Nov. 26, 1935. B. GROB 2,022,035

OPERATING MEANS FOR SWITCHES AND OTHER APPARATUS

Filed Oct. 15, 1928 2 Sheets-Sheet 1

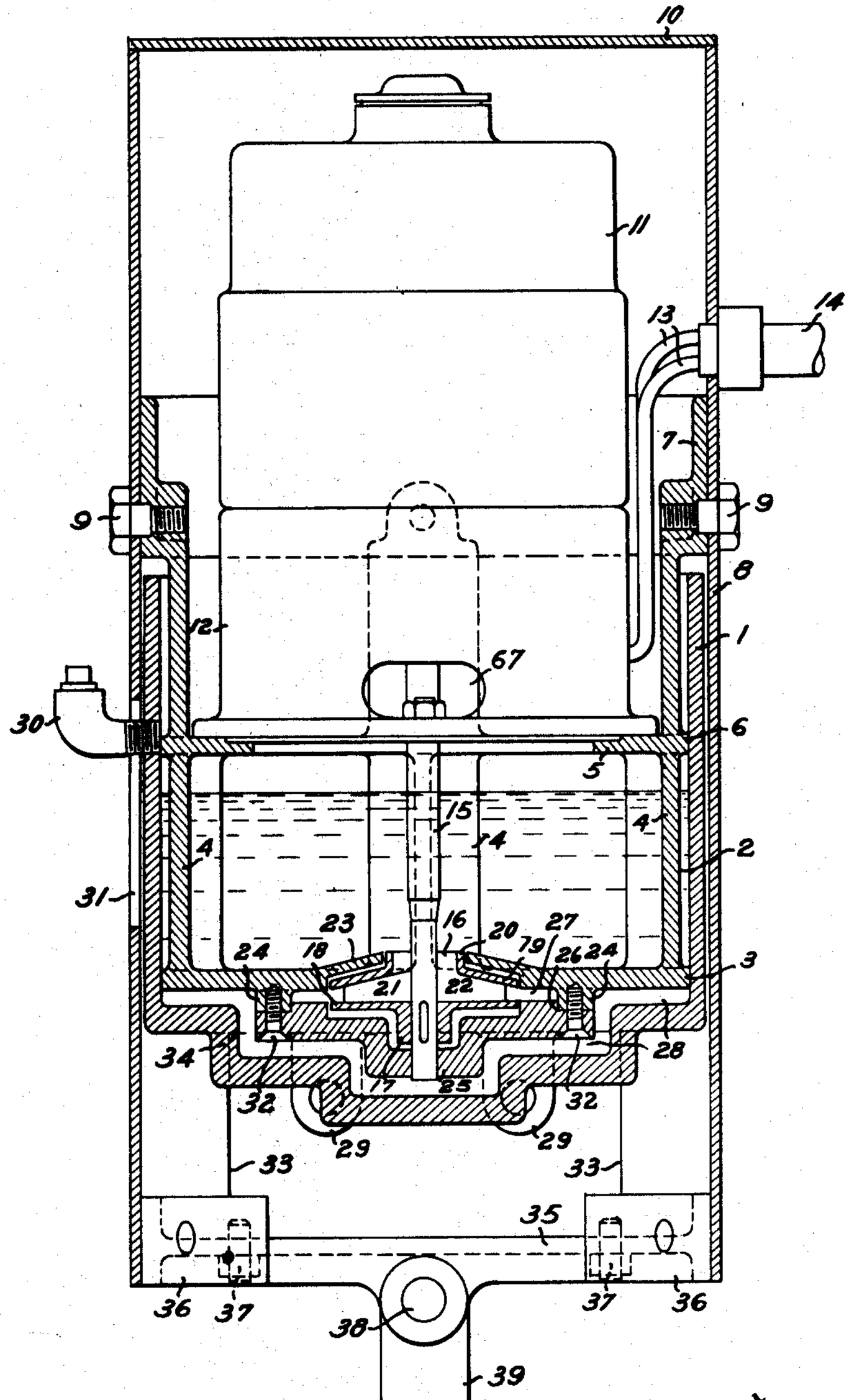

Fig. 1

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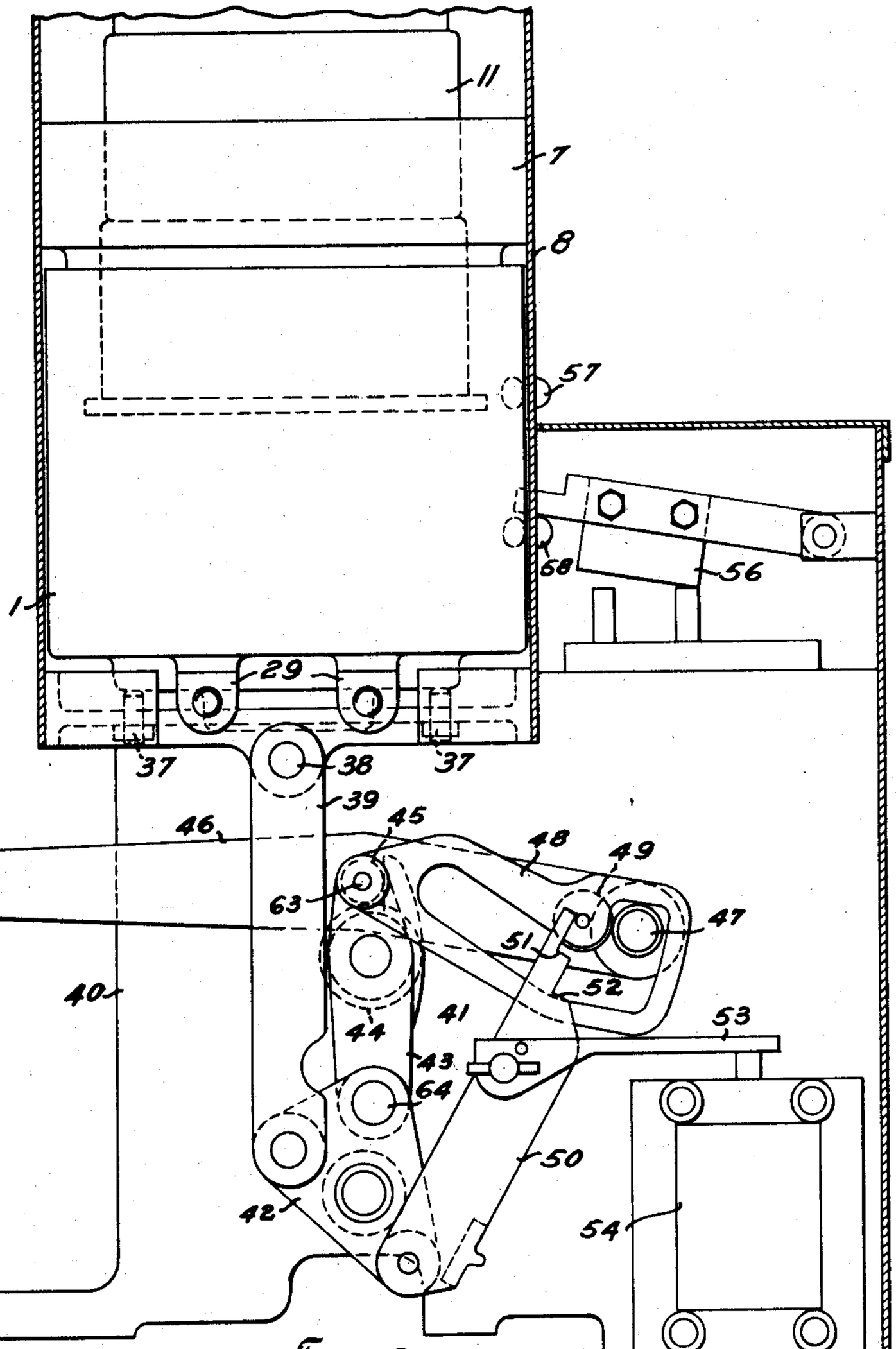

Fig. 2

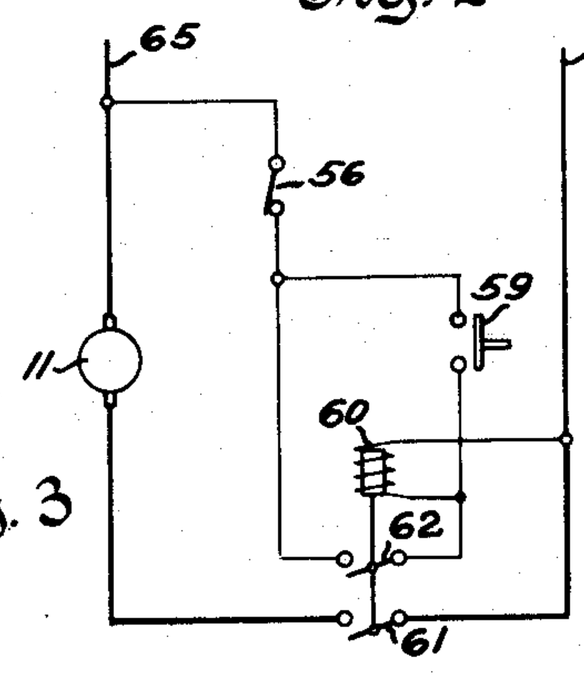

Fig. 3

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OPERATING MEANS FOR SWITCHES AND OTHER APPARATUS

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11 Claims. (Cl. 60—52)

This invention relates to an operating means or motive device which is particularly adapted for use in combination with electric switches and more specifically with switches of the trip-free type, but is not limited to such use.

One of the objects of the invention is the provision of a motive device which eliminates the use of operating solenoids. A more specific object is the provision of an operating means adapted for use with a motor having a revolving shaft, as an electric motor. In this connection another object is the provision of means which will make unnecessary the use of brakes on the motor, and also which will in general simplify the connection between the motor and the load, such as a switch, to be operated. More specifically an object is to provide means whereby the motor may continue to rotate after the load has been brought to its desired limiting position, without breaking or straining any parts.

Other objects will appear hereinafter as the description of the invention proceeds.

The novel features of the invention will appear from this specification and the accompanying drawings forming a part thereof and all these novel features are intended to be pointed out in the claims.

In the drawings:

Fig. 1 is a view in sectional elevation of an operating means or motive device embodying the invention, a portion of the means for transmitting power to a load being shown.

Fig. 2 is a view in elevation of mechanism embodying the invention as it may be applied in the operation of electric switches.

Fig. 3 is a simplified circuit diagram of the control circuits for the motor forming part of the motive device.

Referring to Fig. 1 of the drawings the embodiment as here illustrated includes a cylinder 1 which is open at the top and closed at the bottom by a wall of suitable conformation. The cylinder has disposed in it a cage like member 2 which includes a transverse wall forming a piston proper 3. The cage like member has axially extending bars 4 which as here shown are spaced somewhat from the cylinder 1. The cage also includes a transverse annular web 5, which, as here shown may be considered as extended peripherally to form a peripheral guiding surface 6 in sliding contact with the cylinder 1. The cage also includes a ring member 7 which is offset sufficiently to extend radially beyond the outside of the cylinder 1. The cage may be formed in any suitable manner but is here indicated as having its parts made integral by casting.

The ring member 7 of the cage is here shown as fastened to a tubular member 8 by means of a suitable number of studs 9. The tubular member 8 is of sufficient internal diameter so that relative motion between it and the cylinder 1 may freely take place. The tube 8 may be provided with a cover 10.

The prime source of power for the motive device is here indicated as an electric motor 11, the motor being provided with a suitable base 12 which as here shown is centered by and rests on the annular web 5. The current may be led to the motor 11 by means of conductors 13 which pass through an opening in tube 8 and through a flexible conduit 14. The motor 11 is provided with a shaft 15.

The motor base 12 may be provided with one or more openings 67 so that the surface of liquid in cylinder 1 will be exposed to atmosphere.

A pump runner 16 is suitably keyed to the motor shaft 15. The runner has a hub 17 which as here shown has a radially extending flange forming one shroud 18 for the runner. Spaced from the shroud 18 is another shroud 19 which is here shown as having a slightly conical surface. The shroud 19 is also provided with an axially extending annular portion 20 which forms an inlet opening for the runner. Between the shrouds 18, 19 are disposed any desired number of impelling vanes 21, 22. The piston wall 3 is suitably formed to provide a recess for the shroud element 19, 20, thus providing a slightly conical portion 23. The shroud portions 19, 20 are of course sufficiently spaced from the adjacent piston surfaces so as to provide a running clearance.

The piston wall 3 is provided with a suitable number of axially extending lugs 24 which serve to space the upper surface of a bottom plate 25 from the piston 3 and from the runner. The lugs 24 fit into and abut against the faces of peripheral recesses 26 in the bottom plate 25. The bottom plate 25 may be suitably fastened by means of screws 32 passing into the lugs 24. A hole in the center of the bottom plate 25 serves as a guide bearing surface for that portion of the shaft 15 extending below the runner 16. The bottom plate 25 is suitably shaped to accommodate the hub of the runner and to provide a running clearance between the outer periphery of the shroud 18 and the recess in the bottom plate. The upper surface of the bottom plate and the lower surface of the piston 3 are preferably flush with the

discharge edges of the shrouds 18 and 19 respectively.

It will of course be obvious that the space 27 between the piston and the bottom plate 25 is freely connected with the space 28 between the outer surface of the bottom plate 25, the portion of the piston surface 3 radially beyond the lugs 24, and the opposing surfaces of the cylinder. The space 27 and also a portion of the space 28 forms a diffusing space for the pump.

The cylinder 1 is provided with any suitable means, such as the lugs 29, for connecting it to some stationary element. A pipe elbow 30 is screwed through a threaded hole in the cylinder 1, and serves as a means for introducing any suitable liquid into the inside of the cylinder 1. It will of course be obvious that liquid which is poured in through the filler 30 readily finds its way into the lower parts of the cylinder and piston inasmuch as the piston above the wall 3 is of cage like formation and the liquid may flow between the axially extending bars 4 through the opening in the pump rinner into the spaces 27, 28. Under normal conditions the said spaces and the cylinder space above the piston wall 3 will be filled with liquid up to a predetermined level limited by the height of the filler 30.

The tubular member 8 is provided with a slot 31 to accommodate the passage of the filler 30 and to permit relative motion between the tube 8 and the filler.

The tube 8 is cut away on the axially extending lines 33 on both the front and rear sides of the tube, as viewed in Fig. 1. The upper limit of the cut away portion is here shown as on a horizontal line 34. These cut away portions of the tube 8 serve to permit relative motion between the tube and the fastening means for the cylinder, as for example bolts passing through the lugs 29.

The tube 8 is here shown as having fastened thereto a transversely extending member or spider 35 which has arcuate end portions 36 suitably fastened to the tube 8. The spider 35 may carry screws 37 which are adapted to abut against that portion of the bottom of the cylinder 1 directly above these screws, thus limiting the upward movement of the tube 8. The spider 35 is also provided with a pin or pivot 38 to which may be pivoted rods 39 for transmitting motion to the device to be operated. It is of course obvious that motion may be transmitted from the tube 8 or from the piston itself to the device to be operated in any other suitable manner.

Referring now to Fig. 2, the motive device illustrated in Fig. 1 is here shown, chiefly in outline, as it may be applied in combination with a suitable electric switch operating means. The lugs 29 of the cylinder 1 may be suitably fastened to the housing 40 of the operating mechanism. The operating mechanism is indicated in general by the reference character 41, and includes as here shown a bell crank lever 42 which has pivoted thereto the rod 39. Also pivoted to the bell crank 42 is a link 43 which carries a roller 44 adapted to engage a pin 45 in thrust relationship. The pin 45 is in the illustrated example shown as carried by an operating lever 46 pivoted on a pin or shaft 47. The switch 55 which is connected in any suitable manner to the operating lever 46, is here shown in its fully closed position, the screws 37 being shown in engagement with the bottom of the cylinder 1. The reaction of the switch 55 due to the inherent resilience of the contacts and the weight of the parts would naturally tend to move the roller 44 out of thrust relationship with the pin 45. In order to prevent this maintaining means is provided which is here shown as a slotted link 48 pivoted at 63 to the lever 43. The link 48 carries a roller 49 which is adapted to be normally in thrust relationship with the shaft 47.

The roller 44 and the necessary parts associated therewith as will be clear, constitute a trip-free mechanism which will permit opening movement of the switch 55 irrespective of the position of tube 8. The trip-free mechanism may be released, for example, by means of either a trip lever 53 which may be raised into engagement with link 48 by means of a solenoid 54, or by means of a trip link 50 which is pivoted to the lever 42. The trip link 50 is provided with a pair of shoulders 51, 52 either of which is adapted to engage a portion of link 48, as for example, the pin carrying the roller 49, to thereby lift the link 48 so that the roller 49 passes out of thrust relationship with shaft 47. Such movement of link 50 would be produced if, for example, the bell crank lever 42 were rotated in a counter-clockwise direction from its position as shown. The consequent tripping of the trip-free mechanism would occur before sufficient movement of lever 42 had occurred to possibly move the switch to the open position slowly. The shoulder 52 would come into action in case, for example, the tube 8 had moved upwardly sufficiently to just cause switch 55 to close but not sufficiently to fully compress the contacts or rotate the lever 42 sufficiently to bring the axis of pin 64 over the dead center position. Under the said conditions the shoulder 52 of link 50 would be just below the pin of roller 49 so that if the motor 11 should, for example, cease rotation and the tube stop its upward movement and slowly move downwardly, the motion of link 50 would also reverse and the consequent upward motion would cause release of the trip-free mechanism. This feature is of particular advantage in connection with the motive device of the present invention inasmuch as should the motor 11 have current shut-off therefrom before it had completed its work, the runner 16 would gradually drop in speed and liquid would gradually return from beneath piston 3 through the passage 27 through the runner 16 to the space above the piston.

The operating mechanism 41 has been hereinbefore described in sufficient detail for the sake of completeness of the present application, but as far as some of the features thereof are concerned it will be clear that it is not necessary that in a combination between the motive device as illustrated in Fig. 1, that the operating mechanism for the switch, or the trip-free mechanism forming a part thereof, need be of the particular form herein illustrated. The particular form of this operating mechanism viewed from the point of its utility in connection with motive devices of other form than that illustrated in the present application is illustrated and claimed in applicant's copending application Ser. No. 312,421, filed October 15, 1928, which has matured into Patent No. 1,860,501, May 31, 1932, and reference may be had thereto for details not included in the present application.

Referring to Fig. 3, which shows a simplified diagram of the electrical control circuits for the motor 11, a push button 59 is provided which when closed for the purpose of causing the motor 11 to close the switch 55, for example, will energize a relay 60 from the supply conductors 65, 66 through a switch 56 which at that time is closed.

As soon as relay 60 is energized it closes a holding circuit for itself which includes the relay contact 62, and at the same time closes a contact 61 which causes current to flow through motor 11. When the motor 11 has completed its work the switch 56 automatically opens and deenergizes relay 60 and consequently also the motor 11. The switch 56 may be operated as shown in Fig. 2 by means of lugs 57, 58 which are here shown as carried by the tube 8. In the position of the parts shown the lug 58 is beneath the switch lever having engaged the same in the upward movement of the tube. The lug 57 is adapted to reclose the switch 56 upon descent of the tube 8.

If it be assumed that the parts are as shown in Fig. 2 and that the solenoid 54 is energized in any desired manner, the trip-free mechanism of the operating means 41 will permit the switch 55 to instantly open. The tendency for downward movement of the tube 8 and its associated parts being no longer resisted by the reaction of the switch 55 will cause the descent of the tube 8 and consequent rotation of the lever 42 in a counterclockwise direction. The motor 11 is at this time, for example, not rotating and liquid will be caused to flow from beneath piston 3 through passage 27 through the runner to the space above the piston. The said rotation of lever 42 causes the resetting of the trip-free mechanism so that roller 44 is again in thrust relationship with pin 45, the same being true of roller 49 and shaft 47. The descent of tube 8 has caused the lug 57 to close the switch 56, the electrical circuits being then as indicated in Fig. 3. If now it is desired to reclose the switch 55 the button 59 is closed with the consequent energization of motor 11 as hereinbefore described. The operation of motor 11 and consequent rotation of runner 16 causes liquid to be drawn into the inlet opening 20 and pumped into the spaces 27, 28. The liquid under pressure in these spaces acting against all of the horizontal surfaces of the piston and the associated bottom plate 25 causes the lifting of the piston with the cage 2 forming a part thereof. The entire motor 11 is also lifted along with the tube 8 thereby pulling the tube upwardly from the position shown in Fig. 1 to the position shown in Fig. 2 in which the screws 37 abut against the bottom of the cylinder. In this position of the parts the axis of pin 64 being slightly to the right of the line joining the axis of pin 45 and the axis of the pivot lever 42, the toggle formed by the elements between the last two named axes is overset so that the reaction of the switch 55, including the weight thereof, tends to lift the tube 8 and its associated parts. This reaction is sufficient to hold the switch in closed position. The amount of oversetting of the aforesaid toggle may of course be adjusted by means of the screws 37.

It may be noted that the armature of motor 11 and the runner itself will, after the motor has gotten up to speed sufficiently to cause switch closing movement, have considerable momentum which will be sufficient to pull the switch to the closed position even if the switch 56 is not very accurately adjusted and should act to open the motor circuit before the point 64 has gone to the overset position. Moreover, it is immaterial whether or not the motor continues to run for a time after the current is shut off therefrom inasmuch as this results in nothing more than rotation of the runner 16 and churning of the liquid. In other words, no parts can be broken by overrunning of the motor even if it is not stopped at exactly the time when the operating mechanism has reached the fully closed position.

It should be understood that it is not desired to limit the invention to the exact details of construction shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In combination, a vertical cylinder, a piston non-rotatably slidable within said cylinder, said piston having a head portion with an opening therethrough, an impeller-type pump runner arranged in said opening for rotation substantially in the plane of said head portion, means for biasing said piston to a return position, a body of liquid within said cylinder free to flow through said opening when said piston is moved by said biasing means, and means comprising a motor mounted on said piston for rotating said pump runner to move said piston away from said return position.

2. In combination, a vertical cylinder, a body of liquid in said cylinder, a piston slidable only vertically within said cylinder and having a head portion comprising an integral wall and a detachable wall forming the casing of an impeller-type pump having passages to and from said pump and the opposite sides of the head portions of said piston, a pump runner arranged withins aid casing, and a motor mounted on said piston for rotating said runner to move said liquid from one side of said piston to the other to move said piston.

3. In combination, a stationary cylinder member, a body of liquid within said cylinder, a piston slidably arranged within said cylinder and having a passageway therethrough for said liquid, a motor driven pump attached to said piston and having an impeller runner arranged in said passageway for pumping said liquid through said passageway to actuate said piston, a movable element arranged below said stationary cylinder, a movable tubular member surrounding said stationary cylinder member and connecting said movable element with said piston, and cooperating stop members mounted on said tubular member and on said stationary cylinder respectively for limiting the movement of said piston.

4. In combination, a stationary cylinder member, a body of liquid within said cylinder, a piston slidably arranged within said cylinder and having a passageway therethrough for said liquid, a motor driven pump attached to said piston and having an impeller runner arranged in said passageway for pumping said liquid through said passageway to actuate said piston, a movable element arranged below said stationary cylinder, means symetrically disposed around said stationary cylinder for transmitting the motion of said piston to said movable element, and means for limiting the movement of said piston comprising a stop member actuated in accordance with the movement of said piston and a stationary stop member cooperating therewith.

5. The combination with a movable element, of operating means therefor comprising a vertical stationary cylinder, a piston slidable non-rotatably within said cylinder and having an opening therethrough, an electric motor vertically mounted on said piston for movement therewith and having a rotatable shaft extending through said opening, an impeller-type pump runner disposed in said opening and attached to said rotat-

able shaft, a quantity of liquid within said cylinder free to flow through said opening when said runner is at rest, a guide bearing for said rotatable shaft attached to said piston and arranged below said runner, means for connecting said piston to said movable element comprising a tube surrounding said cylinder, said movable member being operable to bias said piston to a return position, and means for energizing said motor so as to cause said pump runner to transfer liquid from above said piston through said opening to below said piston whereby said piston is moved from said return position.

6. In combination, a stationary cylinder, a piston slidable within said cylinder, said piston having a head portion with an opening therethrough, a body of liquid in said cylinder, an impeller-type pump runner arranged in said opening leaving a passageway for said liquid, a reciprocating member, means for operatively connecting said piston with said reciprocating member, an electric motor attached to said piston for rotating said pump runner, a switch for said motor operable when closed to cause said piston to move said reciprocating member to an operating position, means for latching said first means so that said reciprocating member is maintained in said operating position, means actuated upon the movement of said member to said operating position for opening said switch, whereupon said pump runner and motor will continue to rotate due to the inertia thereof.

7. In combination, a stationary cylinder, a piston slidable within said cylinder, a body of liquid within said cylinder, an impeller type pump runner associated with said piston for moving liquid from one side of said piston to the other side thereof to move said piston, an electric motor mounted on said piston for operating said pump runner, a reciprocable member operable to and from initial and limiting positions, means for biasing said reciprocating member to its initial position, means for operatively connecting said piston with said reciprocating member so that said piston is operable to actuate said reciprocating member toward said limit position against said biasing means when said motor is energized, an adjustable abutment arranged to limit the movement of said piston when said reciprocating member reaches its limit position, said connecting means comprising latching means for holding said reciprocating member in its limit position, means for deenergizing said electric motor substantially when said adjustable abutment limits the movement of said piston, and means for rendering said latching means ineffective to hold said reciprocating member in its limit position so that said biasing means will return said reciprocating member to its initial position and so that liquid moves from said other side of said piston to said one side of said piston.

8. In combination, a stationary cylinder, a piston slidable within said cylinder, a body of liquid within said cylinder, an impeller-type pump mounted on said piston for moving said liquid from one side of said piston to the other to move said piston, an electric motor mounted on said piston for rotating said pump, an adjustable stop movable in accordance with the movement of said piston into engagement with a stationary stop for limiting the movement of said piston, said impeller pump having a non-overloading characteristic whereby the stopping of the movement of said piston by said stops does not overload said electric motor.

9. In combination, a cylinder containing a quantity of liquid, a non-rotatable piston in said cylinder, said piston having an opening therethrough, a pump arranged in said opening and operable to transfer liquid from one side of said piston through said opening to the other side of said piston to thereby move said piston, an electric motor carried by said piston for operating said pump, a movable element, means including a tube surrounding said cylinder for connecting said piston to said movable element, a switch operable when closed to start said motor, and means carried by said tube for causing said switch to open when said piston moves a predetermined amount.

10. In combination, a vertical cylinder, a piston slidable only vertically within said cylinder, said piston comprising a head portion with an opening therethrough and an annular guiding portion spaced from said head portion by means of a plurality of vertical struts, a quantity of liquid within said cylinder, an electric motor vertically mounted on said guiding portion and having a rotatable shaft extending into said opening, an impeller-type pump runner disposed in said opening and attached to said rotatable shaft, and means for energizing said electric motor so as to cause said pump to transfer a portion of said liquid from above said head portion through said opening to beolw said head portion whereby said piston is caused to move upwardly.

11. A fluid pressure operating mechanism for exerting force, comprising a cylinder containing an operating fluid, a piston having a passageway therethrough disposed within said cylinder in cooperating relation therewith for movement longitudinally thereof, a pump impeller carried by said piston in cooperating relation with said passageway and arranged in such manner as to permit free flow of fluid through said passageway from one to the other side of said piston to allow movement of said piston longitudinally of said cylinder under the influence of external force, and a motor mounted on said piston and operatively connected to actuate said pump impeller to force fluid from one to the other side of said piston for forcibly moving said piston longitudinally of said cylinder.

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