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3,235,683

AIR COMPRESSOR CONTROL MECHANISM

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3 Sheets-Sheet 1

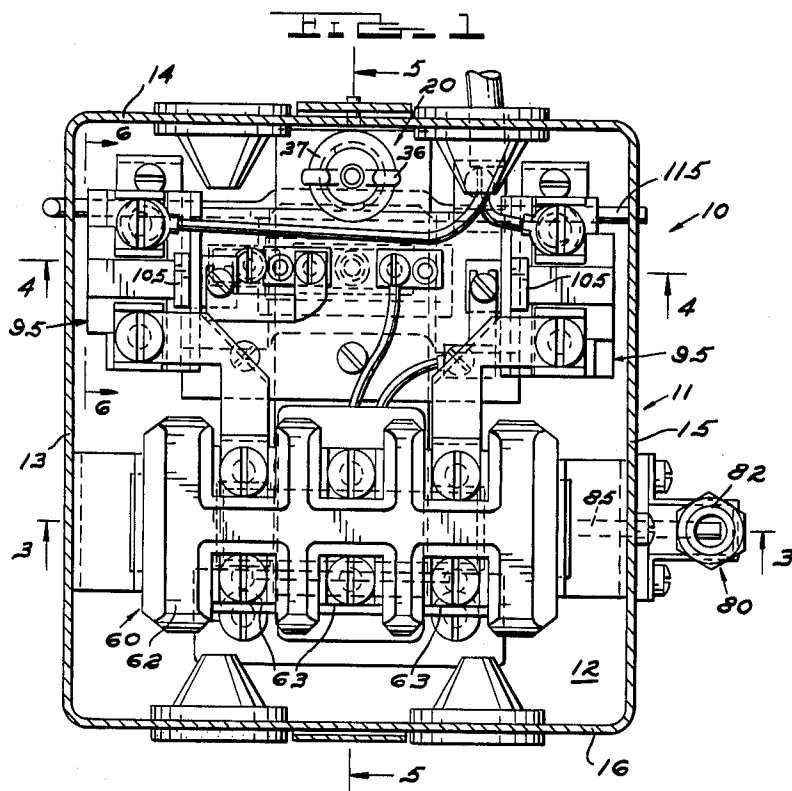
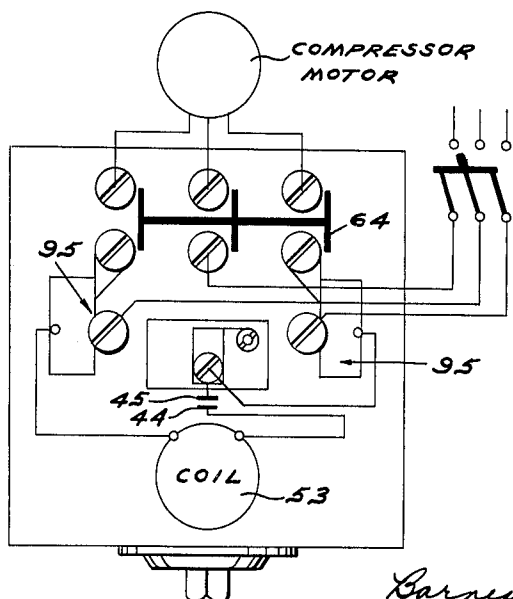


FIG. 1



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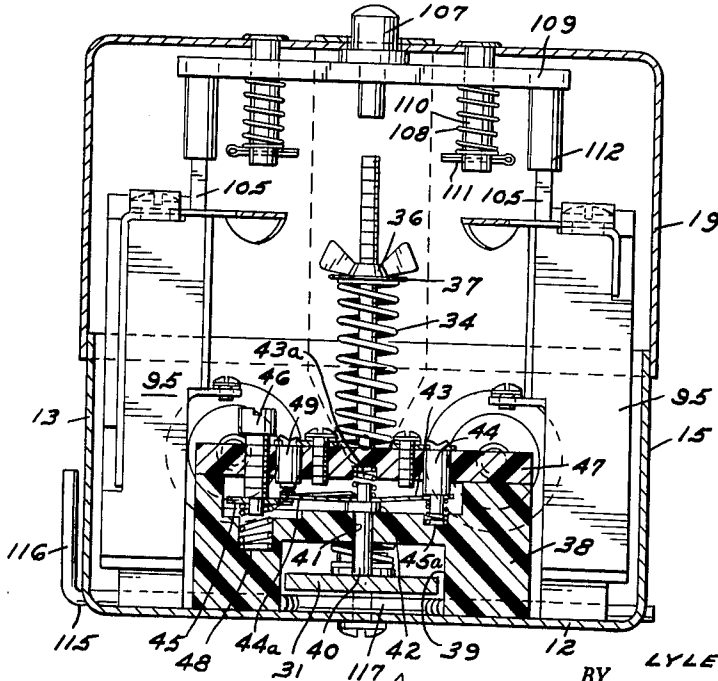
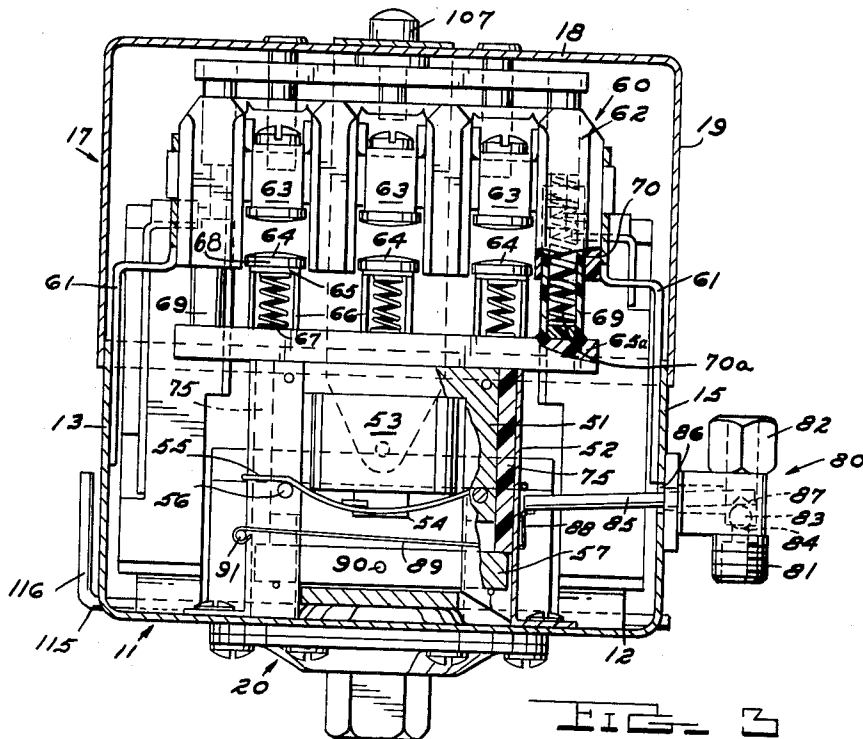
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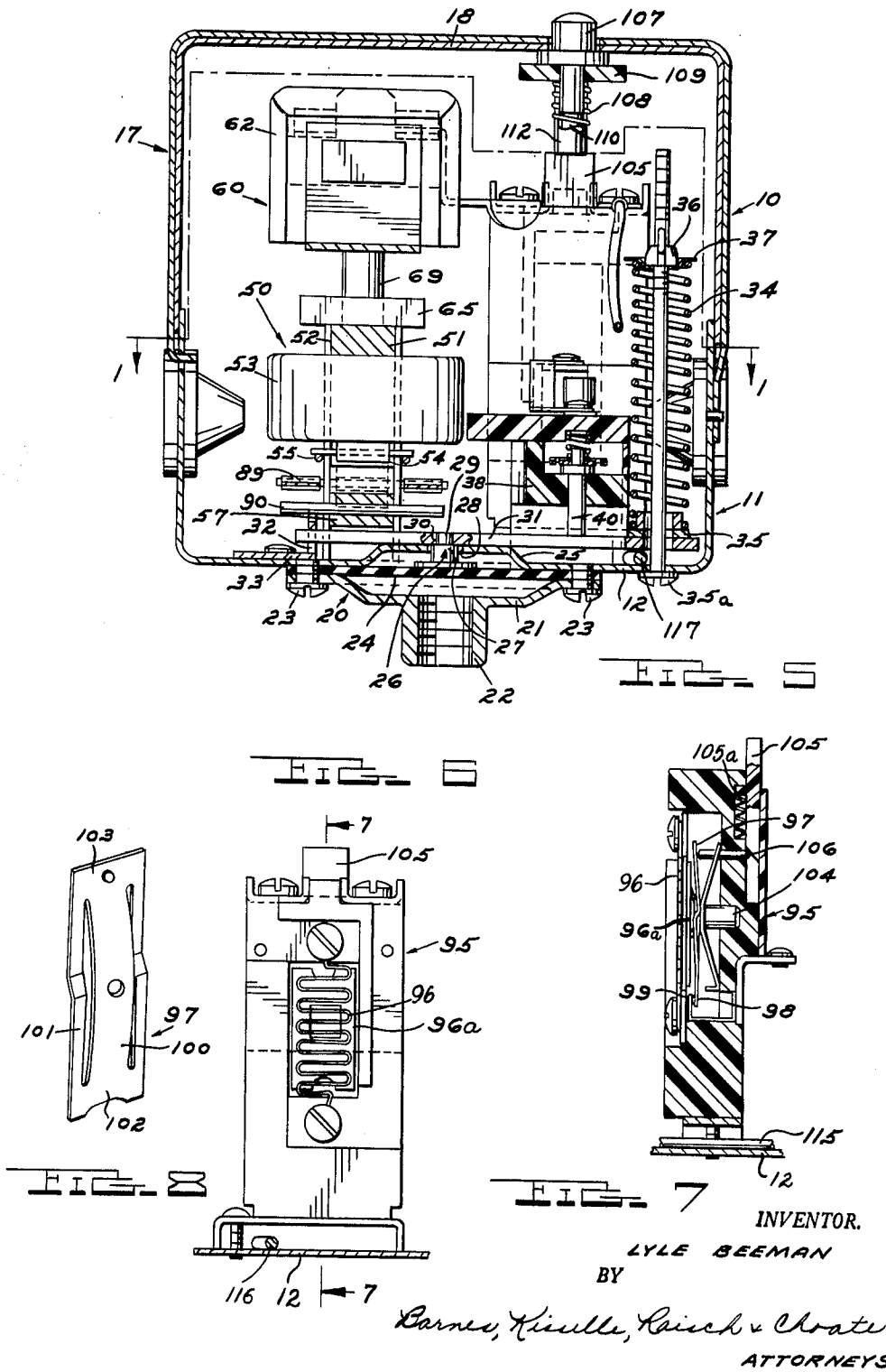
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AIR COMPRESSOR CONTROL MECHANISM

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5 Claims. (Cl. 200—52)

This invention relates to air compressors and particularly to control mechanisms for starting and stopping air compressors which are of the piston type.

In air compressors which are used for charging tanks or reservoirs from which the air is withdrawn for use, it is customary to provide a mechanism which is responsive to the pressure in the tank for starting and stopping the compressor. Such mechanism conventionally comprises a pressure switch of the mechanical type which is operated when the pressure from the tank drops to energize the magnet of an across-the-line starter which, in turn, closes the main switch to the electric motor that drives the compressor. In addition, where the compressors are of the piston type of a capacity of five to ten horsepower, it is desirable to vent the air remaining in the cylinders above the pistons when the compressor is stopped in order that the compressor will not have to be started against the load of the compressed air in the cylinders and therefore will be easier to start. It has heretofore been suggested that a mechanically operated pressure switch be used to control a magnetic unloader valve for this purpose. It can be appreciated that the apparatus described requires a multiplicity of units and is expensive.

It is an object of this invention to provide a single control mechanism which will start and stop the compressor, unload the compressed air in the cylinders when the compressor is stopped, and stop the operation of the compressor in the case of overload.

It is a further object of the invention to provide such a single control mechanism, all parts of which are within one housing.

It is a further object of the invention to provide such a control mechanism which utilizes a minimum number of parts and can be manufactured at low cost.

Basically, the single control mechanism comprises a housing on which a diaphragm type pressure operated switch is mounted so that it can be readily connected by a conduit to a tank or reservoir to which the air compressor is supplying air. The diaphragm type pressure switch controls the operation of a magnetic coil assembly which includes a movable armature that is adapted to actuate a motor power switch within the housing. When the coil is energized, the armature closes the motor power switch to operate the electric motor of the compressor. When the coil is de-energized, the armature moves into position opening the motor power switch. An unloader valve is mounted on the housing and is adapted to be connected to the ends of the cylinders above the pistons of the compressor. The unloader valve is mechanically connected to the armature so that when the armature moves upon energization of the coil, the unloader valve is closed and when the armature moves upon de-energization of the coil, the unloader valve is opened venting or unloading the air in the cylinders. In addition, the mechanism includes a thermal overload switch within the housing which is operatively connected to the contacts of the motor control switch. The switch is adapted to be reset by manual means in the housing projecting exteriorly of the housing. Finally, the mechanism includes an on-off mechanism which is adapted to lock the pressure operated switch in position such that the energization of the coil and, in turn, the motor power switch, is prevented and the unloader valve is in open or vent position.

In the drawings:

FIG. 1 is a sectional plan view of the mechanism em-

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bodily the invention taken substantially along the line 1—1 in FIG. 5.

FIG. 2 is a schematic block wiring diagram of the mechanism.

FIG. 3 is a sectional view taken along the line 3—3 in FIG. 1.

FIG. 4 is a sectional view taken along the line 4—4 in FIG. 1.

FIG. 5 is a sectional view taken along the line 5—5 in FIG. 1.

FIG. 6 is a fragmentary sectional view taken along the line 6—6 in FIG. 1.

FIG. 7 is a fragmentary sectional view taken along the line 7—7 in FIG. 6.

FIG. 8 is a perspective view of a part of the switch shown in FIGS. 6 and 7.

Referring to FIGS. 1, 3, 4 and 5, the control mechanism comprises a housing 10 that includes a first section 11 having a bottom wall 12 and side walls 13, 14, 15 and 16. Housing 10 includes a cover 17 that has a top wall 18 and side walls 19 that are partially telescoped over the side walls 13—16.

As shown in FIG. 1, a diaphragm operated pressure switch 20 is mounted on the bottom wall 12 adjacent side wall 14. As shown in FIG. 5, pressure switch 20 comprises an enclosure 21 including an integral nipple 22 for connection of a conduit to the tank or reservoir (not shown) which is supplied with air by the compressor (not shown). Enclosure 21 is mounted on the bottom wall 12 by screws 23 which clamp a flexible diaphragm 24 between the enclosure and the bottom wall 12. Bottom wall 12 includes an upwardly projecting depression 25 centrally located with respect to enclosure 21.

A button 26 is positioned on the diaphragm 24 and includes a central enlarged portion 27 that projects upwardly through an opening 28 in the portion 25. The upper end 29 of the button is of reduced cross section and extends into an opening 30 on a lever 31 that has one end thereof extending into a slot 32 of a bracket 33 fixed on the top surface of the bottom wall 12. The other end of the lever 31 is yieldingly urged downwardly by a spring 34 that engages a collar 35 mounted on the top surface of the lever 31. The compression on the spring 34 is maintained and adjusted by a bolt 35a which extends upwardly through an opening in the bottom wall 12 and through the spring 34 and a wing nut 36 is threaded on the upper end of the bolt and engages a washer 37 which is interposed between the wing nut 36 and the spring 34. By this arrangement, when the pressure in the tank of the compressor is high, the diaphragm 24 moves upwardly forcing the button 26 upwardly and swinging the lever 31, in turn, upwardly against the action of the spring 34.

As shown in FIGS. 4 and 5, a block 38 of dielectric material is provided on the bottom wall 12 and has a portion thereof cut away as at 39 to provide a space overlying a portion of the lever 31. A vertical pin 40 engages the top surface of the lever 31 and extends upwardly through an opening 41 in the portion of the block 38 that overlies the lever 31. The pin 40 extends through an opening in a leaf spring member 43 and has a shoulder 42 which engages the underside of the leaf member 43. A light spring 43a is interposed between the underside of a block 47, which overlies block 38, and leaf spring 43 and surrounds the upper end of pin 40 to yieldingly urge the center portion of leaf spring 43 downwardly. As further shown in FIG. 4, one end of the leaf spring 43 is held in position against a shoulder on a spacer 44 on block 47 by a light spring 45a that is interposed between leaf spring 43 and block 38 and surrounds the reduced lower end of the spacer 44. The other

end of the leaf spring 43 is provided with a contact 44a. The underside of the other end of leaf spring 43 engages a washer 45 on an adjustable stop 46 that is threaded through block 47 on block 38. A spring 48 yieldingly urges the washer 45 upwardly against a shoulder on stop 46 and thereby forms a stop for the other end of the leaf spring 43. Movable contact 44a on leaf spring 43 is adapted to engage contact 49 on the block 47. Contact 44a and contact 49 are adapted to be electrically connected to the magnetic coil as presently described.

When the lever 31 is moved upwardly by increased pressure on a diaphragm 24, the central portion of the leaf spring 43 is also moved upwardly causing the leaf spring to snap from a downwardly bowed position into an upwardly bowed position to move the contact 44a out of engagement with the contact 49. In this position, the position of the washer 45 determines the distance that the contact 44a must travel before contact is again made. In this manner, the pressure at which the switch closes is determined.

The pressure operated switch upon closing energizes a magnetic coil assembly 50 (FIGS. 3 and 5). The assembly includes an armature 51 that is mounted in a casing 52 and a coil 53 that is supported on the center post 54 of the armature by a wire clip 55 that is interposed between the coil 53 and projections 56 on the exterior of the casing. The assembly also includes an armature 57 adjacent the lower end of the coil 53 which is adapted to be moved upwardly when the coil 53 is energized.

The armature is adapted to open and close the contacts of a motor power switch 60 which is, in turn, mounted within the housing on brackets 61 (FIG. 3). The switch includes a block 62 of dielectric material that supports fixed contacts 63 and movable contacts 64 that are mounted on a plate 65 of dielectric material. Each movable contact 64 is fixed to a lever 65a which, in turn, is reciprocable between walls 66 and is yieldingly urged upwardly by spring 67. Inwardly extending projections 68 on the wall 66 limit the upward movement of the contacts 64. The movement of the dielectric plate 65 upwardly and downwardly relative to the block 62 of the switch is guided by integral hollow pins 69 that are telescoped into openings 70 in the block. Springs 70a are interposed between the bases of openings 70 and hollow pins 69 and yieldingly urge plate 65 and contacts 64 downwardly.

The movement of the armature 57 is transmitted to the plate 65 in order to close the contacts 63, 64 by thrust members 75 of dielectric material which are interposed between the core 51 and the casing 52 and extend between the underside of the plate 65 and the top side of the armature 57. When the coil is energized by closing of the diaphragm operated pressure switch, the armature 57 moves upwardly and forces the thrust members 75 against the plate 65, moving the plate 65 upwardly against the action of springs 70a and closing the contacts 63, 64. When the coil 53 is de-energized, the armature 57 drops downwardly and the plate 65 is moved downwardly by springs 70a carrying the contacts 64 out of contact with the fixed contacts 63.

The movement of the armature 57 into and out of closing position is also utilized to control the operation of an unloading valve 80 which is mounted on the wall 15 of the casing (FIGS. 1 and 3). Valve 80 includes an inlet 81 that is adapted to be connected to the cylinder head of the compressor and an outlet 82 that is vented to the atmosphere. A ball 83 is adapted to engage a seat 84 to close the vent when the compressor is being operated. The seating of the ball 83 is controlled by a rod 85 that is pivoted in an opening 86 in the wall 15 of the casing. One end of the rod extends through the body of valve 80 and is provided with a depression 87 for engaging the top surface of the ball 83. The other end of the rod 85 is adapted to be engaged by a flange

88 of a bifurcated element 89, the free ends of which are pivoted by a pin 91 to the casing 52. Element 89 is made of spring material. When the coil 53 is energized to close the contacts 63, 64 and start the compressor, during the upward movement of the armature 57 the rod 85 is first pivoted to close the valve 83 and the contacts 63, 64 are then closed. The resiliency of the element 89 provides sufficient overtravel to permit the closing of valve 83 before the closing of contacts 63, 64. The movement of the element 89 is achieved by contact of projections 90 on the armature 57 with the legs of the element 89.

The control mechanism includes, in addition, thermal overload switches 95 which are mounted on the bottom wall 12. Each overload switch includes a resistor 96 which is electrically connected to the contacts 63 so that any excessive load on the compressor causes an immediate heating of resistor 96 in the thermal overload switch 95 which, in turn, actuates a bi-metallic element 97 and moves contact 98 on element 97 out of contact with a fixed contact 99 to open the line to the contacts 63. Each bi-metallic element 97 is of the snap-over type as shown in FIG. 8 and comprises a bowed central portion 100 and spaced leg portions 101 connected by transverse end portions 102, 103. The spaced leg portions 101 are bent intermediate their ends. Element 97 is mounted on switch 95 by a rivet 104 and is normally bowed outwardly away from the resistor 96 at ambient temperatures. In order to control the sensitivity of the element 97, a shield 96a of copper or material having a similar high heat conductivity is mounted on the end of the rivet 104 between the element 97 and the resistor 96. By varying the size of the resistor 96, the switch can be accommodated to compressors of different sizes. For larger compressors, resistor 96 is of greater capacity, that is, cross sectional size. Shield 96a prevents surges of heat, such as from momentary overloads, from activating bi-metallic element 97 causing erratic action of the switch since it must first be heated up before heat will pass directly to element 97.

The switches 95 are such that they must be reset once opened and this achieved by reset members 105 which are adapted to be pushed downwardly on pins 106 for resetting the overload switches. The lower end of each reset member 105 is beveled so that when the member 105 is pushed downwardly it engages the end of the pin 106 which has been moved laterally by the snap-over action of the element 97. This forces the pin 106 to the left as shown in FIG. 7 returning the snap-over element 97 to its original position. The element 97 will only remain in its normally bowed position if the temperature of the resistor 96 has been reduced below the predetermined value. A coil spring 105a is interposed between a projection on reset member 105 and the body of switch 95 and yieldingly urges element 105 upwardly.

As shown in FIGS. 4 and 5, the reset members 105 of switches 95 are adapted to be simultaneously actuated. A plate 109 of insulating material is mounted for movement upwardly and downwardly on pins 110 fixed to the underside of the top wall 18 of the cover. Plate 109 is yieldingly urged upwardly by springs 108 that are interposed between the underside of the plate 109 and cotter pins 111 on pins 110. A button 107 on plate 109 extends upwardly through the top wall 18 of the housing. When button 107 is depressed, pins 112 on the underside of plate 109 engage the upper ends of the reset members 105. When the button is released, the springs 108 urge the plate 109 upwardly permitting the pins 106 to cam the reset members 105 upwardly (FIG. 7).

FIG. 2 is a diagrammatic representation of the wiring diagram of the control mechanism. In this figure, corresponding numbers have been used for purposes of simplicity and clarity.

In order to lock the pressure operated switch in position such that energization of the coil is prevented and the

unloader valve is in open or vent position, a rod 115 is provided that extends horizontally through aligned opening in walls 13, 15 (FIG. 4). Rod 115 includes a bent end 116 forming a hand lever. An intermediate portion 117 of rod is bent out of alignment with the holes in openings in walls 13, 15 so that when the rod is rotated by bringing the hand lever 116 into a horizontal position lever 31 is moved upwardly moving contact 44a out of engagement with contact 49. This prevents coil 53 from becoming energized and, in turn, prevents the motor power switch 60 from closing. At the same time, lever 85 is not moved upwardly so the valve 80 is kept open.

It can thus be seen that there has been provided a single control mechanism which will start and stop the compressor, unload the cylinder head when the compressor is stopped, and stop the operation of the compressor in the case of overload. The single control mechanism contains all the parts within one housing and utilizes a minimum number of parts so that it can be manufactured at low cost.

I claim:

1. In an air compressor switch, the combination comprising a housing, said housing having a wall with an opening therein, a diaphragm type pressure operated switch positioned within said housing with a diaphragm thereof adjacent said opening, said switch being opened when the pressure thereon exceeds a predetermined limit and being closed when the pressure thereon falls below a predetermined limit, a magnetic coil electrically connected to said switch and energized by the closing of said switch, said coil having a movable armature, an unloader valve mounted on said housing and having an inlet adapted to be connected to a head end of cylinders of a compressor and an outlet connected to the atmosphere, means in said valve for opening and closing said valve, and means mechanically connecting said last-mentioned means to said armature such that said valve is positively closed by said last-mentioned means when the armature is energized and when the armature is de-energized said valve is free to open, said unloader valve comprising a ball, a seat for said ball, said means mechanically connecting said valve and said armature comprising a lever pivoted in the wall of said casing and having one end thereof engaging said ball and urging it into its seat and a bifurcated spring element having one end thereof in contact with the other end of said lever, and the other end thereof pivoted to said housing, said spring element being engaged by said armature when the coil is energized to pivot the lever into position urging the ball against itself.

2. In an air compressor switch, the combination comprising a housing, said housing having a wall with an opening therein, a diaphragm type pressure operated switch positioned within said housing with a diaphragm thereof adjacent said opening, said switch being opened when the pressure thereon exceeds a predetermined limit and being closed when the pressure thereon falls below a predetermined limit, a magnetic coil electrically connected to said switch and energized by the closing of said switch, said coil having a movable armature, an unloader valve mounted on said housing and having an inlet adapted to be connected to a head end of cylinders of a compressor and an outlet connected to the atmosphere, means in said valve for opening and closing said valve, and means mechanically connecting said last-mentioned means to said armature such that said valve is positively closed by said last-mentioned means when the armature is energized and when the armature is de-energized said valve

is free to open, and means for locking said pressure operated switch in position such that energization of the coil is prevented.

3. In an air compressor switch, the combination comprising a housing, said housing having a wall with an opening therein, a diaphragm type pressure operated switch positioned within said housing with a diaphragm thereof adjacent said opening, said switch being opened when the pressure thereon exceeds a predetermined limit and being closed when the pressure thereon falls below a predetermined limit, a magnetic coil electrically connected to said switch and energized by the closing of said switch, said coil having a movable armature, a motor power switch, said motor power switch comprising a bar having a plurality of yieldable contacts, a plurality of fixed contacts associated with said yieldable contacts, means yieldingly urging said bar in a direction to hold said movable contacts out of closed position, means mechanically connecting said movable armature to said bar whereby when the coil is energized said bar is moved to move the yieldable contacts into contact with said fixed contacts of said motor power switch against said yieldable means, an unloader valve mounted on said housing and having an inlet adapted to be connected to a head end of cylinders of a compressor and an outlet connected to the atmosphere, means in said valve for opening and closing said valve, and means mechanically connecting said last-mentioned means to said armature to close said valve by said last-mentioned means before said movable contacts contact said fixed contacts when said coil is energized and to open said valve when said coil is de-energized such that said compressor switch can be operated in any position of said housing, and a thermal overload switch mounted in said housing in series with the fixed contacts of said motor switch, said switch comprising a resistor connected to the fixed contacts, a bi-metallic element positioned adjacent said resistor, said element being of the snap-over type and being normally bowed in one direction and movable into a reversely bowed position when heated to a predetermined temperature, a contact on said bi-metallic element, a fixed contact associated with said contact on said element, and reset means extending through said housing adapted to return the bi-metallic element to its original position.

4. The combination set forth in claim 3 including a shield interposed between the resistor and the bi-metallic element.

5. The combination set forth in claim 4 including a single support on which said bi-metallic element and said shield are centrally mounted.

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