Dec. 29, 1931. H. KERSHAW 1,838,228

COMBINED AUTOMATIC UNLOADER PILOT AND SWITCH

Filed April 23, 1929 2 Sheets-Sheet 1

Fig. 1.

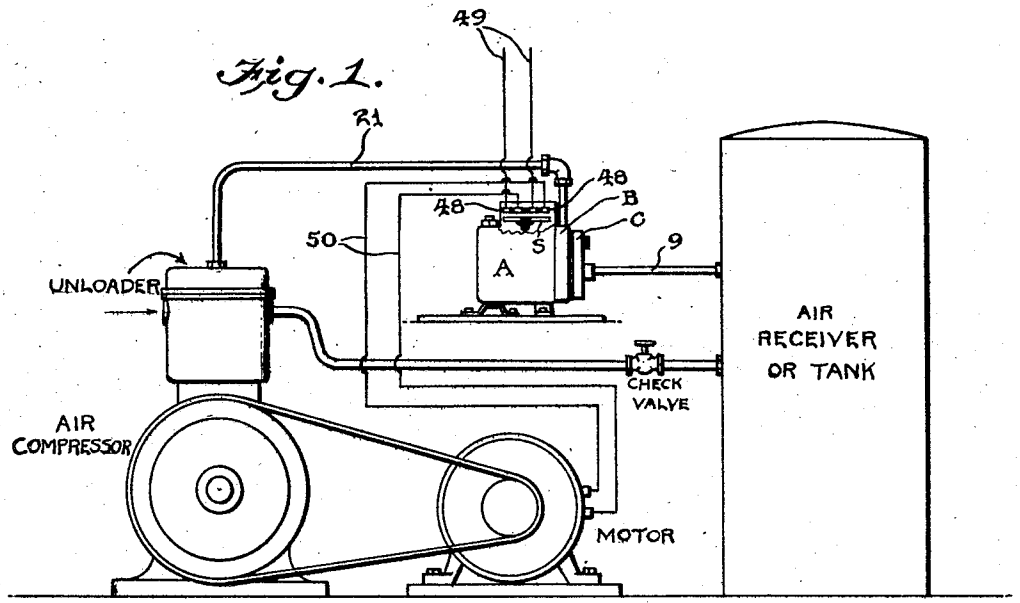


Fig. 4.

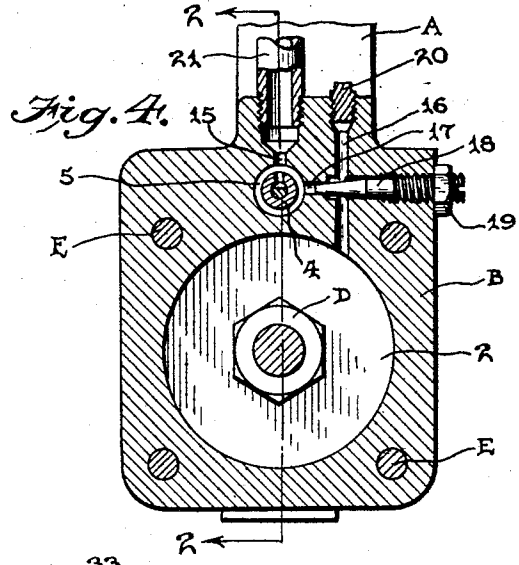
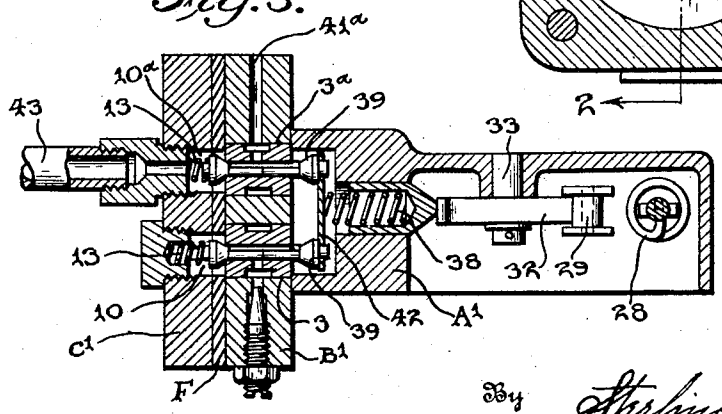


Fig. 5.



Inventor
Harold Kershaw,

By Sterling P. Buck,
Attorney.

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Fig. 2.

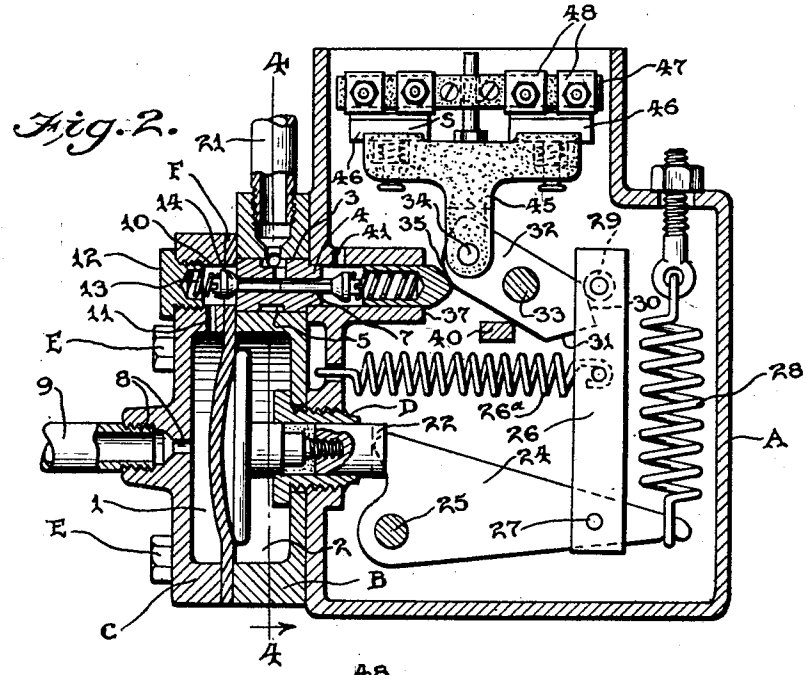
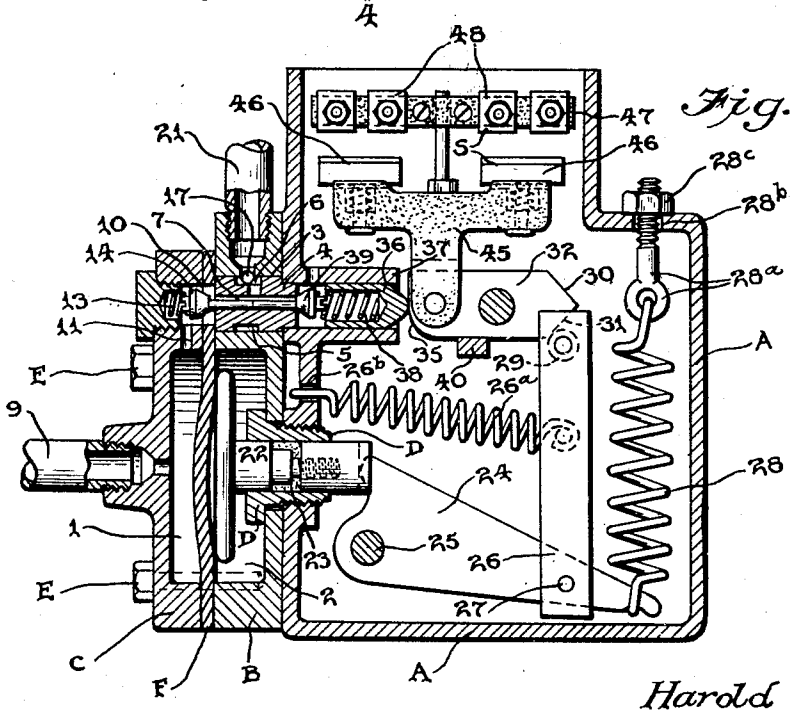


Fig. 3.



Inventor,
Harold Kershaw.

By Sterling P. Buck,
Attorney.

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UNITED STATES PATENT OFFICE

HAROLD KERSHAW, OF QUINCY, ILLINOIS

COMBINED AUTOMATIC UNLOADER PILOT AND SWITCH

Application filed April 23, 1929. Serial No. 357,558.

This invention relates to automatic controlling devices for compressors of air or other fluids, and especially to a combined automatic unloader pilot and switch.

One object of the invention is to provide an improved device which automatically stops or decreases the electro-motive power whenever a predetermined maximum pressure of the fluid is reached, and which automatically restores or increases the electro-motive power whenever the pressure of the fluid falls to a predetermined minimum, thereby maintaining an approximately uniform pressure at all times when the adjustment is unchanged.

Another object is to provide an improved combination of this character which is exceedingly quick and positive in its operations of controlling the electro-motive power, and also in diminishing the fluid pressure to a predetermined normal.

Other objects and important features are pointed out or implied in the following details of description, in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic view showing the application of my invention in connection with a compressor provided with an unloader, an electric motor to operate the compressor, a fluid receiver or pressure tank, and the necessary electric connections and fluid-pipes.

Figure 2 is a vertical sectional view substantially on the line 2—2 of Figure 4.

Figure 3 is a view similar to Figure 2, but showing the working parts in positions differing from Figure 2.

Figure 4 is a vertical sectional view along the line 4—4 of Figure 2.

Figure 5 is a horizontal sectional view through a somewhat modified form of the invention.

Referring to these drawings in detail, in which similar reference characters refer to similar parts in Figures 1 to 4, inclusive, the details of the invention will now be described as follows:

The main frame or casing includes three separable castings or parts A, B and C. The parts A and B are secured together by means of a headed and screw-threaded member D which also constitutes a tubular bearing. The parts B and C are secured together by means of bolts or screws E.

A diaphragm F is clamped between the parts B and C, so these parts form separate fluid pressure chambers 1 and 2. The part B is bored at 3 to form a seat for a valve-seat member 4 which is peripherally recessed at 5, radially apertured at 6, and axially bored at 7. The valve-seat member 4 is tightly fitted in the bore 3, and clamped between the member A and the diaphragm F, so it cannot move from the effective position shown.

The member C is provided with an inlet opening 8 which is provided with screw threads for engagement with a pipe 9 through which the chamber 1 is in open communication with the air receiver or pressure-tank, as shown in Figure 1. The member C is also provided with a bore 10 and with an outlet opening 11, the latter establishing an open communication between the bore 10 and the chamber 1. The outer end of the bore 10 is closed by a removable plug 12 which also constitutes a spring seat against which a compression spring 13 is seated for holding a valve-member 14 yieldingly seated against the valve-member 4 so as to normally close the bore 7.

The member B is provided with openings or passages 15, 16 and 17, the latter being provided with a needle valve 18 which is screw-threaded into the member B and provided with a lock-nut 19 for holding it in its different adjusted positions. By means of this needle valve, the opening 17 can be choked or unchoked to the desired extent. The passage 17 is in open communication with the bore 5 and with the bore or passage 16, while the latter is in open communication with the pressure chamber 2, and has its outer end plugged, as shown at 20 in Figure 4. The opening or bore 15 is in screw-threaded engagement with a pipe 21 which connects to the unloader (Figure 1) and is in open communication therewith, so compressed fluid passes from air receiver to the unloader only when the pressure in chamber 1 reaches its predetermined maximum and

after deflecting the diaphragm F against the head of a plunger 22 which extends through the member D and is provided with an air-tight packing 23. Air from the receiver passes through the pipe 9, chamber 1, valve-member 4 and pipe 21, to the unloader.

The plunger 22 bears against a short arm of a lever 24 which is pivoted at 25 and transmits motion to a link 26 to which it is pivoted at 27. The long arm of the lever 24 extends horizontally past the pivot 27 and connects to one end of a retractile spring 28 which has its other end connected to an adjusting bolt 28*a*. This bolt 28*a* extends through an opening 28*b* in the top of the casing member A, and has a nut 28*c* for cooperation therewith in tensioning the spring 28. By means of this adjustment and tensioning of the spring 28, the maximum pressure of the fluid is determined, the minimum pressure being determined by adjustment of the needle valve 18.

The link 26 has its intermediate part connected to one end of a retractile spring 26*a* which has its other end anchored at 26*b*, and at its upper end, it carries a roller 29 which rests against upper and lower cams 30 and 31 of a lever 32 on an axle or pivot 33. This lever 32 has a pivot 34 at its end opposite to the cams 30 and 31, and it also has a cam surface or edge 35 substantially under the pivot 34. This cam edge 35 abuts against a plunger 36 which is slidable in a hollow boss 37 and constitutes a spring seat against which one end of a compression spring 38 is seated, while the other end of the compression spring bears against a valve member 39 which normally closes the bore 7 of the valve member 4. A fixed lug or stop 40 limits the downward movement of the cam edge 35 (as shown in Figure 3), while the upward movement of this cam edge is limited by the switch-members 45, 46, 47 and 48 (as shown in Figure 2). The hollow boss 37 is provided with a radial bore or outlet 41.

The operation of the device, as thus far described, will now be explained as follows:

When the predetermined maximum pressure causes the diaphragm F to press the plunger 22 inward, its power is transmitted to the lever 24, overcoming the elastic resistance of the springs 28 and 26*a*, and drawing the roller 29 down from the position shown in Figure 2 to that shown in Figure 3. Just before the roller 29 reaches its lowest position, it bears against the apex of the angle which forms the cam edges 30 and 31; and when its center passes slightly beyond said apex, it cooperates with the cam edge 31 for instantly moving the lever 32 from the position shown in Figure 2 to that shown in Figure 3. This operation of the lever 32 causes its cam edge 35 to depress the plunger 36, so the pressure of the spring 38 is increased and overcomes the pressure of the spring 13, in consequence of the ends of the valve-members 14 and 39 abutting against one another; so these valve-members move as a unit, and the bore 7 is closed by the valve-member 39 while the valve-member 14 moves away from the bore 7. This relation of the valve-members is clearly shown in Figure 3, and it will be seen that the fluid flows from the pressure chamber 1 through the openings 11, 10, 7, 6, 5 and 15 into pipe 21 and to the unloader. At the same time pressure is also admitted to secondary chamber 2, through openings 17 and 16, but is restricted by needle valve 18, in order to assist the power of the spring 28 to balance the gradually reducing pressure in chamber 1. The adjustment of needle valve 18 determines this minimum pressure which permits the spring 28 to automatically return the lever 24 to the normal position shown in Figure 2. In returning to the normal or upper position, the lever 24 and link 26 cause the roller 29 to pass upward over the apex of the cam edges 30 and 31; and when it reaches the cam edge 30, the spring 26*a* causes the roller 29 and cam edge 30 to cooperate in moving the lever 32 to the position shown in Figure 2, wherein the cam edge 35 permits the pressure of the spring 13 to return the valve members 14 and 39 to the position shown in Figure 2. When the valve members are in this position, the fluid pressure is released from the unloader and passes through pipe 21, and openings 5, 6 and 7 and out to atmosphere through outlet 41. Pressure is simultaneously released from counter chamber 2 by escaping to atmosphere through opening 16, past the valve 18, and thence through openings 17 and 41. From the foregoing explanation of the operation, it will be seen that by adjusting needle valve 18 the pressure entering the secondary chamber 2 can be made to either maintain a constant pressure in the air receiver or vary the differential between wide limits very quickly and effectively as may be desired.

Referring now to Figure 5, it will be seen that two sets of valves are provided, one valve of each set being connected by a bridge or plate 42, so the valves are operated in unison by their springs 13 and 38. In this figure, all parts are the same as those described where similar reference characters are used; but it may be seen that the parts B1 and C1 have additional bores 3*a* and 10*a*, respectively, and that the outlet opening or bore 41*a* is to release to atmosphere the pressure in the bleeder receiver, connected by pipe 43 to wall of the bore 10*a*. This bleeder receiver (not shown but well known) is sometimes used instead of a regular unloader and is for the purpose of relieving the compressor of load for a brief period of time when starting up by motor to allow full speed running before full load is reached. When this form is used, (Figure 5), pipe 21 is omitted and its

threaded connection plugged. Bore 41 then serves as a release for pressure from secondary chamber 2 only.

The chamber 1 is the primary pressure chamber, and the chamber 2 is the secondary pressure chamber, in all forms of the invention, except when used for vacuum operation with valves arranged as shown in Figures 5*a* and 6. Chamber 2 then becomes the primary, and chamber 1 becomes the secondary.

All forms of the invention may be used either in connection with an electric switch or independently thereof. Figure 1 shows the electric switch conventionally at S, while Figures 2 and 3 show it more in detail. An insulating member 45 is pivotally mounted on the cam-lever 32 and carries spring-pressed contacts 46. An insulating bar 47 is secured to the casing member A, and carries fixed contacts 48 which connect to the power line 49 and to the motor by means of wires 50, as shown in Figure 1.

From the foregoing description and explanation, it is evident that when the fluid pressure actuates the plunger 22 and the parts actuated thereby for reducing the fluid pressure, the same lever 32 that depresses the plunger 36 also lowers the switch members 45 and 46 and thereby opens the switch, so the motor stops actuating the pump or at least slows down, so the pressure very quickly reaches the predetermined minimum at which time the switch is again closed by the previously described operation of the lever 32.

Although I have described these embodiments of my invention specifically, it is not my intention to limit my patent protection to these exact details of construction and arrangement, for the invention is susceptible of various alternatives and modifications without departure from the inventive ideas as implied and claimed.

What I claim is:

1. In an unloader pilot, the combination of a casing including primary and secondary pressure chambers, a flexible diaphragm clamped between said chambers, a valve-member to establish and interrupt communication between said chambers, the primary chamber having an inlet for connection with the interior of a tank of compressed fluid, said secondary chamber having an outlet for expelling the compressed fluid therefrom, said secondary chamber having a fluid-tight bearing, a plunger in said bearing and operable by said diaphragm, and means operable by said plunger to actuate said valve-member, for the purpose specified.

2. In an unloader pilot, the combination of a casing including primary and secondary pressure chambers, a flexible diaphragm normally separating said chambers from communication with one another, a valve-member operable for establishing and interrupting communication between said primary and secondary chambers, means to communicate with a tank of compressed fluid and to introduce such compressed fluid into said primary chamber, said secondary chamber having a valved outlet for expelling the pressure fluid, said secondary chamber having a wall provided with a bearing, a plunger seated slidably in said bearing and operable by said diaphragm, a lever having cam-edges on one end and forming an apex, a roller, means operable by said plunger to move said roller over said apex and thereby quickly move said lever from one extreme position to the other extreme position, and means including a cam on said lever for operating said valve-member for the purpose specified.

3. The structure defined by claim 2, a compressor for introducing fluid into said tank and compressing it therein, an electric motor operatively connected to the compressor, and an electric circuit including a switch, said electric circuit being connected to said motor and connectible to a source of electromotive power, said switch being operatively connected to said lever so as to be opened and closed thereby, for the purposes specified.

4. In an unloader pilot, the combination of a casing including primary and secondary pressure chambers, a flexible diaphragm normally separating said chambers from communication with one another, said primary and secondary chambers being provided with a fluid-passage for establishing communication between them, a valve-member in said fluid-passage and normally closing the fluid-passage to prevent such communication between the chambers, said primary chamber being provided with an inlet for connection with a pressure tank so as to introduce compressed fluid into the primary chamber, said secondary chamber being provided with a passage for communication with an unloader of a compressor, said passage having an outlet for the discharge of fluid from said secondary chamber and from said unloader, said secondary chamber having a bearing through a wall thereof, a plunger slidable in said bearing and operable by pressure against said diaphragm, and means operable by said plunger to move said valve-member for permitting pressure fluid to pass from said primary chamber to said secondary chamber.

5. In an unloader pilot, the combination of three casing members, a diaphragm clamped between two of said casing members and separating them to provide a primary pressure chamber and a secondary pressure chamber, said primary and secondary chambers being provided with a fluid-passage for communication between them, a valve-member in said fluid-passage, the third casing member having a screw-threaded opening therethrough and having a tubular boss, a plunger slidable

in said tubular boss, a bearing member seated in said screw-threaded opening and extending into said secondary chamber and being effective to secure the secondary pressure chamber to said third casing member, a plunger slidable in said bearing and operable by said diaphragm under pressure of fluid in said primary pressure chamber, means operable by the second said plunger for depressing the first said plunger, and means operable by the first said plunger to move said valve-member for opening said passage.

6. In an unloader pilot, the combination of three casing members each having a bore, a diaphragm between two of said casing members and combining therewith to form a primary pressure chamber and a secondary pressure chamber, means securing said casing members together in such relation that the bore of each casing member is alined with the bore of the other casing members, a valve-seat-member fixed in the bore of the intermediate one of the three casing members, a valve-member, a spring in the bore of a second one of these casing members for causing said valve-member to close said valve-seat-member, a plunger in the bore of the third one of these casing members and operable to move said valve-member for opening said valve-seat-member, and means operable by said diaphragm for operating said plunger.

7. In an unloader pilot, the combination of three casing members each having a bore, a diaphragm between two of said casing members and combining therewith to form a primary pressure chamber and a secondary pressure chamber, the third casing member having a threaded opening, a combined securing member and plunger-bearing threaded in said opening and securing the third casing member to the said secondary pressure chamber in such relation that the bores of the three casing members are alined, a valve mechanism operable in these alined bores for establishing and interrupting communication between the primary and secondary pressure chambers, a plunger in said plunger-bearing and depressible by said diaphragm, and means operable by said plunger for actuating said valve mechanism.

8. In an electric switch operating mechanism, the combination with a switch including a movable switch member, of a pivotally mounted lever having the movable switch member pivoted thereon and having two meeting cam-edges forming an apex, a roller, a link on which the roller is pivoted, a spring combining with the link to hold said roller against said cam edges alternately, a lever to which said link is pivoted, means to move the lever in one direction, and a spring to move the lever in the opposite direction.

9. In a combined valve-operating and switch-operating mechanism, the combination with a valve and a switch each having a movable member, of a lever pivotally supported at a point between its ends and having a pivotal connection with the movable member of said switch and having cam-edges on its opposite ends, a plunger in position to be depressed by the cam-edge on one end of the lever and to actuate said movable member of the valve, a roller, a link carrying said roller, a spring combining with said link for holding the roller against the cam-edge of the other end of the lever, and means to move the link in such manner that the said roller and adjacent cam-edge cooperate in swinging said lever on its pivotal mounting and simultaneously actuating said movable members of the switch and valve.

In testimony whereof I affix my signature.

HAROLD KERSHAW.