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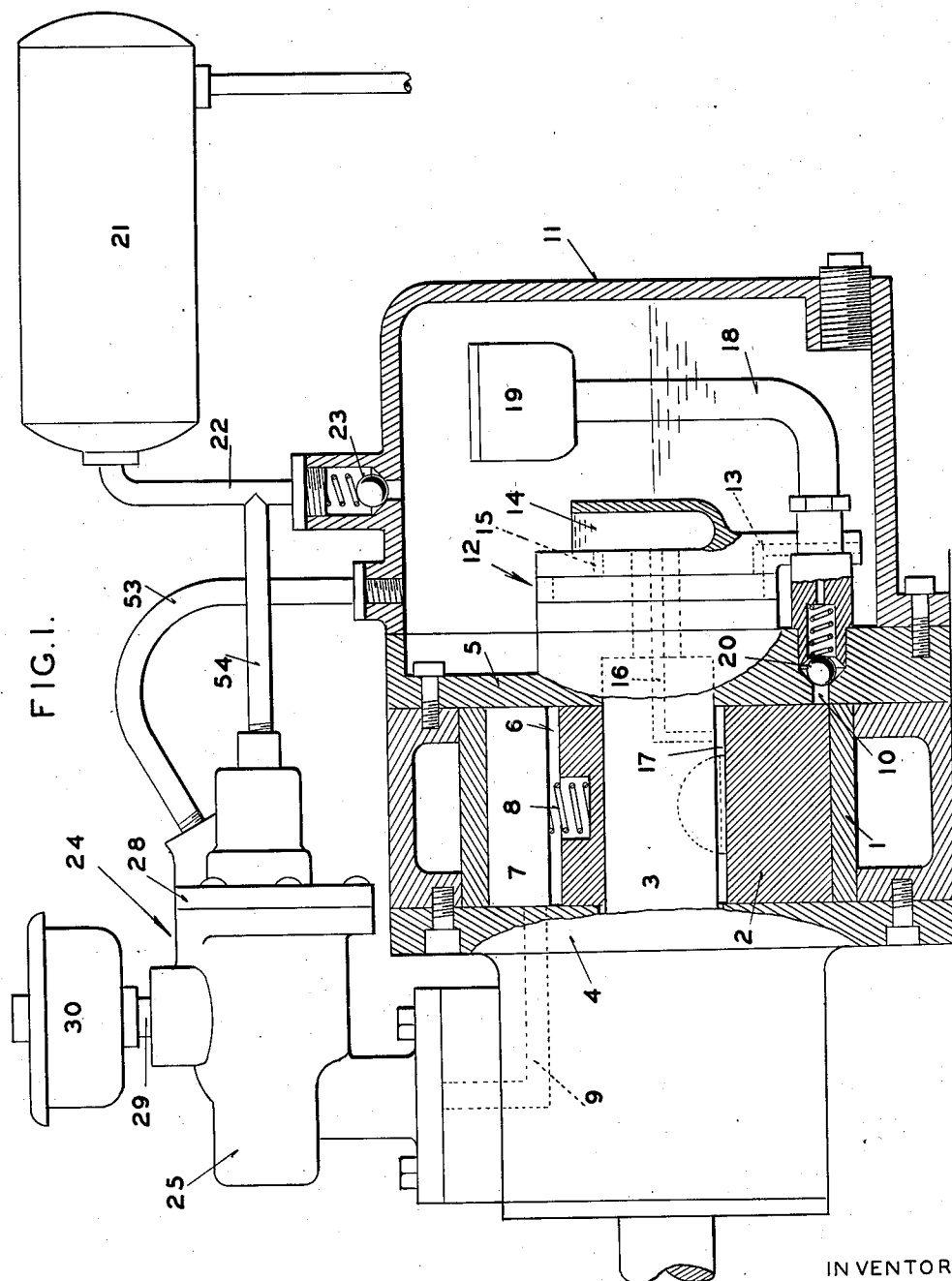
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2,234,462

VALVE MECHANISM FOR UNLOADING COMPRESSORS

Filed Dec. 28, 1939

2 Sheets-Sheet 1



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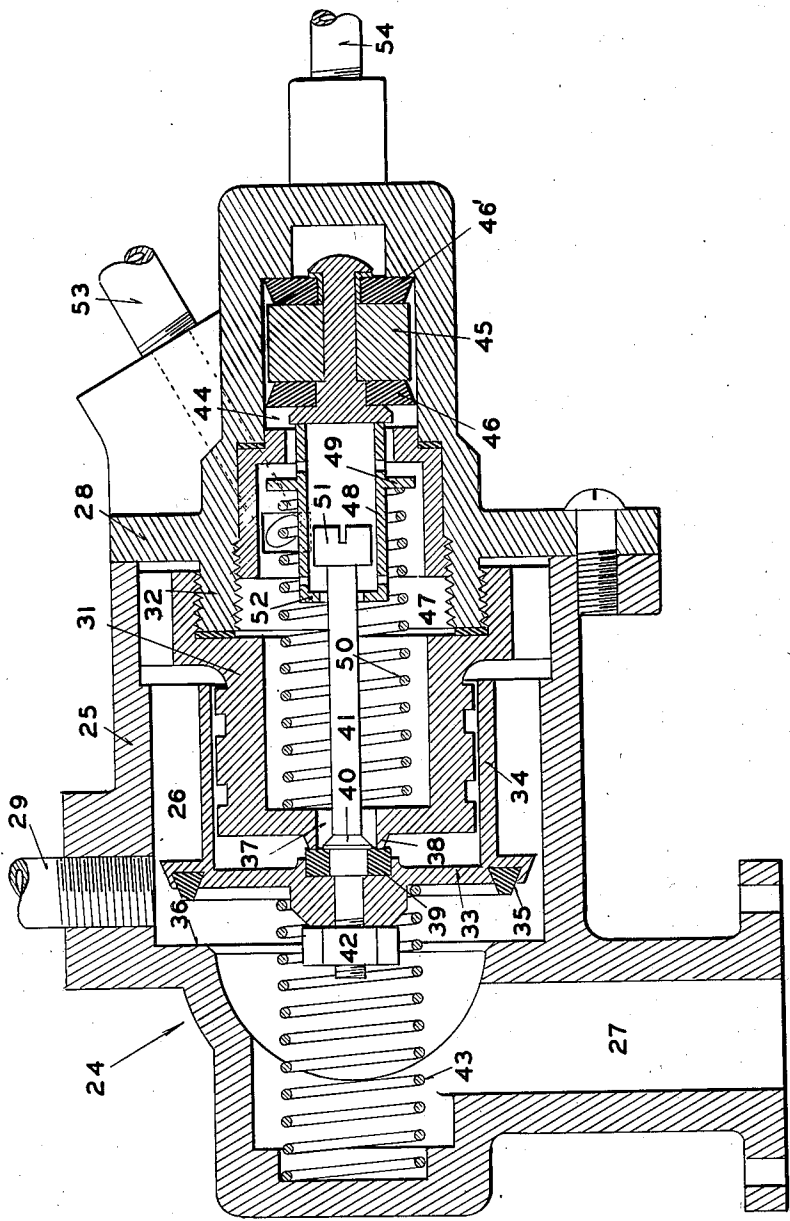
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FIG. 2.



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VALVE MECHANISM FOR UNLOADING
COMPRESSORSWerner F. Boldt, Clayton, Mo., assignor to Wagner
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7 Claims. (Cl. 230—31)

My invention relates to compressors and more particularly to valve mechanism for unloading the compressor under certain conditions.

One of the objects of my invention is to provide an improved valve mechanism for automatically closing the intake port of a compressor and connecting the discharge port to atmosphere when the pressure in the receiver of the compressor is a predetermined value.

Another object of my invention is to provide a valve mechanism of the type referred to which after being caused to be moved to a position closing the intake port of the compressor by a predetermined fluid pressure produced by the compressor will allow said pressure to be dissipated and permit the valve mechanism to be held in a closed position by a force created by fluid pressure from the receiver which force is less than that employed to close the valve thereby permitting the valve mechanism to again assume an open position when there is a relatively small drop in receiver 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 showing a rotary compressor, an oil dome therefor and a receiver tank having associated therewith my improved valve mechanism for unloading the compressor; and Figure 2 is a cross-sectional view showing details of the valve mechanism.

Referring to the drawings in detail, the rotary compressor 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 well 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. The oil dome communicates with the compressed air receiver or tank 21 by a conduit 22 and a check valve 23 prevents return of compressed air to the dome. The compressed air may be used for any purpose desired, as for example, the actuation of vehicle brakes.

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 the air remaining in the compressor 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.

My improved valve mechanism for closing the intake to the compressor and connecting the oil dome to the atmosphere is indicated generally by the numeral 24 mounted on the compressor adjacent to the intake passage as shown in Figure 1. The valve mechanism comprising a casing 25 provided with a large chamber 26 and a communicating passage 27 leading to the intake passage 9 of the compressor. The casing 25 is provided with a closure member 28 and the chamber 26 is in communication with the atmosphere by means of a conduit 29 and an air cleaner 30 (Figure 1).

Within the chamber 26 is a fixed cylindrical member 31 which is threaded on an annular flange 32 carried by the closure member 28. Also within the chamber 26 is a valve member 33 having a cylindrical extension 34 which loosely fits on the cylindrical member 31. The forward face of this valve member carries a yieldable sealing ring 35 for cooperation with an annular surface or valve seat 36 at the end of the chamber 26 which communicates with the passage 27. When the valve member moves into engagement with the seat 36 communication will be cut off between the intake passage 9 of the compressor and the atmosphere.

The cylindrical member 31 upon which the valve member 33 is slidably mounted is provided with a passage 37 in its end wall and surrounding this passage is a valve seat 38. The valve member 33 carries a valve element 39 for cooperation with the valve seat, this valve element being held to the valve member by a shoulder 40 on a rod 41 which is secured to the valve member by a nut 42. A spring 43 is interposed between the valve member and the casing and biases the valve member to a position where the valve element 39 will be held on the valve seat 38.

The closure member 28 is provided with a cylinder 44 in which is reciprocable a piston 45 carrying packing elements 46 and 46' on its ends to prevent fluid from passing the piston in either direction. In the chamber 47 formed by the cylindrical member 31 is a cylindrical element 48 having an outer flange 49 whereby a spring 50 interposed between said flange and the end of the cylindrical member 31 will normally bias the cylindrical element 48 into abutting engagement with the piston 45 and holds the piston at the right hand end of its cylinder. This cylindrical element also receives an enlarged end 51 of rod 41 for cooperation with an end flange 52 whereby the cylindrical element may be picked up and moved with the pin and valve member 33 when said valve member is moved to engage its seat 36. When the valve member is in open position as shown in Figure 2 the distance between the enlarged end 51 of the rod and the flange 52 is such that the enlarged end will not engage the flange to move the cylindrical element until the valve member approaches its closed position.

The chamber 47 is placed in constant communication with the oil dome 11 of the compressor by means of a conduit 53 thus causing this chamber to contain fluid under pressure equal to that in the oil dome. The right hand end of the cylinder 44 is connected to the air receiver or tank 21 by means of a conduit 54 thus

subjecting at all times the right hand end of the piston 45 to the same pressure that is in the receiver.

When the pressure in the receiver is below a selected predetermined value, say, for example, 100 pounds per square inch, the parts of the valve mechanism are in the position shown in Figure 2 and under these conditions the compressor will operate to compress air and force it out the discharge port into the top of the oil dome and from there through the check valve 23 into the receiver. Air from the atmosphere will be free to pass into the intake 9 of the compressor since the valve member 33 is disengaged from the seat 36. The air pressure in the dome will be the same as the air pressure in the tank 21 since the check valve 23 only prevents fluid from passing from the tank to the oil dome. Since the chamber 47 formed by the cylindrical member 31 is connected to the oil dome by the conduit 53 the pressure in this chamber will be the same as that in the oil dome. This pressure acts upon the left hand end of the piston 45 and will balance the pressure from the air tank which is acting on the right hand end of the piston since the tank and dome pressure are equal. The piston will be maintained in the position shown in Figure 2 by means of the spring 50 which will act through the cylindrical element 58. The valve element 39 will be held seated by the spring 43 and this latter spring is so proportioned as to hold the valve element 39 seated against a pressure of 100 pounds per square inch in the chamber 47.

When the compressor has operated for a sufficient time to cause the air pressure in the oil dome and in the receiver 21 to reach the value of 100 pounds per square inch the valve element 39 will be forced off its seat 38 thus permitting fluid under pressure to escape through the passage 37 and act on the total area of the valve member 33. This will cause the valve member to be moved rapidly to the left and to a position where it will engage the seat 36. When the valve member is seated the suction in the passage 27 caused by the operation of the compressor will now hold the valve member 33 in closed position. As the valve member 37 approaches its seat the enlarged head 51 of the rod will pick up the cylindrical element 48 and compress the spring 50. The movement of the cylindrical element to the left will cause the spring 52 to be no longer effective on the piston 45 to hold it at the right hand end of its cylinder.

The loose fit of the cylindrical extension 34 with the cylindrical member 32 permits the fluid under pressure in the oil dome and the chamber 47 to quite rapidly escape to the atmosphere through the air cleaner as soon as the valve member 33 becomes seated. Thus the pressure in the dome will fall to atmospheric pressure. Since there is no longer any pressure acting on the left hand end of the piston 45 this piston will now be forced to the left by the action of the pressure in the receiver which as previously stated is 100 pounds per square inch. This will compress spring 50 and hold the element 48 in a position where flange 52 is not engaged by the head 51 of the rod.

With the intake of the compressor closed and the dome at atmospheric pressure the compressor will be completely unloaded and any air which may be in the compressor or which may leak into the compressor will be readily forced out into the dome at a low pressure since there

is no pressure in the dome tending to hold the outlet port check valve 12 seated. When the compressor is unloaded in the manner set forth it will not perform any work and therefore the power necessary to rotate the rotor will be at a minimum. Further the temperature of the compressor will drop rapidly due to the fact that the blades are not compressing any fluid. Also with the dome at atmospheric pressure there will be no pressure acting on the oil in the well 14 to force an excessive amount of oil into the compressor and cause it to become "choked."

When fluid under pressure is used from the receiver 21 and the pressure therein drops to such a predetermined value, say, for example, 90 pounds per square inch, that the spring 52 can move the element 48 and piston 45 to the right, the element 48 will pick up the enlarged head 51 of the rod and move the valve member 33 away from its seat. As soon as the vacuum is broken the valve member will be quickly moved under the action of the spring 43 to its normal open position. The parts will then assume the positions shown in Figure 2 wherein the valve element 39 will close the passage 37 and thus cut off communication between the oil dome and the atmosphere. With the valve member 33 open the air will be free to again enter the compressor through the intake passage where it will be compressed and forced out into the oil dome and then into the tank until the pressure in the tank reaches the predetermined value of 100 pounds per square inch. When this occurs the compressor intake will again be closed and the fluid pressure in the oil dome dissipated to atmosphere.

It is to be noted that by the use of my improved valve mechanism the compressor is shut off by the fluid pressure in the dome and that the fluid pressure from the receiver only controls the opening of the valve. Because of the method of control the pressures at which the valve closes and opens can be maintained at a fixed value. Also the construction and method of operation insures that the valve will be closed and opened quickly.

Being aware of the possibilities of modification 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 compressed air storage apparatus comprising a receiver and an air compressor provided with intake and discharge ports and having associated therewith a chamber receiving compressed air from the discharge port and communicating with the receiver, a valve member for closing the intake port, means comprising a second valve for connecting the chamber to atmosphere and movable to an open position by the pressure in the chamber when it is a predetermined value, said second valve being so associated with the intake valve that when it is opened the fluid pressure released from the chamber will act on the intake valve to move it to closed position, and means for causing the intake valve to assume an open position when the fluid pressure in the receiver falls below a predetermined value.

2. In combination with a compressor provided with an intake port and a discharge port, a storage receiver for receiving compressed fluid

from the compressor, a chamber between the discharge port and the receiver, and a check valve for preventing fluid from passing from the receiver to the chamber, of valve means comprising a movable member for controlling the compressor intake and being so associated therewith that when in closed position it will be held closed by the suction created by the compressor, means comprising a pressure controlled valve for permitting fluid under a predetermined pressure from the chamber to move the movable member of the valve means to a closed position, means allowing the fluid pressure in the chamber to escape to atmosphere when the pressure controlled valve is open and the intake valve means is closed, and means operable when the fluid pressure in the receiver falls below a predetermined value for moving the movable member of the intake valve means to open position.

3. In combination with a compressor provided with an intake port and a discharge port, a storage receiver for receiving compressed fluid from the compressor, a chamber between the discharge port and the receiver, and a check valve for preventing fluid from passing from the receiver to the chamber, of valve means comprising a movable member for controlling the compressor intake and being so associated therewith that when closed it will be held closed by the suction created by the compressor, means comprising a pressure controlled valve for permitting fluid under a predetermined pressure from the chamber to move the movable member of the valve means to a closed position, means permitting the fluid pressure in the chamber to escape to atmosphere when the pressure controlled valve is open and the intake valve means is closed, a spring controlled member operatively connected to the movable member of the intake valve means when it is in closed position and tending to move said movable member to open position, and a fluid motor subject to the fluid pressure in the receiver for preventing said spring controlled member from moving the movable member of the valve means to open position when the fluid pressure in the receiver is above a predetermined value.

4. In combination with a compressor provided with an intake port and a discharge port, a storage receiver for receiving compressed fluid from the compressor, a chamber between the discharge port and the receiver, and a check valve for preventing fluid from passing from the receiver to the chamber, of valve means comprising a piston for controlling the compressor intake and being so associated therewith that when in closed position it will be held closed by the suction created by the compressor, means including said piston for forming an enclosure having an escape passage to atmosphere, conduit means for connecting the chamber to the enclosure, a pressure controlled valve in said conduit means for admitting pressure to the enclosure to move the piston to valve closed position only when there is a predetermined pressure in the chamber, and means operable when the fluid pressure in the receiver falls below a predetermined value for moving the piston to open the intake port.

5. In combination with a compressor provided with an intake port and a discharge port, a storage receiver for receiving compressed fluid from the compressor, a chamber between the discharge port and the receiver, and a check valve for preventing fluid from passing from the receiver to

the chamber, of valve means comprising a piston for controlling the compressor intake and being so associated therewith that when in closed position it will be held closed by the suction created by the compressor, means including said piston for forming an enclosure having an escape passage to atmosphere, conduit means for connecting the chamber to the enclosure, a pressure controlled valve in said conduit means for admitting pressure to the enclosure to move the piston to valve closed position only when there is a predetermined pressure in the chamber, a spring controlled member operatively connected to the piston only when the piston is in valve closed position and tending to move said piston to valve open position, and fluid pressure means for preventing said spring controlled member from moving the piston to valve open position when the fluid pressure in the receiver is above a predetermined value.

6. In combination with a compressor provided with an intake port and a discharge port, a storage receiver for receiving compressed fluid from the compressor, a chamber between the discharge port and the receiver, and a check valve for preventing fluid from passing from the receiver to the chamber, of valve means for controlling the compressor intake, means operable by a predetermined pressure in the chamber for causing the closing of said valve means and the simultaneous placing of the chamber in communication with the atmosphere, means comprising a spring for opening said valve means, and means controlled by fluid in the receiver for preventing said spring from opening said valve means except when the fluid pressure in the receiver is below a predetermined value.

7. In combination with a compressor provided with an intake port and a discharge port, a storage receiver for receiving compressed fluid from the compressor, a chamber between the discharge port and the receiver, and a check valve for preventing fluid from passing from the receiver to the chamber, of valve means comprising a movable member for controlling the compressor intake and being so associated therewith that when closed it will be held closed by the suction created by the compressor, means comprising a pressure controlled valve for permitting fluid under a predetermined pressure from the chamber to move the movable member of the valve means to a closed position, means permitting the fluid pressure in the chamber to escape to atmosphere when the pressure controlled valve is open and the intake valve means is closed, a spring controlled member for moving the movable member to valve open position, means for connecting the spring controlled member to the movable member of the valve means only when said member assumes a valve closed position, and a two face piston constantly subject to the fluid pressure of the receiver on one of its faces and tending to move the piston to a position preventing said spring controlled member from moving the movable member to valve open position as long as the pressure in the receiver is above a predetermined value, said other face of the piston being subject to the pressure from the chamber when the pressure controlled valve is closed.

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