

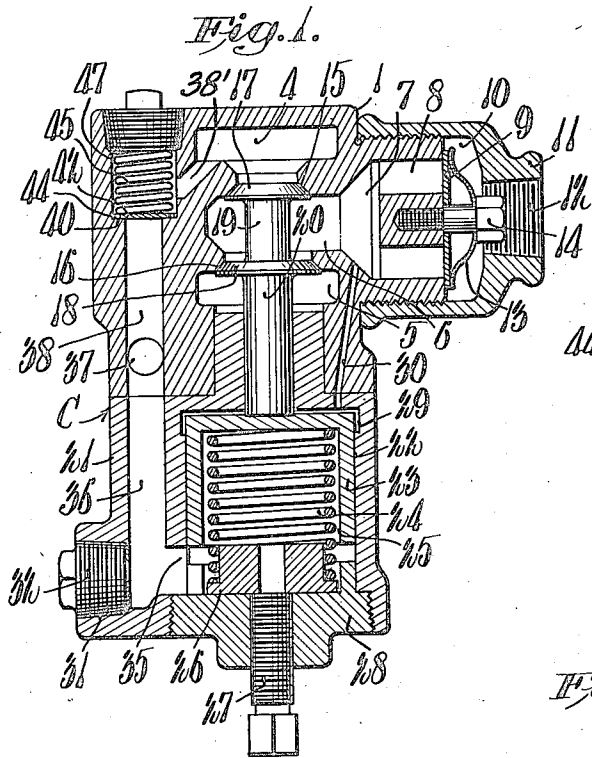
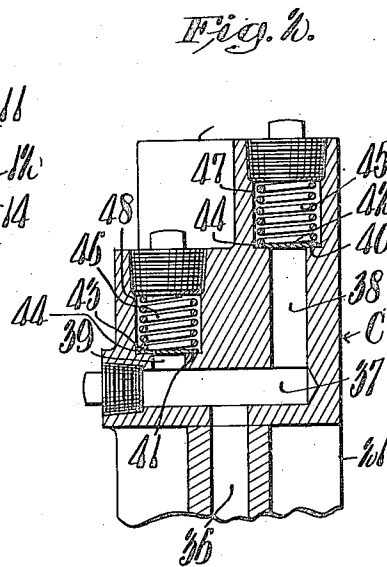
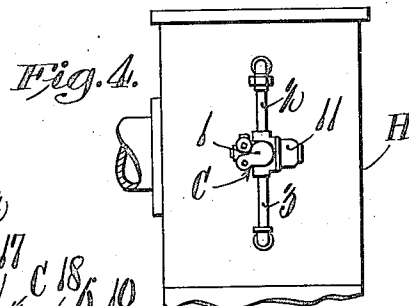
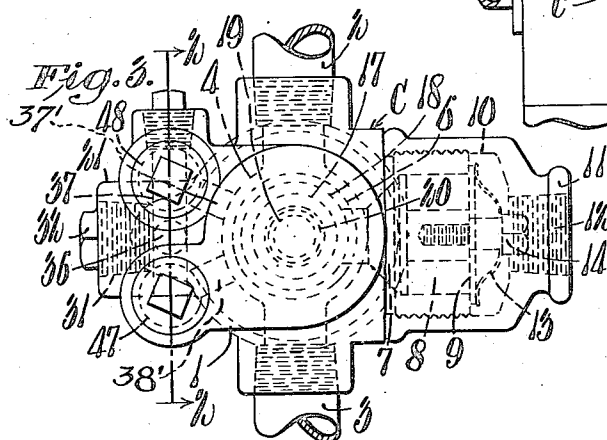
April 9, 1929.

H. B. HALVORSEN

1,708,172

COMPRESSOR

Filed April 3, 1924



Inventor:
Halvor B. Halvorsen.
by
Howell
att'y.

UNITED STATES PATENT OFFICE.

HALBERT B. HALVORSEN, OF MICHIGAN CITY, INDIANA, ASSIGNOR TO SULLIVAN
MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

COMPRESSOR.

Application filed April 3, 1924. Serial No. 703,970.

My invention relates to compressors, and more particularly to compressor unloading means.

An object of my invention is to provide an improved unloading means especially adapted to use with the high pressure cylinders of compressors. Another object of the present invention is to provide very simple and efficient unloading means which may be attached to one of the higher stages of a multi-stage compressor to prevent excessive temperatures in this stage when the inlet to one of the lower stages is wholly or partially closed. These and other objects and advantages of my invention will hereinafter more fully appear.

In the accompanying drawings I have shown for purposes of illustration one form which my invention may assume in practice.

In these drawings,—

Fig. 1 is a central vertical section through an illustrative embodiment of my invention.

Fig. 2 is a detailed sectional view, taken substantially on line 2—2 of Fig. 3.

Fig. 3 is a plan view of the mechanism shown in Fig. 1.

Fig. 4 is a view showing this improved unloading means turned through 90° and applied to the side of the high pressure cylinder of a compressor.

It is a well-known fact that if the intake controlling valve of a compound compressor be closed for the purpose of unloading such a compressor, the continued reciprocation of the piston in the high pressure cylinder will speedily pump down the pressure in the inter-cooler to a partial vacuum with the result that any leakage which may occur past the intake closure valve will admit air to the compressor which must be compressed in the high pressure cylinder from a pressure substantially sub-atmospheric up to the full discharge pressure of the high pressure cylinder. As a result of this fact there will be a considerably larger number of compressions of the air in this cylinder than is the case during normal running and due to the number of compressions a temperature which may reach or pass 500 degrees Fahrenheit will be produced. This of course is not desirable as it is apt to carbonize the lubricant and in the event that an explosive mixture of finely divided lubricant and air is present in the compressor an explosion is likely to result. Various means have been provided for preventing

the compression of air to the normal discharge pressure by permitting it to be discharged to the atmosphere as soon as a pressure somewhat above atmospheric is reached while the compressor is unloaded. My invention herein consists of improved means for accomplishing the result of preventing production of such temperatures by interconnecting the opposite ends of the high pressure cylinder a reasonable time after unloading occurs with a result that there is substantially no compressing action in the high pressure cylinder. I further provide means which will automatically vent to the atmosphere any air which may be pumped to the high pressure cylinder from the low pressure cylinder as soon as a pressure a little above atmospheric is reached.

In the illustrative embodiment shown for purposes of illustration my invention comprises a two-part casing C from whose upper part 1 there extend from opposite sides pipe lines 2 and 3, these being adapted to be connected to the counterbores at the opposite ends of a high pressure cylinder H (see Fig. 4). The pipes 2 and 3 open into chambers 4 and 5 which are arranged at opposite sides of a chamber 6 which opens into another chamber 7 which in turn is connected by a series of ports 8 controlled by a thin annular valve 9 with a recess 10 formed in a cap member 11 through which an opening 12 extends to the atmosphere. A transversely bowed flexible spring 13 is held in place by a machine screw 14 which serves to maintain the valve 9 normally closed but permits it to open when the pressure in the chamber 7 is substantially above atmospheric pressure. Between the chambers 4 and 6, and 5 and 6 there are arranged respectively valve seats 15 and 16, which are mutually coaxial and which are adapted to provide seats for a pair of coaxially arranged valves 17 and 18 which are connected by a stem portion 19 and mounted upon the upper end of a rod 20. In the lower portion of the casing C which is designated 21 there is formed a cylinder bore 22 in which a piston 23 is reciprocable, this piston being adapted to engage the bottom of the rod 20 and to force the valves 17 and 18 to their seats. The piston is normally held in raised position by a spring 24 which engages the piston within a bore 25 in the latter at its upper end while its lower end cooperates with a follower 26 which may be adjusted by an ad-

justing screw 27 in the lower head 28 of the cylinder member 21. It will be observed that a counterbore 29 is arranged at the upper end of the cylinder and that the length of the rod 20 is such that it is impossible for the piston to contact with the upper end of the cylinder when the valves are seated. A passage 30 serves to constantly vent the space above the piston 23 to the chamber 7 with the result that no pressure leaking around the rod 20 can build up to oppose the upwardly acting pressure below the piston 23. This might obviously lead directly to the atmosphere. The position of the piston 23 could be controlled by intercooler pressure if desired by connecting to an opening 31, which is herein closed by a plug 32, a line leading to the intercooler. However, this method is not employed and instead a connection 35 with the bottom of the cylinder opens into a passage 36 and means is provided for controlling the pressure below the piston by the conditions in the opposite ends of the compressor cylinder. At its end away from the cylinder the passage 36 is branched as indicated at 37 and from the opposite ends of this branch there extend passages 38 and 39 parallel to the passage 36 and respectively surrounded by valve seats 40 and 41. Passages 37' and 38' lead respectively to the chambers 4 and 5 which in turn are connected respectively with opposite ends of the compressor cylinder by pipes 2 and 3. With these valve seats valves 42 and 43 are adapted to cooperate, these valves being of thin sheet material and so formed by means of projections 44 at their peripheries as to be properly centered while still permitting air to pass them when they are open. Suitable springs 45 and 46 arranged in chambers 47 and 48 containing these valves normally maintain them closed. It will be evident that if it is necessary for pressure to build up beneath the piston 23 when the compressor is loaded in order that the valve 17 may be maintained closed, there must be some means whereby the pressure in the counterbores of the cylinder may pass the valves 42 and 43 toward the cylinder 22. For the accomplishment of this result reliance may be placed upon the lack of perfect seating of these valves, or fine bypasses extending around the valves may be used, or the valves may be drilled with small holes to permit the pressure to pass through them, these holes being of such size as not to interfere with the operation of these valves during unloaded operation, but sufficiently large to allow pressure to pass through the valves in sufficient quantities when the compressor is running loaded.

From the description so far given the mode of operation of this mechanism will be readily apparent. Let it be assumed that the compressor is running loaded. It will then be observed that the intercooler pressure which

may be, say, 25 or 30 pounds, is acting beneath the piston 23. If we assume that this piston has an area of, say, 3 square inches, there would be an upward pressure of 75 to 90 pounds. If we assume that the area of the valve 17 exposed to pressure in the chamber 4 is one-half a square inch and that the maximum discharge pressure of the high pressure cylinder is 120 pounds, it will be evident that there is a downward pressure of 60 pounds. If the compressor is loaded, there is also a constant pressure acting upon the unbalanced area in the chamber 5, the lower side of the valve member 18, and this area will provide a further upwardly acting pressure of a substantial additional amount. It will thus be clear that the maximum pressure which might tend to unseat the valve 17 will be entirely insufficient to accomplish this result and that during normal running of the compressor both the bypass and the atmospheric vent will be completely closed off from the opposite ends of the cylinder. Of course when the maximum pressure is in the end of the cylinder connected with the space 5, this will simply result in the valve seating more tightly. Now, if the compressor be unloaded by the closure of the intake closure valve there will be developed in the intercooler after a few revolutions a partial vacuum and in like manner within the ends of the high pressure cylinder there would be reduced pressures produced. During these periods of sub-atmospheric pressure the valves 42 and 43 will be unseated by the pressure below the piston 23 and the latter will be allowed to be moved downwardly by the pressure acting upon the top of the piston through the opening 30. This will permit the bypass valve to drop open and as there is an unbalanced area upon the valves 17, 18, etc., tending to keep them open, they will be maintained open throughout the continuing unloaded running of the compressor. There will therefore be no substantial compression in the high pressure cylinder for the fluid will pump back and forth from end to end of the latter. In case the leakage past the intake closure valve is such as to build up a pressure a little above atmospheric in the intercooler, this pressure will have access to the high pressure cylinder and will pass out past the valve 9 to the atmosphere.

While I have in this application specifically described one form which my invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In an unloading mechanism, a casing providing chambers connected directly with

the opposite ends of the compressor cylinder and an intermediate chamber, interconnected valves adapted to control the communication between said first mentioned chambers and said last mentioned chamber, and means for controlling the operation of said valves responsive to a vacuum condition in the compressor cylinder proper for causing said valves to interconnect the opposite ends of the cylinder.

2. A compressor controlling valve mechanism comprising a casing containing a chamber having walls formed to present aligned valve seats, interconnected valves cooperating with said seats, means for subjecting said valves on their respective opposite sides to pressures in the opposite ends of a compressor cylinder, and means for normally holding said valves seated including a spring pressed piston exposed on its side away from said valves to pressure in the cylinder proper.

3. A compressor controlling valve mechanism comprising a casing containing a chamber having walls formed to present aligned valve seats, interconnected valves cooperating with said seats, means for subjecting said valves on their respective opposite sides to pressures in the opposite ends of a compressor cylinder, and means for normally holding said valves seated including a spring pressed piston exposed on its side away from said valves to pressure in the cylinder proper, the opposite end of said piston being vented to prevent the accumulation of pressure to act thereon.

4. In a mechanism for effecting unloading of a high pressure compressor cylinder, a cylinder, a piston therein, means for connecting one end of said cylinder with both ends of such a high pressure cylinder, and valve means whose position is controlled by said piston for controlling interconnection between the ends of the high pressure cylinder.

5. Means for interconnecting the opposite ends of a high pressure compressor cylinder when said compressor is unloaded including two coaxial interconnected valves each controlling the connection between one end of the cylinder and the space between the valves, and means responsive directly to the pressure in the high pressure cylinder proper for controlling said valves.

6. In a compressor unloading mechanism, a casing including three aligned chambers and a cylinder, connections between two of said chambers and the ends of a compressor cylinder, means controlling the connections between said last mentioned chambers and the third chamber, and a single piston in said cylinder controlled by the pressures in said cylinder and controlling said controlling means.

7. In a compressor unloading mechanism, a casing including three aligned chambers and a cylinder, connections between two of

said chambers and the ends of a compressor cylinder, a valved connection between the third of said chambers and the atmosphere, means controlling the connections between said several chambers, and a single piston in said cylinder controlled by the pressures in said cylinder and controlling said controlling means.

8. In a compressor unloading mechanism, a casing including three aligned chambers and a cylinder, connections between two of said chambers and the ends of a compressor cylinder, a valved connection between the third of said chambers and the atmosphere, means controlling the connections between said several chambers, and a single piston in said cylinder controlled by the pressures in the opposite ends of said cylinder and controlling said controlling means.

9. In a compressor unloading mechanism, a casing including three aligned chambers and a cylinder, connections between two of said chambers and the ends of a compressor cylinder, a valved connection between the third of said chambers and the atmosphere, means controlling the connections between said several chambers, and a single piston in said cylinder controlled by the pressures in the opposite ends of said cylinder and controlling said controlling means, one end of said cylinder being connected to said third chamber and the other having check valved connections with the ends of a compressor cylinder.

10. An unloading mechanism adapted for connection to a compressor cylinder, said mechanism having two passages, one connected to each end of the cylinder, and comprising valve means movable as a unit to interconnect the ends of the compressor cylinder, and means directly controlled by the cylinder pressure for controlling said valve means.

11. An unloading mechanism adapted for connection to a compressor cylinder, said mechanism having two passages, one connected to each end of the cylinder and comprising valve means for controlling fluid flow through said passages and operative in one position to open communication between the ends of the cylinder through said passages, and means for operating said valve means, said operating means including a chamber with connections between the same and the two ends of the cylinder and a check valve in each connection for preventing back flow of fluid to said chamber from the compressor cylinder whereby said operating means is responsive to minimum pressure in the cylinder ends.

12. Means for interconnecting the opposite ends of a high pressure compressor cylinder when said compressor is unloaded including means providing a chamber and connections between both ends of such a high pressure cylinder and said chamber, a member movable in response to the pressure within said

cylinder, and valve means operated by said member for controlling interconnection between the ends of the high pressure cylinder and movable to a position to effect such interconnection.

5 13. An unloading mechanism for the cylinder of an air compressor comprising a casing communicating directly with the opposite ends of such a cylinder, interconnected valve
10 means in said casing for opening communica-

tion through the latter between the ends of said cylinder and normally held in a position to interrupt communication between the ends of the compressor cylinder, and means responsive to a vacuum condition in the cylinder for releasing said valve means to permit the opening of such communication.

In testimony whereof I affix my signature.

HALBERT B. HALVORSEN.