

May 5, 1936.

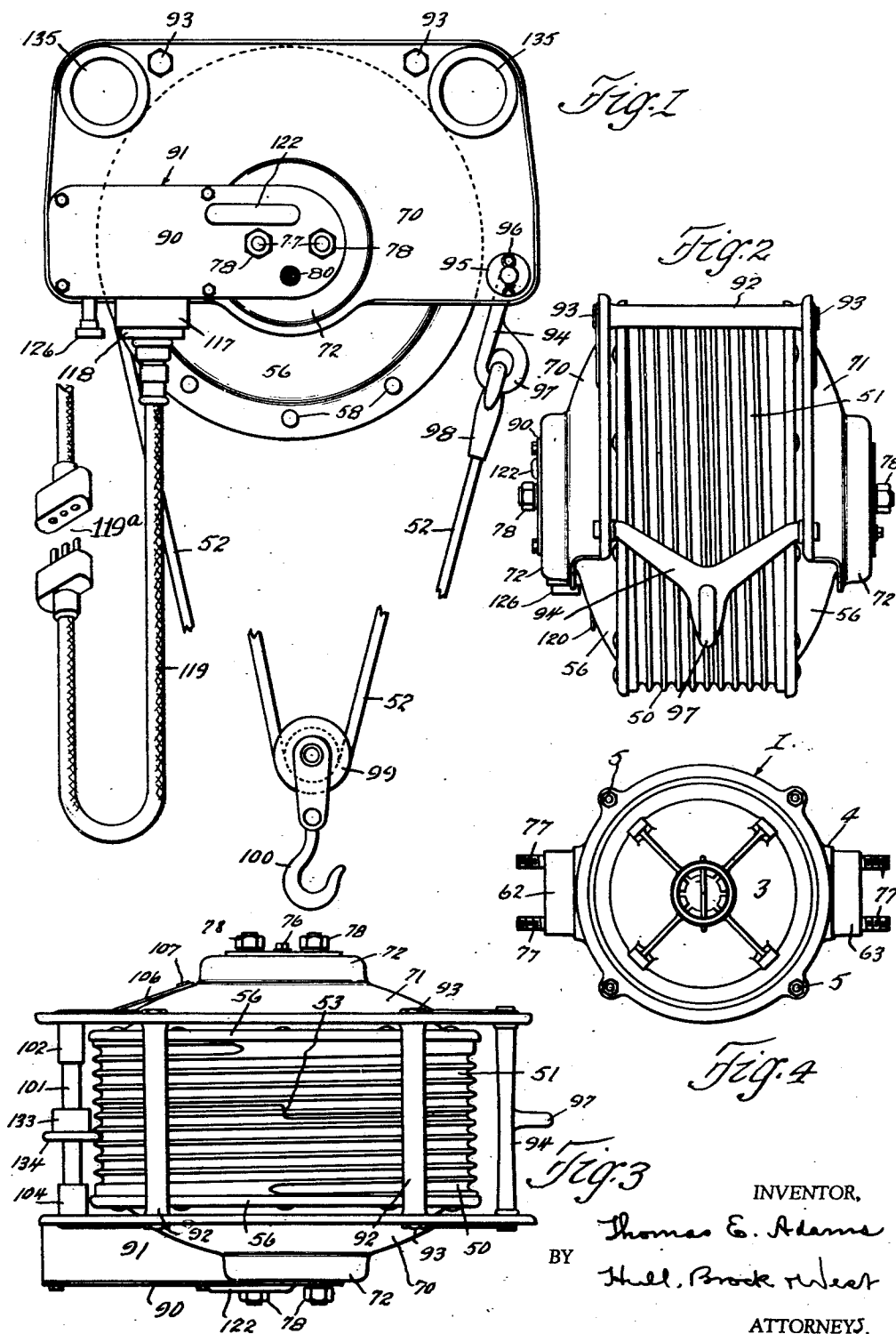
T. E. ADAMS

2,039,870

HOIST

Filed Aug. 20, 1935

3 Sheets-Sheet 1



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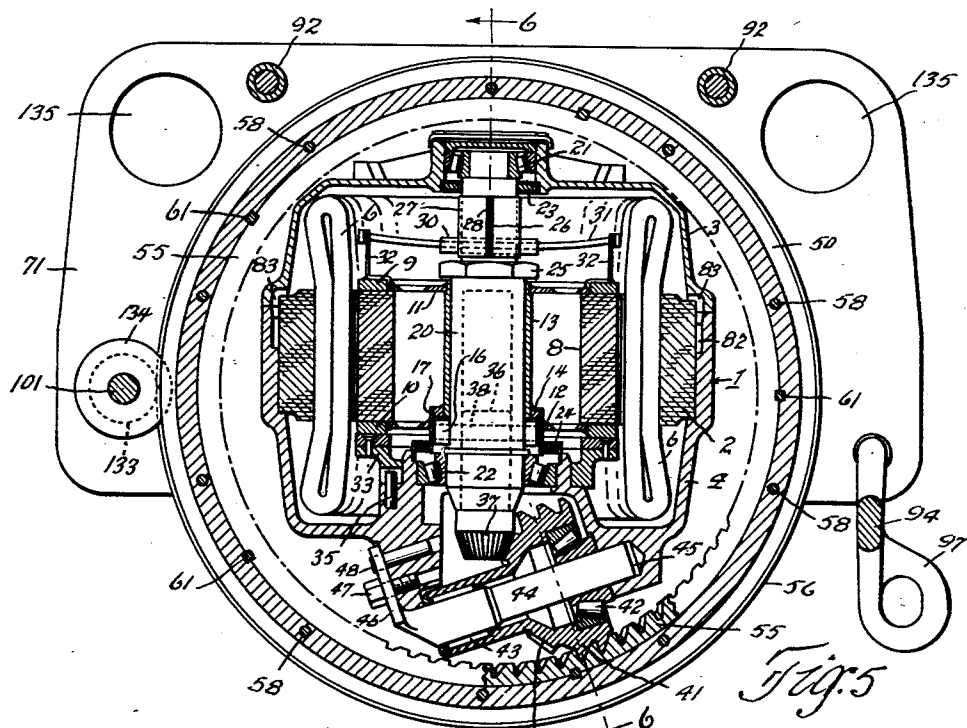
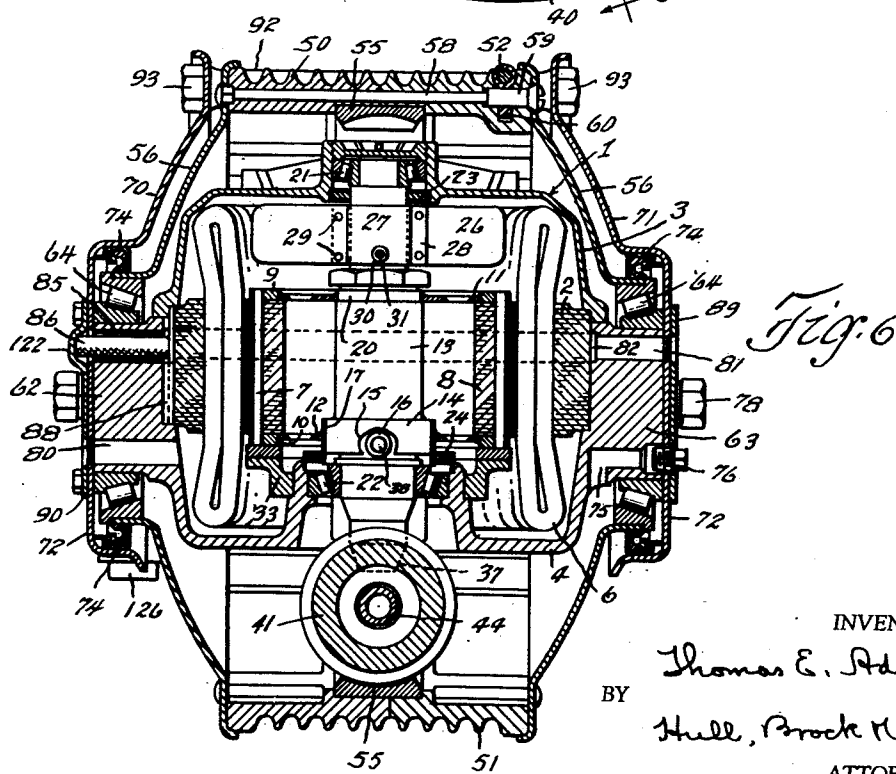
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3 Sheets-Sheet 2



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May 5, 1936.

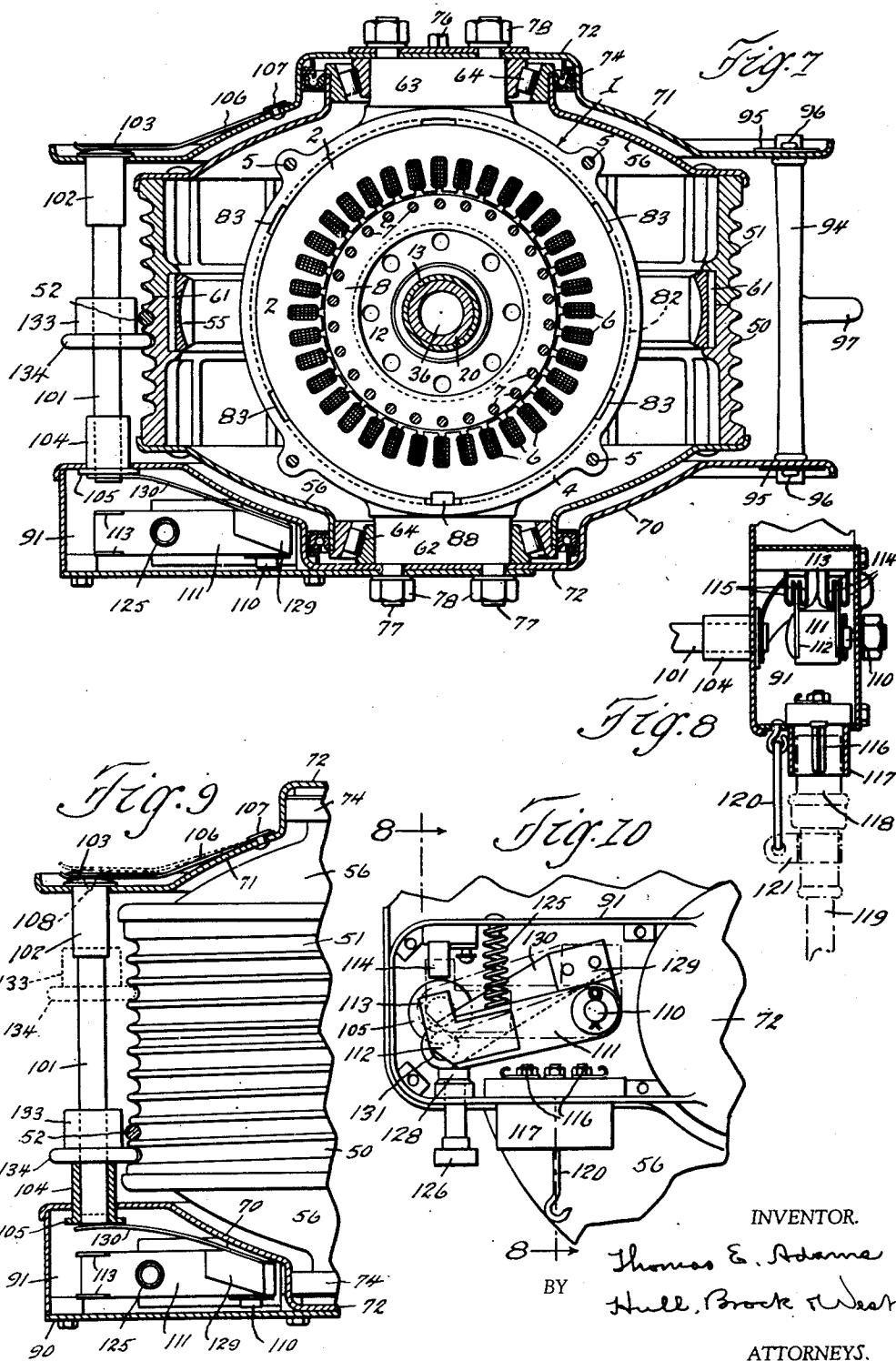
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HOIST

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UNITED STATES PATENT OFFICE

2,039,870

HOIST

Thomas E. Adams, Derby, N. Y.

Application August 20, 1935, Serial No. 36,993

24 Claims. (Cl. 254-168)

This invention relates primarily to hoisting machinery, and in particular to improvements in the type of portable hoist disclosed and claimed in my former Patent No. 1,555,094, dated September 29, 1925, wherein the drive includes an internal worm gear.

Objects of the present invention are to increase the lifting efficiency and load sustaining quality of a hoist of the aforesaid character by utilizing an internal worm gear and worm whose respective teeth and thread are of the buttress type arranged with their steep side or face substantially radial to the rotating center of the gear; to provide effectual ventilation for the electric motor, which, in the present construction, is completely enclosed within the main casing comprised of the hoisting drum; to make the hoist oil-tight so that ample lubrication for the driving gears may be carried without leakage occurring regardless of position, as when the hoist is turned or laid on its side; also, to seal the enclosed motor housing against ingress of oil from the main casing; to provide an extremely simple, efficient, and reliable automatic non-electric brake for the motor that will positively release when the motor is started in either direction and will become effective the instant the power of the motor ceases to predominate the load; to provide a thoroughly dependable automatic circuit breaker that operates when the hoisting drum exceeds its normal range of operation in either direction; to provide a substantially symmetrical and well balanced structure in which the motor is arranged with its axis of rotation perpendicular to and bisecting that of the hoisting drum, the motor shaft being vertical when the hoist is in use and, more generally, to provide a portable hoist that is safe and convenient of use and prompt in its response to the manual and automatic controls as regards both starting and stopping.

Further objects and advantages will appear as I proceed to describe, with reference to the accompanying drawings, a specific embodiment of the invention, although it is to be understood that those features susceptible to a more general application are not restricted to their present environment further than required by the terms of the appended claims.

In the drawings, Fig. 1 is a side elevation of my improved portable electric hoist; Fig. 2 is an elevational view taken from the right of Fig. 1; Fig. 3 is a plan view of the hoist; Fig. 4 is a similar view of the motor housing; Fig. 5 is a sectional side elevation of the hoist, this and the follow-

ing views being on a scale considerably enlarged over that of the preceding figures; Fig. 6 is a vertical section through the hoist, substantially on the line 6-6 of Fig. 5, the motor shaft, worm, and parts associated therewith being in elevation; Fig. 7 is a central horizontal section with the lower part of the motor housing in elevation; Fig. 8 is a detail of the automatic circuit breaker showing the switch thereof closed, the view being a section in offset planes, as indicated by the line 8-8 of Fig. 10; Fig. 9 is a fragmentary sectional plan of the hoist, illustrating the operation of the automatic circuit breaker, the parts being shown in full lines in one of the positions they occupy when the switch has been opened by excessive rotation of the drum, and in dotted lines in the other, and Fig. 10 is a side elevation of the automatic circuit breaker with the cover plate removed, showing the switch in full lines in open position and in broken lines in closed position.

The structure involves the following general divisions or parts: An electric motor complete with its housing, the latter being formed with cylindrical bosses that project from opposite sides in axial alignment with each other; a main casing enclosing the motor and comprising the hoisting drum whose end walls have apertures wherein the aforesaid bosses have bearing and through which the bosses are exposed; and a supporting frame consisting of side plates secured to the bosses and suitably spaced apart and connected together beyond the periphery of the drum.

The motor, designated generally by the reference numeral 1, is preferably of the three-phase induction type. The laminated stator 2 is clamped between opposed internal shoulders of the upper and lower parts 3 and 4 of the motor housing, said parts being secured together by fastening means 5, which may consist of studs with nuts applied thereto. The primary winding 6 is suitably engaged within slots or grooves of the stator, while the secondary "winding", so-called, is made up of conductor rods 7 (Figs. 6 and 7) which extend through the laminations of the rotor 8 and are connected at their ends to end rings 9 and 10. These rings 9 and 10 are connected, by perforated plates 11 and 12 respectively, to the opposite ends of a sleeve 13 that constitutes the hub of the rotor. At its lower end said sleeve is enlarged, as by having an annulus 14 welded or otherwise secured to the body of the sleeve, the part 14 having cam slots or notches 15 (Fig. 6) within which rollers 16 are located. The enlarged end 14 of the sleeve is

encased by a cylindrical shell 17 that closes the outer sides of the notches or slots 15.

The motor shaft 20, on which the hub of the rotor is mounted for limited relative rotary and longitudinal motion, is journaled at its upper and lower ends, through anti-friction bearings 21 and 22, respectively, in bosses of the parts 3 and 4 of the motor housing. Inwardly of the respective bearings 21 and 22 are oil rings 23 and 24 which prevent ingress of oil to the motor housing. As previously mentioned, the hub of the rotor is capable of movement longitudinally of the shaft 20, and its upward travel is limited by a nut 25 that is applied to the shaft. Between said nut 15 and the top wall of the motor housing is a fan 26, shown as constructed of reversed identical stampings each having one of its ends formed with a semi-cylindrical portion 27 and a terminal flange 28. The cylindrical portions 27 of the two blades 20 are engaged about opposite sides of the shaft and the blades are held together by fastening means or rivets 29 that are engaged through holes in the flanges 28 and in the adjacent portions of the blades.

25 Occupying aligned holes in the portions 27 of the fan blades and in the portion of the motor shaft surrounded thereby is a tubular member 30 through which a spring 31 is extended, the ends of said spring bearing within the upper ends of brackets 32 that rise from the adjacent end of the rotor. This spring assists gravity in depressing the rotor so as to engage its end ring 10 with a suitably faced brake member 33 that is mounted upon the central boss of the lower part 4 of the motor housing and is shown as secured thereto against turning by a dowel pin 35 (Fig. 5).

The lower portion of the motor shaft 20 is formed with a relatively large bore, indicated by dotted lines in Fig. 5, into which the shank 36 of a beveled driving pinion 37 is extended, and the pinion and shaft are held against relative rotation by a pin 38 that is extended through aligned holes in the shaft and pinion shank and on whose ends are mounted the previously mentioned rollers 16.

45 The driving pinion 37 meshes with a beveled gear 40 which constitutes a part of a worm 41 that is rotatably supported, through anti-friction bearings 42 and 43, upon a shaft 44, whose inner end is supported within a socket 45 in a downward extension of the part 4 of the motor housing, the opposite end of the shaft 44 having a lateral extension 46 that is fastened, by a screw 47 and a dowel pin 48, to the adjacent portion of said part 4 of the motor housing.

55 The drum 50 of the hoist is made up of two cylindrical parts that are engaged endwise along a circumferential line of separation that preferably follows the central convolutions of a spiral groove 51 formed in the outer surface of the drum for the reception of the lifting cable 52. At the point designated 53 in Fig. 3 the line of separation between the two cylindrical portions of the drum cuts through one of the separating ribs at substantially right angles thereto. Confined between opposed internal shoulders of the drum sections is a ring-like internal worm gear 55 with the teeth of which the thread of the previously mentioned worm 41 meshes. End walls 56 are engaged with the ends of the drum 50, and they, with the drum sections 70 and gear are securely clamped together by bolts 58 and sleeved nuts 59, the former being engaged through transverse bores of the drum sections and through holes in one of the end walls, while the latter are projected through holes in the other 75 end wall and into counterbores of the adjacent

drum section for application to the threaded ends of said bolts. It may here be explained that one end of the hoisting cable 52 is anchored to the drum through the medium of a member 60 that is suitably fastened to the cable and occupies a recess in the drum that bisects the counterbore into which one of the sleeved nuts 59 is extended, this detail appearing in Fig. 6. The worm gear 55 is locked to the drum at intervals about the same by keys 61 (Fig. 5).

The drum 50, with its end walls 56, constitutes the main casing hereinbefore referred to. It will be observed that said end walls are dished to provide room for the motor housing and are flanged outwardly about central openings therein through which lateral extensions 62 and 63 of the motor housing project. The main casing, comprising the drum, is rotatably supported upon said lateral extensions through anti-friction bearings 64.

What has previously been referred to as the supporting frame is made up of side plates 70 and 71 that rise slightly above the top of the drum and extend a material distance fore and aft thereof and terminate, at their lower edges, somewhat below the openings in the end walls 56 of the main casing or drum. The central regions of the side plates 70 and 71 are bulged to accommodate the dished end walls of the main casing or drum and have circular outward depressions 72 that receive the lateral extensions 62 and 63 of the motor housing, with the surrounding bearings 64 in the flanged openings of the main casing or drum. Suitable oil arresters 74 seal the space between the main casing or drum and the supporting frame outwardly beyond the bearings 64 thereby to prevent leakage of oil when the hoist is tilted to an appreciable angle or laid on its side, it being understood that oil fills the main casing to a depth sufficient to maintain ample lubrication for the gearing. Oil is adapted to be introduced into the main casing through a port 75 in the extension 63 that registers at its outer end with an opening in the supporting frame, the same being normally closed by a screw plug 76. The side plates 70 and 71 are secured to the lateral extensions 62 and 63 of the motor housing by studs 77 to which nuts 78 are applied.

The extensions 62 and 63 are also formed with ventilating ports 80 and 81, respectively, shown as fitted at their outer ends with screens, and the port 81 opens into a circumferential channel 82 that surrounds the stator 2 and communicates with the interior of the upper portion of the motor housing through a plurality of vertical passageways 83 (Figs. 5 and 7). The extension 62 is provided with a hole 85 for the passage of wires or conductors 86 that carry current to the motor, said hole being preferably lined with a sleeve of insulating material. As will appear from Figs. 6 and 7, registering keyways in the stator and motor housing contain a key 88 that secures the stator against any possible turning with respect to the housing.

The depressed portion 72 of the side plate 71 is reinforced by a plate or disk 89; and similarly associated with the depressed portion of the opposite side plate 70 is the end portion of a cover 90 of a switch casing 91 that projects from the side plate 70 and occupies the lower left hand corner thereof, as the hoist is viewed in Fig. 1.

The top portions of the side plates 70 and 71 are connected together and spaced apart by cross bars 92. Screws 93 are extended through holes in the side plates and are threaded into the ends of said bars so as to clamp the side plates to the

bars. The ends of a yoke 94 are projected through holes in the lower corners of the side plates 70 and 71 at the end of the main frame opposite the switch casing 91, washers 95 being applied to the protruding ends of the yoke and cotter pins 96 being engaged through holes in said ends. The yoke includes an eye 97 through which a hook 98, on the free end of the cable 52, may be engaged, when the arrangement illustrated in Fig. 1 is used, the same involving a sheave 99 about which the cable is trained and which carries the load hook 100.

I will now describe the automatic circuit breaker. This involves a pin 101 having an enlargement 102 adjacent its head 103, which enlargement is slidable within an opening in the lower corner of the side plate 71 opposite that portion of the side plate 70 that is occupied by the switch casing 91. The end of the pin 101 remote from its head is guided within the bore of a bushing 104 which, in turn, is slidable through an aperture in the side plate 70 and has an annular head 105 inside the casing 91 and beyond which head the end of the pin normally projects. The pin is retained in normal position by a spring 106 pivotally connected at 107 to the side plate 71 and has its free end engaged with the head 103 of the pin, the spring carrying a protuberance 108 (Fig. 9) that is adapted to occupy a recess in the head of the pin. The spring 106, besides serving to yieldingly retain the pin in normal position, prevents its dislodgment, although by retracting the spring sufficiently to disengage its protuberance 108 from the recess in the pin, the spring, by virtue of the pivot 107, may be swung to one side to allow the complete withdrawal of the pin.

Within the casing 91 is a stud 110 on which is pivotally supported a switch member 111 that carries a contact element 112 having spaced blades 113 that are arranged to be inserted between pairs of contact springs 114 and 115. It will be understood that the contact springs 114 and 115 are insulated from each other, and they are connected by suitable conductors, omitted for clearness, with the terminal posts 116 that project downwardly into a socket member 117 depending from the bottom wall of the casing 91. A plug 118 (Figs. 1 and 8) is adapted to be inserted within the socket member 117 for cooperation with the terminal posts 116, the plug being connected in the usual way to the end of a conductor or cable 119 through which electric current is carried to the hoist. The circuit involving the conductor 119 includes at some convenient point a manual control in the nature of a reversing switch 119^a. To prevent accidental dislodgment of the plug 118 from the socket member 117, the former may be sustained by a hook 120 that depends from the bottom wall of the casing 91 and is adapted to be engaged through an eye 121 attached to the plug.

The previously mentioned conductors or wires 86, that lead out through the hole 85 in the lateral extension 62 of the motor housing, extend through a channel formed by an offset portion 122 of the cover 90 into the casing 91 where they have connection with the electrical controls housed therein.

A helical spring 125, compressed between the top wall of the casing 91 and the switch member 111, tends to depress the latter to disengage the blades 113 from the contact springs 114 and 115; and the switch member is adapted to be lifted in opposition to said spring by the push button

126 whose shank is extended upwardly through an opening in the bottom of the casing 91 and is equipped thereabove with a head 128. Fastened to a part 129 of the switch member 111 is one end of a leaf spring that constitutes a latch 130. The free end of this latch has an aperture 131 (Fig. 10) for the reception of the end of the pin 101. When the switch is closed by a thrust on the push button 126, the aperture 131 of the latch 130 engages over the pin, provided the pin 101 is in normal position, resulting in the switch being held closed. When the pin is retracted against the action of spring 106 sufficiently to withdraw its end beyond the outer plane of the head 105 of bushing 104, the latch 130 will be released, whereupon spring 125 will depress the switch member 111 and open the switch so as to break the circuit. Also, when the bushing 104 is moved inwardly to, or beyond, the plane of the end of the pin 101, it will strip the latch 130 from the pin, allowing the spring 125 to open the switch.

These movements of the pin and bushing are accomplished by a follower 133 that is slidably mounted on the pin 101 and has a circumferential flange 134 engaged within the spiral groove of the drum 50. It may here be explained that in the normal working range of the hoist, the follower 133 does not move far enough to engage the bushing 104 or the enlargement 102 of the pin. If, however, the drum rotates further than intended in one direction, it will propel the follower 133 along the pin 101 until it engages the enlargement 102 and retracts the pin against the tension of spring 106 in the manner and with the result above described; and similarly, if rotated in the opposite direction beyond its normal range of operation it will actuate the circuit breaker or switch through the medium of the bushing 104, as already explained.

In case the switch is opened through excessive movement of the drum, the hoist cannot again be operated until, by means of a belt pole or the like, the button 126 is thrust upwardly to close the switch. Before this is done, however, the manual control (not shown) should be operated to reverse the motor and then, upon holding the switch closed momentarily the drum will rotate in a reverse direction and immediately shift the follower 133 enough to cause the end of the pin 101 to project beyond the head of the bushing 104 thereby to allow the latch 130 to engage over it and hold the switch closed in opposition to spring 125.

Relatively large openings 135 occupy the upper corners of the side plates 70 and 71 of the main frame for the reception of hooks, chains, ropes or the like by which the hoist may be suspended. With the load hook 100 attached to the object to be lifted, the control (not shown) is operated to energize the motor and cause the rotor 8 to be turned. The incipient movement of the rotor, being independent of the shaft 20, causes the inclined surfaces at the corresponding ends of the opposed slots or notches 15 to ride over the rollers 16 and lift the rotor from the stationary brake member 33 in opposition to its own weight and the depressing influence of the spring 31. When the rotor has moved sufficiently to engage the ends of the slots or notches with the rollers 16, the rotor will pick up the shaft 20 and turn it with the driving pinion 37, thereby to rotate the worm 41 and consequently the worm wheel 55 and drum 50, the main casing of which said drum forms a part revolving on the bearings 64 that are carried by the lateral extensions 62 and 63 of the

motor housing. The instant the current is shut off the rotor 8 will drop upon and be stopped by the brake member 33, this action being enhanced by the spring 31. Assuming that the foregoing operation resulted in the load being lifted, when it is desired to lower the load the manual control or switch is operated to reverse the motor and the foregoing operation is repeated in the reverse direction.

10 An important feature of my present invention is the use of teeth and thread on the worm gear 55 and worm 41, respectively, that are of the buttress type, with their steep sides or faces approximately radial to the center of rotation of the worm wheel and disposed to receive the thrust imposed thereon by the load. This increases the lifting efficiency and load sustaining quality of the hoist.

Another important feature is the ventilation of the enclosed electric motor. When the rotor revolves in either direction the fan 26 draws air inwardly through the port 80 upwardly around and through the rotor 8 (it being remembered that the rotor is lifted free of the brake member 33 when in operation) toward the center of the fan and expels it from the upper portion of the motor housing outwardly through the passageways 83, channel 82 and port 81.

Having thus described my invention, what I claim is:

1. A hoist comprising a motor, a drum surrounding the motor, end walls on the drum fixed with respect thereto and having central openings, supporting means including parts on opposite sides of the drum, connections between said parts and the motor accommodated by said openings and constituting of the motor and said parts a rigid structure, the drum being suitably supported for rotation about the motor, and driving connections between the motor and drum.

2. A hoist comprising a motor, a drum surrounding the motor, end walls on the drum fixed with respect thereto and having central openings, supporting means including parts on opposite sides of the drum, connections between said parts and the motor accommodated by said openings, said means and motor constituting a rigid structure, the drum being supported by said structure for rotation, and driving connections between the motor and drum.

3. A hoist comprising a motor provided with lateral extensions, a drum surrounding the motor, end walls on the drum fixed with respect thereto and having central openings through which said extensions project, supporting means including parts on opposite sides of the drum fixedly secured to said extensions, the drum being rotatably supported by the extensions, and driving connections between the motor and drum.

4. A hoist comprising an electric motor having lateral extensions, one of which is provided with a passageway, a drum enclosing the motor and having end walls provided with central openings through which said extensions project, supporting means including parts on opposite sides of the drum secured to said extensions, the drum being rotatably supported by the extensions, electrical conductors leading to the motor through the aforesaid passageway, and driving connections between the motor and drum.

5. A hoist comprising a motor, a drum including end walls and constituting a leak-proof casing enclosing the motor, the end walls having central openings considerably less in diameter than the motor, supporting means including parts on

opposite sides of the drum extending over the openings in the end walls thereof, connections between said parts and the motor accommodated by said openings, the drum being supported for rotation on the axis of said openings, means interposed between said parts and the end walls sealing said openings against the leakage of lubricant, an internal worm gear secured to the interior of the drum in concentric relation to its rotating axis, a worm cooperating with the worm gear and driving connections between the motor and worm.

6. A hoist comprising a motor, a drum surrounding the motor and having openings in its ends, supporting means including parts on opposite sides of the drum, connections between said parts and the motor, the drum being suitably supported for rotation, an internal worm gear secured to the interior of the drum substantially midway between its ends and in a plane perpendicular to the rotating axis of the drum, the motor being arranged with its shaft in the plane of the worm gear, a worm rotatably supported by the motor in mesh with the teeth of the worm gear, and driving connections between the motor shaft and worm.

7. A hoist comprising a motor, a drum surrounding the motor and having openings in its ends, supporting means including parts on opposite sides of the drum, connections between said parts and the motor accommodated by said openings, the drum being suitably supported for rotation about the motor and being split circumferentially substantially midway of its ends in a plane perpendicular to its rotating axis, means securing the sections of the drum together, an internal worm gear surrounding the interior of the drum and secured between opposed parts of the sections thereof, a worm rotatably supported by the motor and meshing with the worm gear, and driving connections between the motor shaft and worm.

8. A hoist comprising a motor, a drum surrounding the motor and having openings in its ends, supporting means including parts on opposite sides of the drum, connections between said parts and the motor accommodated by said openings, the drum being supported for rotation about the motor, the drum being split circumferentially substantially midway of its ends in a plane perpendicular to its rotating axis, means securing the sections of the drum together, an internal worm gear surrounding the interior of the drum and secured between opposed parts of the sections thereof, a worm rotatably supported by the motor and meshing with the worm gear, the motor being arranged with its shaft in the plane of the worm gear, and driving connections between the motor shaft and worm.

9. A hoist comprising, in combination, an electric motor, a drum surrounding the motor and having end walls with central openings, supporting means including parts on opposite sides of the drum, connections between said parts and the motor accommodated by said openings, said connections including ventilating passageways, air agitating means incorporated in the motor for moving air through the motor casing, the drum being supported for rotation on the axis of the aforesaid openings, and driving connections between the motor and drum.

10. A hoist comprising an electric motor whose housing is provided with lateral extensions, a drum enclosing the motor and having end walls with central openings through which said extensions

slons project, a supporting frame including parts on opposite sides of the drum secured to said extensions, the drum being rotatably supported by the extensions, said extensions having ventilating ports leading to the interior of the motor housing, a fan on the motor shaft for circulating air through the housing, and driving connections between the motor and drum.

11. A hoist comprising a motor, a drum enclosing the motor and having openings in its ends, supporting means including parts on opposite sides of the drum, connections between said parts and the motor accommodated by said openings, bearings within the openings by which the drum is rotatably supported, means for introducing a lubricant into the drum, packing between the drum and supporting means outwardly beyond the bearings so as to give the lubricant access to the latter, and driving connections between the motor and drum.

12. A hoist comprising an electric motor including an oil-tight housing having lateral extensions, a drum surrounding the motor housing and having end walls with central openings that are considerably less in diameter than the motor housing, anti-friction bearings fitted within said openings and supported by the lateral extensions of the motor housing, a supporting frame having parts on opposite sides of the drum secured to said extensions and covering the openings in the end walls, a packing element surrounding the opening in each end wall of the drum and cooperating with the adjacent part of the supporting frame for closing the joint between said end wall and frame, and driving connections between the motor shaft and the drum.

13. A hoist comprising an electric motor including an oil-tight housing having lateral extensions, a drum surrounding the motor housing and having end walls with central openings, anti-friction bearings fitted within said openings and supported by the lateral extensions of the motor housing, a supporting frame having parts on opposite sides of the drum secured to said extensions, a packing element surrounding the opening in each end wall of the drum for closing the joint between said end wall and the adjacent part of the supporting frame, an oil hole leading into the interior of the drum through one of the lateral extensions, a closure therefor, and driving connections between the motor shaft and the drum.

14. A hoist comprising an electric motor including an oil-tight housing having lateral extensions, a drum surrounding the motor housing and having end walls with central openings, anti-friction bearings fitted within said openings and supported by the lateral extensions of the motor housing, a supporting frame having parts on opposite sides of the drum secured to said extensions, a packing element surrounding the opening in each end wall of the drum for closing the joint between said end wall and the adjacent part of the supporting frame, an internal worm gear secured to the interior of the drum substantially midway between its ends and in a plane perpendicular to the rotating axis of the drum, the motor being arranged with its shaft in the plane of said worm gear, a worm rotatably supported by the motor housing in mesh with the worm gear, and driving connections between the motor shaft and worm.

15. Hoisting mechanism including an electric motor arranged with its rotating axis substantially vertical, the rotor whereof is capable of limited movement axially and longitudinally of

the motor shaft, driving connections between the motor shaft and rotor permitting limited relative rotation of the rotor with respect to the shaft and effecting a lifting of the rotor by virtue of said relative rotation, a brake member fixed with respect to the motor housing whereon the rotor rests by gravity when inactive, a hoisting drum, and driving connections between the motor shaft and said drum.

16. Hoisting mechanism including an electric motor arranged with its rotating axis substantially vertical, the rotor whereof is capable of limited movement axially and longitudinally of the motor shaft, driving connections between the motor shaft and rotor permitting limited relative rotation of the rotor with respect to the shaft and effecting a lifting of the rotor by virtue of said relative rotation, a brake member fixed with respect to the motor housing whereon the rotor rests when inactive, a spring urging the rotor toward said brake element, a hoisting drum, and driving connections between the motor shaft and said drum.

17. In combination, an electric motor arranged with its rotating axis substantially vertical and the rotor of which is capable of limited rotative and axial movement with respect to the motor shaft, a brake element secured to the motor housing whereon the rotor rests when inactive, and driving connections between the shaft and rotor permitting the aforesaid limited rotative movement in either direction and effecting a lifting of the rotor from the brake element during such rotation.

18. In combination, an electric motor, the rotor of which is capable of limited rotative and axial movement with respect to the motor shaft, a brake element fixed with respect to the motor housing wherewith the rotor engages when inactive, the rotor being biased in its axial movement toward the brake element and driving connections between the shaft and rotor permitting the aforesaid limited rotative movement and effecting axial movement of the rotor away from the brake element during such rotation.

19. In hoisting machinery, the combination of a drum, a reversible electric motor for rotating the drum in opposite direction, an electric circuit including said motor, a manually operated emergency switch in said circuit biased toward open position, a latch normally holding said switch closed, a member movable in unison with the drum, the same when moved beyond a given position in either direction acting to release the latch, and a reversing switch in said circuit.

20. In hoisting machinery, the combination of a drum, a reversible electric motor for rotating the drum in opposite directions, an electric circuit including the motor, a switch in said circuit biased toward open position, a latch for holding the switch closed, a longitudinally movable element with which the latch cooperates to hold the switch closed, a second element movable longitudinally of the first element, and a member movable in unison with the drum, the same when moved beyond a given position in one direction serving to shift the first mentioned element out of holding relation with the latch and when moved beyond a given position in the opposite direction serving to actuate the second element and by means thereof release the latch from the first element.

21. In hoisting machinery, the combination of a drum having a spiral guide for cooperation with a flexible load sustaining element, a reversible electric motor for rotating the drum in opposite

directions, an electric circuit including the motor, a switch in said circuit biased toward open position, a pin supported for longitudinal movement transversely of the drum, a latch for the aforesaid switch arranged for holding engagement with one end of the pin thereby to retain the switch in closed position, a bushing slidable on the pin adjacent said end, the pin having an abutment remote from said bushing, means yieldingly retaining the pin in position to be engaged by the latch, a member movable longitudinally of the pin and having a part cooperating with the spiral guide of the drum whereby the member is reciprocated along the pin when the drum is rotated in opposite directions, the member when moved beyond a given position in one direction, engaging the aforesaid abutment and retracting the pin out of holding engagement with the latch, and when moved beyond a given position in the opposite direction moving the bushing thereby to disengage the latch from the pin, and a reversing switch in the aforesaid circuit.

22. In a hoist of the character described, the combination of a drum having a spiral guide for a flexible load sustaining element, a supporting frame by which the drum is rotatably carried, the same having opposed parts projecting beyond the periphery of the drum, said parts having axially aligned openings, a bushing slidable within the opening of one of said parts, a pin having one of its ends slidable in the opening of the other of said parts and its opposite end slidable within the bushing, means yieldingly retaining the pin in a position with its last mentioned end projecting beyond the outer end of the bushing, the pin having an abutment opposed to and remote from the inner end of the bushing, a reversible electric motor for driving the drum in opposite directions, an electric circuit including said motor, a switch in said circuit biased toward open position, a latch for the switch cooperating with the end of the aforesaid pin where it projects beyond the bushing for holding the switch in closed position, a member reciprocable along the pin and having a part engaged with the spiral guide of the drum, said member, when moved beyond a given position in one direction engaging the abutment on the pin and shifting the pin in opposition to the aforesaid means to withdraw its ends from holding engagement with the latch and when moved beyond a given position in the opposite direction engaging the bushing to dislodge the latch from the pin, and a reversing switch in the electric circuit.

23. In a hoist of the character described, the

combination of a drum having a spiral guide for cooperation with a flexible load sustaining element, a supporting frame by which the drum is rotatably carried, the same having opposed parts projecting beyond the periphery of the drum, said parts having axially aligned openings, a bushing slidable within the opening of one of said parts, a pin having one of its ends slidable in the opening of the other of said parts and its opposite end slidable within the bushing, a spring movably connected to the last mentioned part of the frame and disengagingly overlying the adjacent end of the pin and serving to yieldingly retain the pin in a position with its remote end projecting beyond the outer end of the bushing, the pin having an abutment opposed to and remote from the inner end of the bushing, a reversible electric motor for driving the drum in opposite directions, an electric circuit including said motor, a switch in said circuit biased toward open position, a latch for the switch cooperating with the end of the aforesaid pin that projects beyond the bushing for holding the switch in closed position, a member reciprocable along the pin and having a part cooperating with the spiral guide of the drum, said member, when moved beyond a given position in one direction engaging the abutment on the pin and shifting the pin in opposition to the aforesaid spring in a direction to withdraw its end from holding engagement with the latch and when moved beyond a given position in the opposite direction engaging the bushing to dislodge the latch from the pin, and a reversing switch in the electric circuit.

24. In hoisting machinery, the combination of a drum having a spiral guide for cooperation with a flexible load supporting element, a reversible electric motor for rotating the drum in opposite directions, an electric circuit including the motor, a switch in said circuit biased toward open position, releasable holding means for retaining the switch closed, a movable element with which said means cooperates to hold the switch closed, a second element movable with respect to the first element, and a member movable transversely of the drum and cooperating with the spiral guide thereof so as to be moved when the drum rotates, said member when moved beyond a given position in one direction serving to shift the first mentioned element to cause it to release the holding means and when moved beyond a given position in the opposite direction serving to actuate the second element and by means thereof release the holding means from the first element.

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