July 22, 1958 P. F. WHITE 2,844,673

MAGNETICALLY ACTUATED SWITCH AND COMPRESSOR UNLOADER

Filed Aug. 31, 1953 2 Sheets-Sheet 1

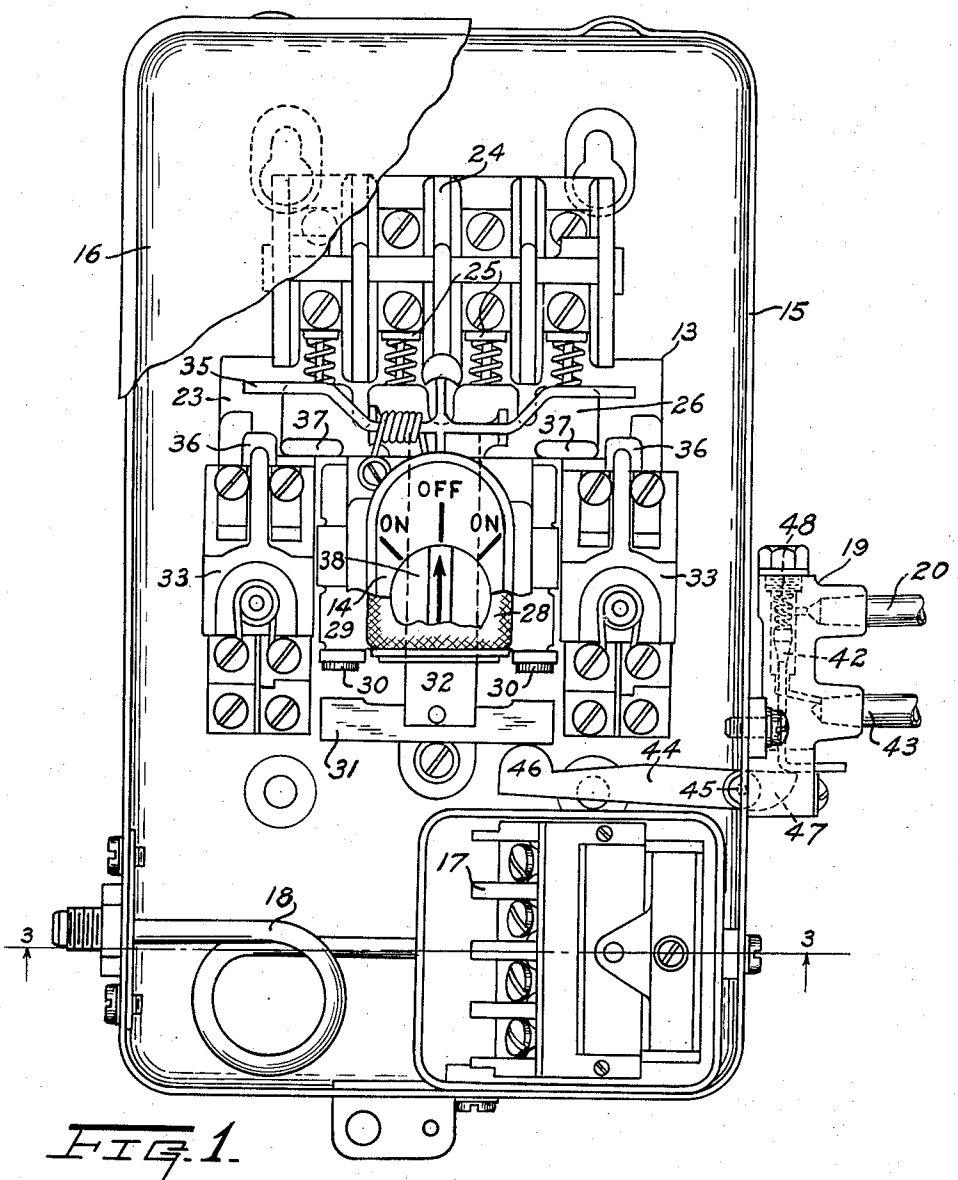


FIG. 1.

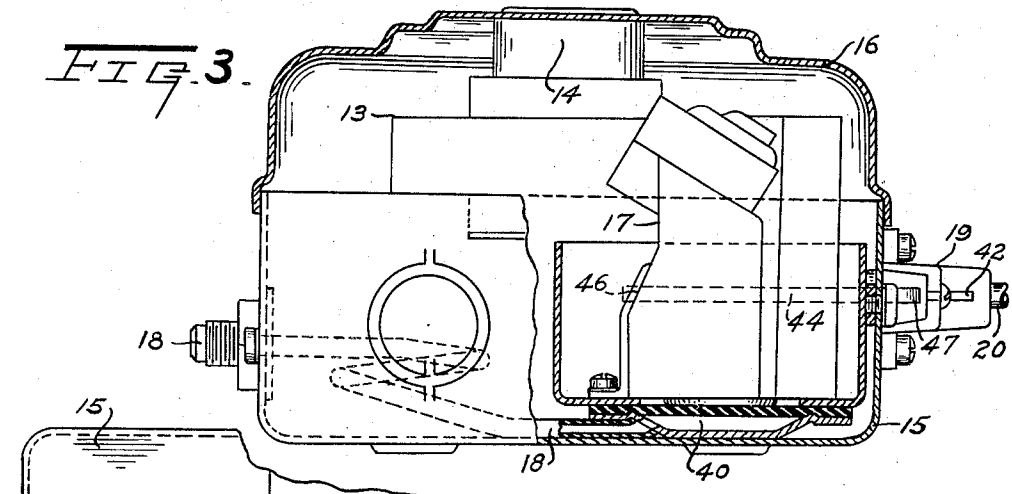
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FIG. 3.



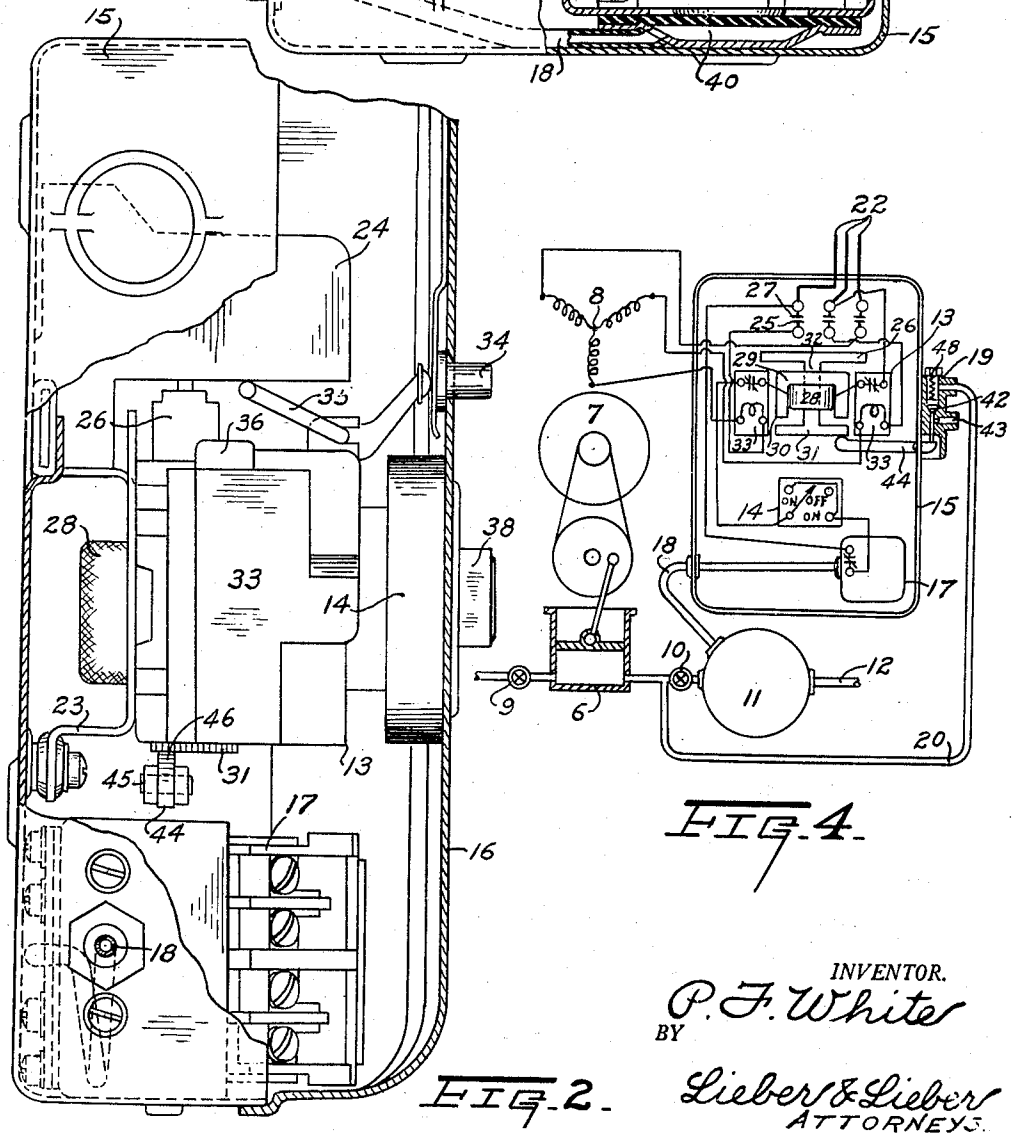


FIG. 4.

FIG. 2.

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MAGNETICALLY ACTUATED SWITCH AND COMPRESSOR UNLOADER

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Application August 31, 1953, Serial No. 377,539

1 Claim. (Cl. 200—52)

The present invention relates in general to improvements in the art of regulating the operation of electrically controlled fluid pressure generating systems, and relates more specifically to improvements in the construction and operation of a combined electro-magnetically actuated switch and unloader for a fluid compressor which is controlled by the switch.

The primary object of my invention is to provide an improved magnetically actuated switch and compressor unloading unit which is simple and compact in construction and highly efficient in operation.

As shown in U. S. Patent No. 2,193,126, granted March 12, 1940, and in U. S. Patent No. 2,600,618, granted June 17, 1952, it has heretofore been proposed to provide a fluid pressure actuated switch cooperating with a special electro-magnet to automatically unload a motor driven compressor adapted to supply a system with compressed fluid, whenever the pressure in the receiver or storage tank of the system reaches a predetermined value. With these prior switch and magnet assemblages it was also necessary to provide a starter switch for the compressor propelling motor, and when the starter used was of the magnetically actuated type it introduced several electro-magnets in the system with considerable complication and added expense. I have found that by utilizing the armature of the magnetic starter switch to actuate the compressor unloading device, the construction of the pressure actuated switch for unloading the compressor can be greatly simplified and all of the various switches may be effectively housed within a single compact casing.

It is therefore an important object of the present invention to provide a combined magnetic starter and pressure switch for effectively controlling the operation of a motor driven compressor while supplying air or other fluid under pressure to a fluid pressure system.

Another important object of this invention is to provide a reliable but simplified motor compressor control unit adapted to be housed and confined within a compact casing and to be readily installed and manipulated so as to insure most efficient operation of the compressor.

A further important object of the invention is to provide an improved and reliable motor control system comprising a motor driven compressor, a magnetic starter for the compressor driving motor, and a fluid pressure unloading device for the compressor, wherein the movable armature of the magnetic starter serves to also actuate the unloader of the compressor whenever the desired limiting pressures are attained in the fluid pressure system supplied by the compressor.

These and other more specific objects and advantages of the invention will be apparent from the following detailed description from which it will be noted that the gist of my invention is the provision of a fluid pressure supply system wherein the compressed fluid is supplied by an electric motor driven compressor having a magnetic starter provided with a movable armature which performs the dual function of actuating both the starter and the compressor unloading device, while the low and high fluid pressure ranges are controlled by a simple pressure actuated switch confined within the same casing in which the starter is housed.

A clear conception of the features constituting the present improvement, and of the construction and operation of a typical commercial fluid pressure supply system embodying the invention, may be had by referring to the drawings accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

Fig. 1 is a front view of a magnetic starter and pressure switch having a portion of the housing cover broken away, and showing the movable armature of the starter solenoid in contact open position and cooperating with an unloading valve to unload the compressor with which the valve is associated;

Fig. 2 is a side view of the starter and pressure switch of the assemblage shown in Fig. 1, a portion of the side wall of the housing casing and cover having been broken away to more clearly reveal normally concealed parts;

Fig. 3 is a bottom view of the same switch unit with a portion of the lower casing wall broken away, and a section through the housing cover and pressure switch having been taken along the line **3—3** of Fig. 1; and

Fig. 4 is a diagram of the entire fluid pressure generating system showing the electric motor driven compressor, the compressed fluid receiver, the improved control unit and the electrical connections associated with the various switches.

While the improvement has been shown and described herein as embodying a gravity actuated magnetic starter of the general type shown and described in the U. S. Patent No. 2,649,521, granted August 18, 1953, and a single pole double throw manual control switch for the starter such as shown in U. S. Patent No. 2,620,409, granted December 2, 1952, it is not my desire or intent to unnecessarily limit the invention by virtue of such embodiment of specific devices; and it is also contemplated that specific descriptive terms used herein be given the broadest possible interpretation consistent with the disclosure.

Referring especially to Fig. 4 of the drawing, the fluid pressure generating and supply system shown diagrammatically therein, comprises in general, a compressor **6** operable by an electric motor **7** having energizing windings **8**, the compressor having the usual inlet and outlet valves **9**, **10** respectively; a storage chamber or receiver **11** communicable with the compressor **6** only past the discharge valve **10** and having an outlet connection **12** leading to a source of fluid pressure utilization; a magnetic starter **13** for the motor **7** manually controllable by a rotary switch **14** and both normally confined within a casing **15** having a removable closure cover **16**; a fluid pressure actuated switch **17** also housed within the casing **15** and having a connection **18** in open communication with the receiver **11**; and an unloading device **19** for the compressor **6** mounted externally on a side wall of the casing **15** and having a connection **20** communicating with the compressor **6** in advance of the discharge valve **10**.

The compressor **6** and propelling motor **7** as well as the receiver **11**, may all be of any suitable and well known type having ample capacity for the service to be performed; but as shown in the diagram the motor **7** is of the three-phase alternating current type operable from a main power line **22**. The magnetic starter **13** is preferably of the type shown in the Cobb and Furnas Patent No. 2,649,521, granted August 18, 1953, and comprises in general a mounting frame **23** detachably suspended within the upper portion of the casing **15** and having thereon a terminal board **24**; three or more movable contacts **25** carried by a transverse bar **26** and being simul-

taneously cooperable with fixed contacts 27 secured within the terminal board 24; an electro-magnet mounted upon the frame 23 and having an energizing coil 28 confined within an inverted U-shaped field piece 29 provided with lower poles 30, and also having an inverted T-shaped armature 31 provided with an upright stem 32 firmly secured to the movable contact carrier bar 26 and slidable through the upper bridge portion of the field piece 29; a thermal overload relay 33 fastened to the frame 23 on each of the opposite sides of the electro-magnet; and a reset button 34 slidably confined within the housing cover 16 and being cooperable through a pivoted yoke 35 with the upwardly protruding reset plungers 36 of the relays 33 and with front projections 37 on the bar 26 to simultaneously lower the movable contacts 25 into open position and to re-establish electric circuits which may have been interrupted by the relays.

The armature of the electro-magnet is adapted to be attracted and moved upwardly by the poles 30 of the field piece 29 whenever the latter is energized by the winding of the coil 28 so as to cause the movable contacts 25 to engage the fixed contacts 27, and drops by gravity whenever the coil 28 is de-energized either by the manual control switch 14 or by the pressure switch 17. The starter switch 14 which is also mounted upon the frame 23 between the relays 33 and which may be of the three phase type shown in the Cobb and Furnas Patent No. 2,620,409, granted December 2, 1952, or of the single or two phase type, has an actuating knob 38 which is accessible through the housing cover 16 and may be set to either de-energize the magnet coil 28, or to effect automatic energization of the coil under the influence of other apparatus such as the pressure switch 17.

The fluid pressure actuated switch 17 which is housed within the lower portion of the casing 15 beneath the starter switch 13 and which has a diaphragm chamber 40 constantly in open communication with the receiver 11 through the pipe connection 18, may be of the type shown in Figs. 1 to 4 inclusive of U. S. Patent No. 2,193,126 except that the connection 18 is preferably located at the side of the chamber 40 instead of centrally at the bottom of the pressure chamber. This change is desirable because the casing 15 is ordinarily suspended by its rear wall and the connection 18 may therefore be brought through a side casing wall as shown in Fig. 3. All of the switches 13, 14, 17 are thus housed and confined within the common casing 15 and cover 16 and one terminal of the pressure switch is connected to the main line 22 while another is connected to the switch 14 for automatic functioning of the pressure regulating switch 17. This switch 17 is readily adjustable to fix the high and low limits of the pressure range which it is desired to establish within the receiver 11, as fully described in the Patent No. 2,193,126, and requires no special electro-magnet since it does not control the operation of the unloading device 19.

The unloading device 19 which is fastened to the exterior of a side wall of the casing 15 and is connected to the displacement chamber of the compressor 6 by the pipe connection 20, has a spring pressed valve plunger 42 adapted to effect release of fluid to the atmosphere through an outlet 43 whenever the magnet coil 28 is de-energized and causes the pump 6 and motor 7 to stop, and such release of pressure from the pump displacement chamber is desirable whenever the selector switch 13 is opened, or the pressure switch opens, or the voltage source connected to line 22 fails. In order to insure such operation, a lever 44 having a medial fulcrum 45 and one end 46 disposed in the path of movement of the armature 31 while its opposite end 47 is cooperable with the lower end of the valve plunger 42, is provided, see Figs. 1 and 4. The unloading assemblage is therefore such that when the armature 31 drops by gravity to its lowermost position, the lever 44 will open the valve plunger 42 against the pressure exerted by the spring 48 and the pressure in the line 20; but as soon as the armature 31 is raised by energization of the coil 28, then the valve plunger 42 will close.

While the functioning of the improved magnetically actuated switch and compressor unloader should be quite apparent from the foregoing description of the details of construction, a short résumé of the operation will be given. The motor driven compressor 6 and the receiver 11 may obviously be located remote from the control unit comprising the switches 13, 14, 17 housed within the casing 15 and the unloading device 19, and upon removal of the casing cover 16 the various electrical connections may be readily made with the main power line 22 as illustrated in the wiring diagram of Fig. 4. The pressure switch 17 should be set to provide the fluid pressure range which it is desired to establish within the receiver 11, whereupon the knob 38 of the control switch 14 may either be thrown to the left or right viewed in Fig. 1 to effect automatic operation of the system, or to the "off" position to prevent the system from operating.

During normal automatic operation, after the switch 14 has been closed, the magnet coil 28 will be energized to cause the magnet field piece 29 to lift the armature 31 against the poles 30 and to permit the spring 48 to close the unloading valve plunger 42 thereby shutting off communication between the displacement chamber of the compressor 6 and the atmosphere through the connection 20 and outlet 43. The movable contacts 25 of the starter 13 will then be brought into engagement with the fixed contacts 27 thereby causing the motor 7 to operate the compressor 6 which will thereafter deliver fluid under pressure to the receiver 11 until the high limit of pressure as determined by the setting of the pressure switch 17 has been established. Upon attainment of such high pressure, the switch 17 will automatically open thereby breaking the electric circuit and causing the coil 28 and the magnet field piece 29 to be deenergized. The armature 31 will then drop by gravity and will simultaneously open the starter switch and cause the lever 44 to open the unloader 19. When the pressure in the receiver 11 drops to the low limit of pressure range as determined by the setting of the pressure switch 17, this switch will automatically close and will again energize the magnet coil 28 thereby promptly closing the unloader valve 19 and causing the compressor to again operate so as to deliver fluid under pressure to the receiver 11.

From the foregoing detailed description it will be apparent that the present invention in fact provides a simple but highly effective and reliable system for controlling the functioning of a motor driven compressor. The improved control switches 13, 14, 17 are all compactly housed within a common casing 15 the interior of which is freely accessible for the purpose of installing electrical connections and for adjustment purposes, upon removal of the cover 16, and the side mounting of the unloading valve 19 and opposite side entry of the pipe connection 18 permits the control unit to be suspended from a vertical support without obstruction. By utilizing the armature 31 of the magnetic starter 13 to actuate the unloading valve 19, the unit is not only simplified but rapid and reliable unloading of the compressor 6 is assured at all times, and a simple pressure switch may also be utilized to determine the limits of the fluid pressure range in the receiver 11. The invention has proven highly satisfactory in actual use and the system may be installed at moderate cost by utilizing commercially developed switches 13, 14, 17 such as described herein.

It should be understood that it is not desired to limit this invention to the exact details of construction or to the precise mode of operation of the several mechanisms herein shown and described, for various modifications within the scope of the appended claim may occur to persons skilled in the art.

I claim:

In a control switch and unloading valve assembly for an electric motor driven compressor, a housing, an automatic electromagnetic control switch for the compressor propelling motor confined within said housing and having a vertically reciprocable inverted T-shaped armature provided with a horizontal cross-bar cooperable with the poles of a magnet and which is movable upwardly against said poles by magnetic influence to operate the motor and downwardly away from said poles by gravity to stop the motor, an unloading valve for the compressor mounted upon said housing closely adjacent to said control switch and having a vertically reciprocable plunger provided with a laterally projecting lower end extending outwardly of said housing, and a lever having its medial portion pivotally secured to said housing and its opposite ends slidably cooperable with bottom surfaces of said armature cross-bar and said valve plunger projection respectively to transmit reciprocating motion from the armature to the unloading valve.

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