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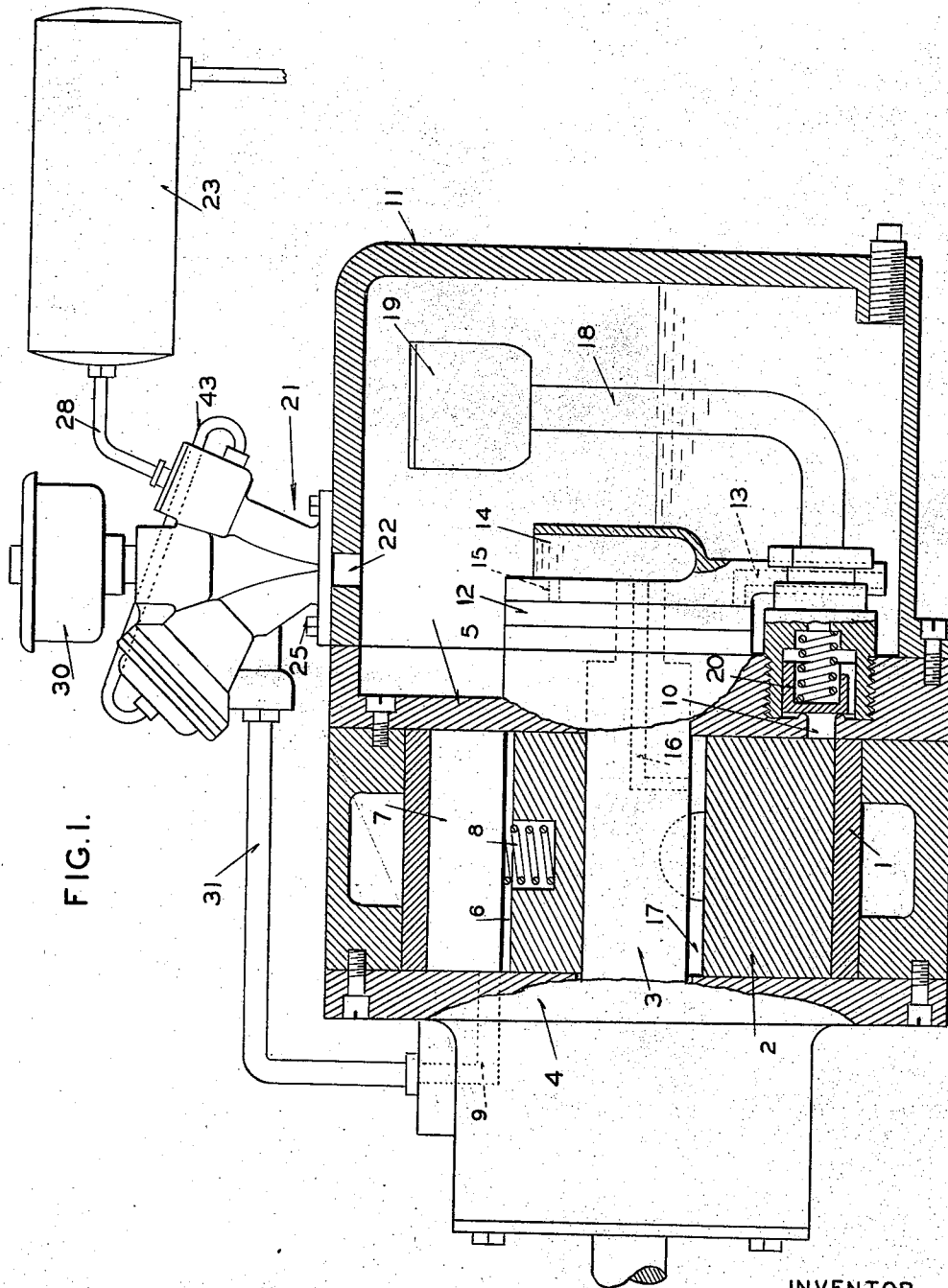
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COMPRESSOR UNLOADING VALVE MECHANISM

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2 Sheets-Sheet 1



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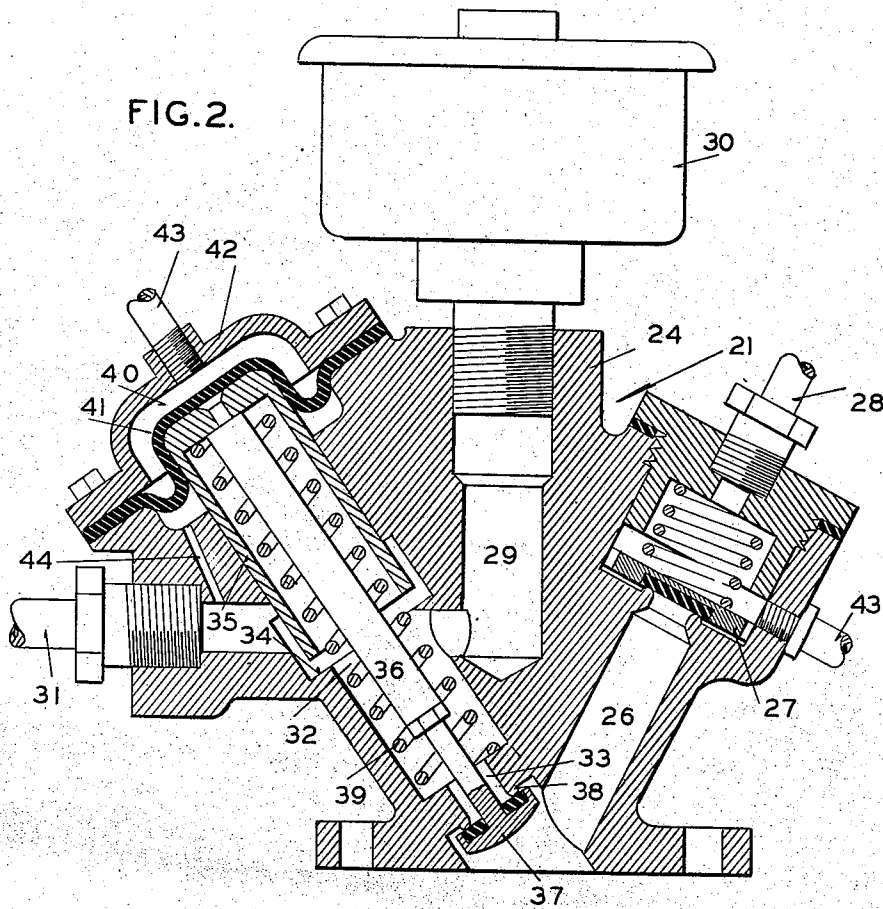
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2 Sheets-Sheet 2



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COMPRESSOR UNLOADING VALVE
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tion of Delaware

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10 Claims. (Cl. 230—30)

My invention relates to valve mechanism and more particularly to an unloading valve mechanism for a compressor.

One of the objects of my invention is to provide a valve mechanism for association with a fluid compressor which will so unload the compressor when a predetermined pressure is present in the receiver that the compressor will not discharge any compressed fluid against previously compressed fluid.

Another object of my invention is to provide a valve mechanism for unloading a compressor and also venting the oil reservoir or dome thereof containing the lubricant for the compressor and which is subject to the pressure of the discharged fluid from the compressor prior to its passage to the receiver or storage tank.

A more specific object of my invention is to provide a valve mechanism for association with an air compressor having an oil dome which will automatically close the intake to the compressor and vent the oil dome to atmosphere, said valve mechanism being operable by the fluid pressure created by the compressor and discharged through the oil dome to the storage tank and at the time when the fluid in said tank reaches a predetermined pressure.

Other objects of my invention will become apparent from the following description taken in connection with the accompanying drawings in which Figure 1 is a view, partly in section, of a compressor provided with an oil dome and having associated therewith my improved valve mechanism, and Figure 2 is a cross-sectional view of the valve mechanism.

Referring to the drawings in detail, the rotary compressor shown is of known construction and comprises a stator 1 having eccentrically mounted therein a rotor 2 secured to a drive shaft 3 journaled in the end plates 4 and 5. The rotor 2 is provided with a plurality of spaced slots 6 extending in an axial direction in which are mounted reciprocable blades 7 (one only being shown) biased outwardly into engagement with the inner surface of the stator by springs 8. The end plate 4 is provided with an intake passage 9 and the end plate 5 with an outlet passage 10. Secured to the end plate 5 is an oil reservoir or dome 11 which contains oil for the purpose of lubricating the compressor. In the construction shown the shaft 3 of the compressor drives an oil pump 12 to pump oil from the body of oil through passage 13 and discharge it into a well 14 through the opening 15. The oil in the well is free to flow through the passage 16 in

shaft 3 and then into the compressor by way of the keyway 17 to thus provide lubrication for the movable parts of the compressor. In order that the oil may be forced into the compressor under pressure during operation of the compressor, the body of oil in the oil dome is caused to be subject to the fluid under pressure discharged from the compressor. This is accomplished by having the discharge port 10 connected to a pipe 18 which extends above the oil line. An oil separator 19 removes any excess oil which may be discharged from the compressor together with the compressed air. The discharge port 10 has associated therewith a check valve 20 for preventing any of the compressed air from returning to the compressor.

In the type of compressor just described the compressor is generally automatically unloaded by shutting off the intake when the receiver for the compressed air discharged by the compressor reaches a predetermined value and again allowed to compress air when the compressed air in the receiver falls to a given pressure below the predetermined value. With such an arrangement it has been discovered that when the compressor is unloaded an excess amount of oil may be fed to the compressor and cause it to become "choked" because of the compressed air acting upon the oil and forcing it into the compressor. It has also been discovered that the shutting off of the compressor by closing the intake does not cause the compressor to run idle since the compressor still operates to compress air which may be partially discharged into the oil dome against the compressed air already therein or, if this is not accomplished due to insufficient air to compress, recirculated and recompressed continuously. By the compressor being partially under load and performing work, it will continue to generate heat and use power notwithstanding no additional compressed air is being added to the receiver. All of these undesirable operating features present when the compressor intake is shut off can be eliminated to a large extent by also unloading the oil dome at the same time the intake is shut off. With the air in the oil dome under atmospheric pressure, the oil forced into the compressor will be reduced and the air and oil being circulated in the compressor will be free to be discharged into the oil dome against atmospheric pressure instead of against compressed air. A superior operating compressor results which will require less power to operate when no air is required to be compressed. Also the compressor will operate at a much cooler

temperature, less oil will be used, and the life of the compressor extended.

In order that the compressor may be shut off and the fluid under pressure in the oil dome vented at the same time, I have associated with the compressor and oil dome a valve mechanism to accomplish this result, this valve mechanism being indicated by the numeral 21 and mounted on the dome at the outlet port 22 thereof through which the compressed fluid passes to the receiver or tank 23 where it can be used for any purpose desired. The valve mechanism shown in detail in Figure 2 comprises a valve casing 24 mounted upon the dome by bolts 25. The casing is provided with a passage 26 which has associated therewith a check valve 27 for permitting fluid from the oil dome outlet port to pass to the air tank 23 through the conduit 28 but preventing any fluid under pressure in the tank from returning to the oil dome.

The casing is also provided with a right angle passage 29 which is connected at one end to atmosphere through the air cleaner 30 and at the other end to the intake passage 9 of the compressor by a conduit 31. Intersecting the passage 19 at an angle thereto is a bore 32, the lower end of which communicates with the outlet port 22 of the oil dome by means of a passage 33. At the point of intersection between the passage 29 and the bore 32 there is provided a valve seat 34 and cooperating therewith is a cup-shaped valve element 35 slidable in the bore above the valve seat. The arrangement is such that when the cup-shaped valve element is seated, the conduit 31 is cut off from the atmosphere so that air cannot reach the intake passage of the compressor.

The valve element 35 carries a rod 36 which has secured to its lower end a valve element 37 for cooperation with a valve seat 38 surrounding the passage 33 whereby communication from the discharge port of the oil dome and the bore may be shut off. This valve element is normally biased to closed position by a spring 39 interposed between the cup-shaped valve element 35 and the bottom of the bore 32. The rod 36 is of such length that when the valve element 37 is seated, the cup-shaped valve element 35 will be disengaged from its seat 34 as shown in Figure 2. When the valve element 35 becomes seated, the valve element 37 will be unseated.

The upper end of the bore 32 has associated therewith a chamber 40 into which the closed end of the cup-shaped valve member 35 projects. A diaphragm 41 cooperates with the end of the valve element and is sealed to the casing by the cap 42. A conduit 43 connects the chamber 40 with the conduit 28 at a point between the check valve 27 and tank 23, thus subjecting the diaphragm 40 to the same fluid pressure which is present in the tank. The spring 39 for normally maintaining the valve 37 seated and the cup-shaped valve element 35 unseated is of such strength as to maintain the valves in this relation until a predetermined pressure is effective in the chamber 40 or, in other words, in the tank since this chamber is connected to the tank. In the construction shown, the spring is so designed that the valve element 35 will not be closed until the pressure in the air tank reaches one hundred pounds per square inch.

When the compressor is operating and the air in tank 23 is below the predetermined pressure of one hundred pounds per square inch, the parts of the valve mechanism will be as shown in Fig-

ure 2. Air will be free to enter the intake of the compressor by passing through the air cleaner 30, the passage 29 and conduit 31. The air compressed by the compressor will be forced out of the discharge port 10 past the check valve 20 and into the oil dome 11 through pipe 18 and oil separator 19. After the air enters the dome, it is free to pass out through port 22 through conduit 26 past the check valve 27 and into the receiver or tank 23. The pressure of the fluid in the top of the oil dome will be the same as that in the air tank and this air under pressure will act on the oil in the well 14 and force it through the channel 16 in the compressor to properly lubricate the working parts thereof.

When the compressor has operated sufficiently to raise the pressure of the air in the tank to the predetermined value of one hundred pounds per square inch, air under pressure will act with sufficient force on the diaphragm 41 in chamber 42 of the valve mechanism to force the cup-shaped valve element 35 downwardly against the action of the spring 39 and onto seat 34 to close off communication between the intake of the compressor and the atmosphere. Since the valve element 37 is connected to the cup-shaped valve element 35, the former will be simultaneously moved off seat 38 as the valve element 35 is seated. The seating of the valve element 35 and the moving of the valve element 37 to open position will be very rapid since once the valve element 37 is moved off its seat, the pressure of the air in the tank acting to keep it seated will be reduced to zero. In order that the valve element 35 may be held seated with a force in addition to that caused by the pressure of the tank, a passage 44 is provided which connects the space beneath the diaphragm 41 with the intake of the compressor. Thus, the suction at the intake caused by closing the valve element 35 will be effective on the diaphragm. When the valve element 37 has been unseated and the passage 33 is open, the air under pressure in the oil dome will be reduced to atmospheric pressure since it is now connected with the atmosphere through passage 29 and the air cleaner. The air under pressure in the tank will remain at the predetermined pressure of one hundred pounds per square inch as the check valve 37 will prevent any back flow of this air.

With the intake of the compressor now closed and the air in the oil dome at atmospheric pressure, the compressor will be substantially completely unloaded and there will be no super-atmospheric pressure acting on the oil in the well 14 to force oil rapidly into the compressor through channel 19 and thus the possibility of an excess amount of oil in the compressor will be substantially eliminated and the compressor will not be required to do an extra amount of work to force the oil back out into the oil dome. Any air which may remain in the compressor can be easily forced out through the check valve 20 since this check valve does not have to be open against any high pressures. The compressor will thus be substantially free of air and the opposite sides of the blades will not be subject to any substantial differential pressures. This will permit the rotor to be rotated with less power and since no compressing operation is taking place, the compressor operates at a much cooler temperature than it would otherwise. Tests have shown that when the air pressure in the oil dome has been reduced substantially to atmospheric pressure at the same time that the intake of the compressor is closed, 75

the operating temperature of the compressor will drop from a temperature of about one hundred and fifty degrees to around seventy degrees. This same compressor, if air in the oil dome is not vented to atmosphere when the intake of the compressor is shut off, will only drop to an operating temperature of around one hundred and twenty-five degrees, thus clearly showing the beneficial results obtained by the use of the improved valve mechanism with the compressor.

When air under pressure is used from the air tank 23 and the pressure therein falls to a lower value, as for example, around ninety pounds per square inch, the spring 39 acting on the cup-shaped valve element 35 will move this valve element off its seat against the forces tending to hold it seated. The valve element 37 will now be moved back onto its seat 38. Thus, the intake of the compressor will again be open and the oil dome sealed. The compressor will now operate in its usual manner to compress air and again restore the maximum pressure in the air tank. When this pressure is reached, the intake of the compressor will again be cut off and the oil dome vented to atmosphere in the manner explained.

Being aware of the possibility of modifications in the particular structure herein described without departing from the fundamental principles of my invention, I do not intend that its scope be limited except as set forth by the appended claims.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with a rotary compressor provided with an intake and a discharge port and having associated therewith an oil reservoir communicating with the compressor for providing lubricant for the rotor and blades of the compressor and wherein the oil in the reservoir is subject to the discharged compressed fluid from the compressor prior to passage to a receiver to thus force oil into the compressor, valve means for automatically closing the intake and opening the oil reservoir to atmosphere when the fluid pressure in the receiver reaches a predetermined value.

2. In combination with a rotary compressor provided with an intake and a discharge port and having associated therewith an oil reservoir communicating with the compressor for providing lubricant for the rotor and blades of the compressor and wherein the oil in the reservoir is subject to the discharged compressed fluid from the compressor prior to passage to a receiver to thus force oil into the compressor, means comprising valve means for simultaneously closing the intake and opening the oil reservoir to atmosphere.

3. In combination with a rotary compressor provided with an intake and a discharge port and having associated therewith an oil reservoir communicating with the compressor for providing lubricant for the rotor and blades of the compressor and wherein the oil in the reservoir is subject to the discharged compressed fluid from the compressor prior to passage to a receiver to thus force oil into the compressor, a normally open valve for closing the intake of the compressor, a normally closed second valve for opening the oil reservoir to atmosphere, and means for causing the first named valve to close and the second valve to open when the pressure in the receiver reaches a predetermined value.

4. In combination with a compressor provided

with an intake and a discharge port and having associated therewith an oil reservoir communicating with the compressor for providing lubricant for the working parts of the compressor and wherein the oil in the reservoir is subject to the discharged compressed fluid from the compressor prior to passage to a receiver, means for automatically closing the intake and opening the oil reservoir to atmosphere, said means comprising a conduit connecting the intake to atmosphere, a valve element associated with said conduit, a branch conduit connecting the oil reservoir to the first named conduit at a point between the valve means and the atmosphere, a second valve element associated with the branch conduit, means connecting the valve elements together for simultaneous movement, a spring for biasing the valve elements to positions where the first element is open and the second closed, and a fluid motor in communication with the receiver for moving the valve elements against the bias of the spring and causing the first valve element to be closed and the second valve element to be open when the fluid pressure in the receiver reaches a predetermined value.

5. In apparatus of the class described, an air compressor provided with an intake port and an exhaust port, a receiver, means including a conduit for connecting the exhaust port to the receiver, a check valve for preventing return flow of air under pressure from the receiver, conduit means for connecting the intake to atmosphere, a valve element for controlling the conduit, conduit means for connecting the exhaust port of the compressor to atmosphere, a valve element for controlling said last named conduit means, means for rigidly connecting the valve elements together for simultaneous movement, a spring for biasing the first valve element open and the second closed, and means operable by a predetermined pressure in the receiver for moving the valves against the bias of the spring and to positions where the first valve element is closed and the second open.

6. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a source of fluid connected to the intake port, a fluid pressure receiver connected to receive compressed fluid from the exhaust port, a check valve for preventing return flow of fluid from the receiver, means for placing the exhaust port in communication with the source of fluid, valve means for closing said communication and comprising a movable element movable off its seat against the pressure of the fluid from the exhaust port, a spring for biasing said valve element to closed position, and means operable by a predetermined pressure from the receiver for moving said valve element off its seat and comprising a chamber communicating with the receiver and a movable element subject to fluid pressure in the chamber and directly connected to the valve.

7. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a source of fluid, a conduit for connecting said source to the intake port, a valve for controlling said conduit, a receiver, a conduit connecting said receiver to the exhaust port, conduit means for connecting the exhaust port to the first named conduit at a point between said valve and the source of fluid, a second valve for controlling said conduit means, means including a stem for rigidly connecting said valves together for simultaneous operation, means for normally maintaining said first named valve open and

said second named valve closed, and means controlled by a predetermined pressure in the receiver for closing said first named valve and opening the second named valve to thereby cause
 5 the compressor to discharge fluid into the fluid source and to positively prevent fluid from entering the compressor intake from the fluid source.

8. An unloading valve mechanism for a compressor having intake and exhaust ports, comprising a casing having a passage therein for connection with a source of fluid and with the compressor intake, a chamber for connection with the exhaust port and a receiver and a second passage intersecting the first passage and communicating with the chamber, a valve associated with the first and second passages for closing the first passage to prevent fluid from entering the intake of the compressor but not preventing said second passage to be in communication with the
 10 source of fluid by way of a portion of the first passage, a second valve associated with the second passage and controlling communication between it and the chamber, means for connecting the movable elements of the valves together for
 15 simultaneous movement, a spring for biasing the first valve open and the second valve closed, and means operable by a predetermined pressure for closing the first valve and opening the second.

9. In combination, a rotary air compressor provided with intake and discharge ports, an oil chamber associated with the compressor, the discharge port opening in to the oil chamber where-

by the oil therein is under pressure during normal operation of the compressor, conduit means for conducting oil to the rotor and blades of the compressor to lubricate same, a compressed air receiver connected to the oil chamber, a normally
 5 open valve for closing the intake port, a valve for placing the oil chamber in communication with the atmosphere, said valve being normally closed, and means governed by predetermined pressure in the receiver for closing the intake valve and substantially simultaneously opening the second
 10 named valve.

10. In combination, a rotary air compressor provided with intake and discharge ports, an oil chamber associated with the compressor, the discharge port opening in to the oil chamber where-
 15 by the oil therein is under pressure during normal operation of the compressor, conduit means for conducting oil to the rotor and blades of the compressor to lubricate same, a compressed air receiver connected to the oil chamber, a normally open valve for closing the intake port, a valve for placing the oil chamber in communication with the atmosphere, said valve being normally closed, and means governed by predetermined
 20 pressure in the receiver for closing the intake valve and substantially simultaneously opening the second named valve, said last named means comprising connecting means between the valves and a single fluid motor operable by said predetermined pressure.

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