly against the action of its spring when the shoe is swung to and from neutral position. The shoe 70 is provided with an arm 83 which preferably extends perpendicular to the plane of the central face of the shoe and has at its end a laterally extending boss 84 in which a stud 85 is mounted which receives the screw threaded shank 86 of a hook 87 which is engaged by a cable 88 which extends upwardly over a pair of sheaves 89 and 90 carried upon a bracket 91 at the upper end of the post 6, thence downwardly beneath sheaves 92 and 93 carried by a bracket 94 secured to the lower end of said post 6 thence upwardly to a turnbuckle 95, the upper end of which engages the screw threaded stem 86 of the hook 87. A suitable lock nut 96 upon the screw abuts against the lower end of the stud 85. Suitable stops 97 and 98 are respectively adjustably secured to the cable 88 and are adapted to be engaged by the arm 99 of a bracket 100 which is mounted upon the platform.

Assume that the platform is in the position indicated in Fig. 1 of the drawings, having been arrested in its upper movement by the engagement of the arm 99 on the platform with the stop 97 on the controlling cable 88 and the flat face 71 of the shoe rocked thereby into engagement with the flat face of the locking plate 72, thus positioning the controller arm in neutral position, and it is desired to lower the platform. The operator grasps the handle 63 of the controller lever 62 and forces it rearwardly, that is toward the end frame. This movement of the lever acting through the link 62 and arm 64 of the rock shaft 66 rotates the gear 67 in a clockwise direction thus imparting a counterclockwise rotation to the gear 68 and its shaft 69, thereby rotating the shoe and causing its side face 77 to engage the flat face of the locking plate 76, the locking plate 72 being forced rearwardly against the action of its spring by this movement. The controller arm when thus positioned supplies a current to the motor which will cause it to rotate the winding drum in an unwinding direction, thus permitting the platform to descend. When the arm 99 on the platform engages the lower stop 98 upon the cable it forces the lead of the cable, to which the stops are attached, downwardly thereby raising the hook 87 which is connected to the arm 83 of the shoe. Further downward movement will raise this arm from the dotted line position to the full line position illustrated in Fig. 4, thereby restoring the central flat face 71 into engagement with the flat face 72 of the locking device and during this movement will rotate the shaft 64 in a clockwise direction, thus causing a counterclockwise rotation of the gear 67 and the consequent restoration of the controller lever 62 to neutral position. The particular stop mechanism disclosed herein may be made of rigid parts which will withstand the shocks

imparted by engagement of the stops with the moving arm upon the platform without danger of breakage and which will insure the certain arrest of the platform either in its upward or downward movement.

Machines of this type may be constructed of any desired height or size and may be employed as stackers for raising loads to any desired height from which they may be removed and piled on others to form a stack, or may be employed for raising articles from one floor to another. The hoisting machine or stacker may be made portable by mounting the base frame upon suitable wheels or casters, but ordinarily machines of this type are permanently located.

It will be understood that the embodiments of the invention disclosed herein are of an illustrative character and are not restrictive and that various changes in form, construction and arrangement of parts may be made within the spirit and scope of the following claims.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is:

1. A hoisting machine comprising a base and end frames, a horizontal platform, means for raising and lowering said platform comprising a cable carried by said end frames extending beneath the platform in parallelism with and adjacent to the side edges thereof and wholly supporting said platform, a winding drum for said cable and means for actuating the same and means for maintaining said platform in a horizontal position during the raising and lowering thereof.

2. A hoisting machine comprising a base and end frames, a horizontal platform, means for raising and lowering said platform comprising a cable carried by said end frames extending beneath the platform in parallelism with and adjacent to the side edges thereof and wholly supporting said platform, a winding drum for said cable and means for actuating the same, flexible guiding means extending beneath and longitudinally of said platform operable to prevent longitudinal tilting of the platform during the raising and lowering thereof.

3. A hoisting machine comprising a base and end frames, a horizontal platform, means for raising and lowering said platform comprising a cable carried by said end frames extending beneath the platform in parallelism with and adjacent to the side edges thereof and wholly supporting said platform, a winding drum for said cable and means for actuating the same and flexible guiding means acting upon each end of said platform to prevent lateral tilting of the platform during the raising and lowering thereof.

4. A hoisting machine comprising end frames, a horizontal platform, means for raising and lowering said platform comprising a cable carried by said end frames and wholly supporting said platform, a winding drum for said cable and means for actuating the same and guiding means for said platform comprising flexible members acting upon the ends of the platform respectively longitudinally and transversely thereof to guide the platform vertically and also to maintain the platform in a horizontal position during the raising and lowering thereof.

5. A hoisting machine comprising end frames, a horizontal platform, means for raising and lowering the same, pairs of sheaves located respectively at or adjacent opposite ends of the platform and complementary flexible guiding members having their respective upper ends connected to the upper portions of different end frames and extending vertically downwardly therefrom and passing under a sheave on the proximate end of the platform, thence over a sheave on the remote end of the platform and extending vertically downwardly from said sheave and anchored at the lower end below the lower limit of movement of the platform, whereby said flexible guiding members will equalize the vertical movements of the ends of the platform when raised or lowered.

6. A hoisting machine comprising end frames presenting free upper ends, a horizontal platform, means for raising and lowering the same, pairs of sheaves located respectively at or adjacent opposite ends of the platform and complementary flexible guiding members having their respective upper ends connected to the upper portions of different end frames and extending vertically downwardly therefrom and passing under a sheave on the proximate end of the platform, thence over a sheave on the remote end of the platform and extending vertically downwardly from said sheave and anchored at the lower end below the lower limit of movement of the platform, whereby said flexible guiding members will equalize the vertical movements of the ends of the platform when raised or lowered and means for adjusting the tension imposed upon the respective flexible guiding members.

7. A hoisting machine comprising end frames presenting free upper ends, a horizontal platform, means for raising and lowering the same, a girder extending longitudinally of the central portion of the platform, pairs of sheaves mounted upon the respective ends of said girder and complementary flexible guiding members having their respective upper ends connected to the upper portions of different end frames and passing vertically under a sheave on the proximate end of said central girder, thence over a sheave on the remote end of said girder and thence vertically downwardly and anchored at the lower end below the lower limit of movement of the platform operable to equalize the movements

of the ends of the platform when raised or lowered.

8. A hoisting machine comprising end frames presenting free upper ends, a horizontal platform, pairs of sheaves attached to each end of the platform and spaced apart symmetrically from the longitudinal axis of the platform, means for raising and lowering the platform, complementary flexible guiding members each having its upper end attached to the upper end of the same end frame substantially vertically above the sheave and extending therefrom vertically downwardly under said sheave, thence over a remote sheave and vertically downwardly and anchored at its lower end below the lower limit of movement of the platform operable to equalize the movements of the sides of the platform when raised or lowered.

9. A hoisting machine comprising end frames, a horizontal platform, pairs of sheaves attached to each end of the platform and spaced apart symmetrically from the longitudinal axis of the platform, means for raising and lowering the platform, complementary flexible guiding members each having its upper end attached to the upper end of the same end frame substantially vertically above a sheave and extending therefrom vertically downwardly under said sheave, thence over a remote sheave and vertically downwardly and anchored at its lower end below the lower limit of movement of the platform operable to equalize the movements of the sides of the platform when raised or lowered and means for adjusting the tension imposed upon the respective flexible guiding means.

10. A hoisting machine comprising end frames, a horizontal platform having at each end pairs of sheaves located substantially equidistant from the longitudinal axis of the platform and adjacent to the sides thereof, means for raising and lowering the platform, pairs of flexible complementary guiding members for each end of the platform each of which guiding members is secured at its upper end to the upper portion of an end frame substantially vertically above a sheave on the adjacent end of the platform and extending therefrom under such sheave, thence over a remote sheave upon the same end of the platform and means located substantially vertically below the latter sheave anchoring the lower end of said flexible member below the lower limit of movement of the platform.

11. A hoisting machine comprising end frames, a platform having at each end pairs of sheaves located substantially equidistant from the longitudinal axis of the platform, means for raising and lowering the platform, pairs of flexible complementary guiding members for each end of the platform each of which guiding members is secured at its upper end to the upper portion of an end frame substantially vertically above a sheave on the adjacent end of the platform and extending therefrom under such sheave, thence over a remote sheave upon the same end of the platform and means located substantially vertically below the latter sheave anchoring the lower end of said flexible member below the lower limit of movement of the platform, a girder extending longitudinally of the central portion of the platform, pairs of sheaves mounted upon the ends of said girder and complementary flexible guiding members having their respective upper ends connected to the upper portions of different end frames and passing vertically downwardly under a sheave on the proximate end of said central girder, thence over a sheave on the remote end thereof and vertically downwardly and anchored at the lower end below the lower limit of movement of the platform, whereby both longitudinal and lateral tilting of the platform will be prevented during the raising and lowering of the platform.

12. A hoisting machine comprising end frames, a platform having girders extending parallel with, and adjacent to, the side edges of the platform, sheaves on the ends of said girders, means for raising and lowering the platform including a winding drum located adjacent to one end frame, a cable extending therefrom over a sheave mounted upon the upper portion of the adjacent end frame, thence beneath the sheaves on the side girder therebeneath, thence upwardly over sheaves on the upper portion of the other end frame located respectively substantially vertically over the sheaves on the respective side girders, thence beneath the sheaves of the other side girder and anchored at its upper end to the upper portion of the end frame which is adjacent to the winding drum, whereby the cable, when wound, will exert substantially equal lifting forces upon all corner portions of the platform.

13. A hoisting machine comprising end frames, a platform having girders extending parallel with, and adjacent to, the side edges of the platform, sheaves on the ends of said girders, means for raising and lowering the platform including a winding drum located adjacent to one end frame, a cable extending over a sheave mounted upon the upper portion of the adjacent end frame, thence beneath the sheaves on the side girder therebeneath, thence upwardly over sheaves on the upper portion of the other end frame located respectively substantially vertically over the sheaves on the respective side girders, thence beneath the sheaves of the other side girder and anchored at its upper end to the upper portion of the end frame which is adjacent to the winding drum, whereby the cable, when wound, will exert substantially equal lifting forces upon all corner portions of the platform, and flexible guiding means connected

at their ends to the upper and lower portions of opposite end frames and extending longitudinally of the platform and engaging sheaves thereupon, operable to prevent longitudinal tilting movement of the platform.

14. A hoisting machine comprising end frames, a platform having girders extending parallel with, and adjacent to, the side edges of the platform, sheaves on the ends of said girders, means for raising and lowering the platform including a winding drum located adjacent to one end frame, a cable extending over a sheave mounted upon the upper portion of the adjacent end frame, thence beneath the sheaves on the side girder therebeneath, thence upwardly over sheaves on the upper portion of the other end frame located respectively substantially vertically over the sheaves on the respective side girders, thence beneath the sheaves of the other side girder and anchored at its upper end to the upper portion of the end frame which is adjacent to the winding drum, whereby the cable, when wound, will exert substantially equal lifting forces upon all corner portions of the platform, and pairs of complementary flexible guiding members connected respectively to the upper and lower portions of the respective end frames and extending in opposite directions from said supported upper ends under a proximate sheave and over a remote sheave on the same end of the platform operable to prevent lateral tilting of the platform.

15. A hoisting machine comprising end frames, a platform having girders extending parallel with, and adjacent to, the side edges of the platform, sheaves on the ends of said girders, means for raising and lowering the platform including a winding drum located adjacent to one end frame, a cable extending over a sheave mounted upon the upper portion of the adjacent end frame, thence beneath the sheaves on the side girder therebeneath, thence upwardly over sheaves on the upper portion of the other end frame located respectively substantially vertically over the sheaves on the respective side girders, thence beneath the sheaves of the other side girder and anchored at its upper end to the upper portion of the end frame which is adjacent to the winding drum, whereby the cable, when wound, will exert substantially equal lifting forces upon all corner portions of the platform, and pairs of complementary flexible guiding members connected respectively to the upper and lower portions of the respective end frames and extending in opposite directions from said supported upper ends under a proximate sheave and over a remote sheave on the same end of the platform operable to prevent lateral tilting of the platform and complementary flexible guiding means connected at their ends to the upper and lower portions of opposite end frames and extending longitudinally of the platform and engaging guiding sheaves thereupon operable to prevent longitudinal tilting movements of the platform during the raising and lowering thereof.

16. A hoisting machine comprising a vertical end frame, a platform, means for raising and lowering said platform including a winding drum, an electric motor and means operable thereby to rotate said drum, controlling mechanism for said motor having a handle operable when moved from neutral position in opposite directions respectively to cause said motor to impart a winding-up or unwinding rotation to said drum, controller-actuating means comprising a pivotally mounted shoe having a central face and angularly disposed side faces, a yieldable locking plate adapted selectively to engage each of said surfaces, connecting means intermediate of said shoe and said controller handle for retaining the controller handle in neutral position when the central face is engaged by the locking plate and for retaining said controller handle in winding-up or unwinding position when the locking plate is engaged by a proper side face and means for oscillating said shoe selectively to cause the respective faces thereof to engage the locking plate.

17. A hoisting machine comprising a vertical end frame, a platform, means for raising and lowering said platform including a winding drum, an electric motor and means operable thereby to rotate said drum, controlling mechanism for said motor having a handle operable when moved from neutral position in opposite directions respectively to cause said motor to impart a winding-up or unwinding rotation to said drum, controller-actuating means comprising a pivotally mounted shoe having a central face and angularly disposed side faces, a yieldable locking plate adapted selectively to engage each of said surfaces, connecting means intermediate of said shoe and said controller handle for retaining the controller handle in neutral position when the central face is engaged by the locking plate and for retaining said controller handle in winding-up or unwinding position when the locking plate is engaged by a proper side face and means for oscillating said shoe selectively to cause the respective faces thereof to engage the locking plate including an endless cable connected to said shoe and extending over guides at the upper and lower ends of the end frame having means adapted to be engaged by said platform in proximity to the desired upper and lower limits of movement thereof and acting when so engaged to cause said cable to restore the central face of said shoe to engagement with said locking plate.

In testimony whereof, I have signed my name to this specification.

NATHANIEL WARSHAW.