Sept. 26, 1939. W. F. BOLDT 2,173,819

COMPRESSOR SHUT-OFF VALVE

Filed July 5, 1938

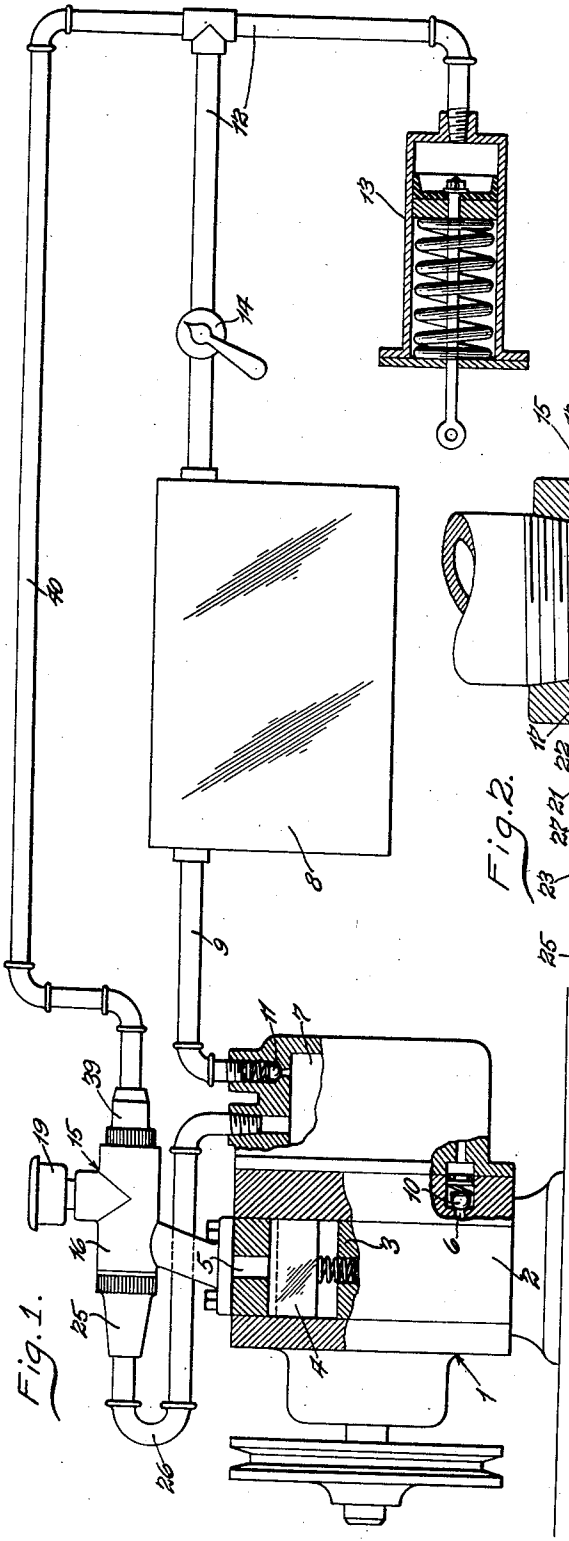


Fig. 1.

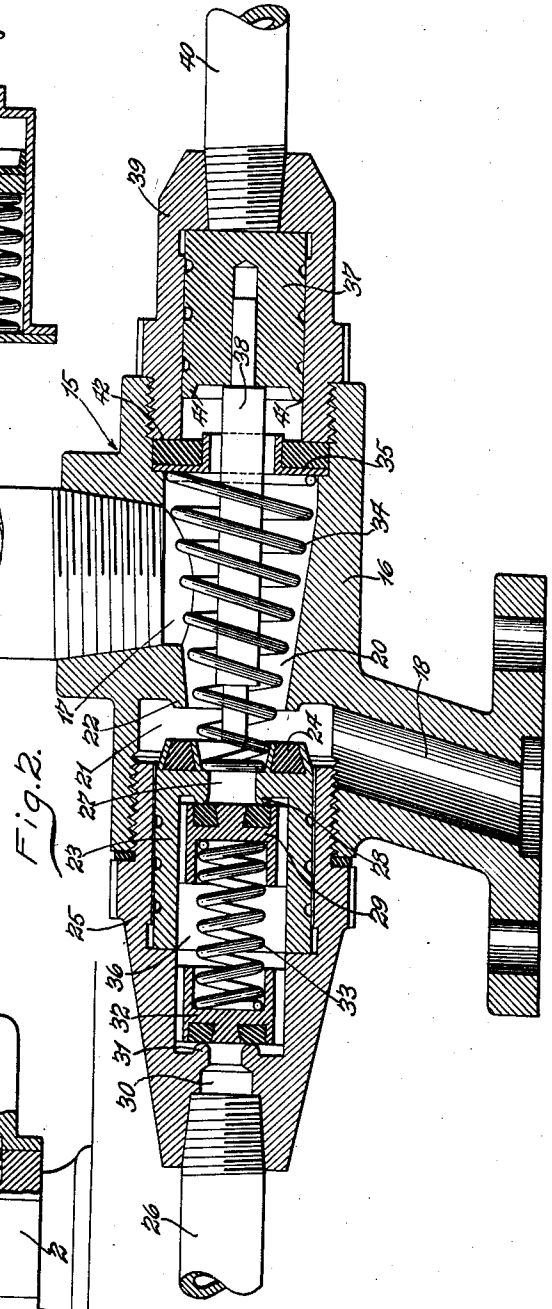


Fig. 2.

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Patented Sept. 26, 1939 2,173,819

UNITED STATES PATENT OFFICE

2,173,819

COMPRESSOR SHUT-OFF VALVE

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Application July 5, 1938, Serial No. 217,486

13 Claims. (Cl. 303—11)

My invention relates to valve mechanism and more particularly to valve mechanism for shutting off the intake of a compressor to unload it. The valve mechanism covered by this application is an improvement in the valve mechanism shown by my copending application Serial No. 217,485, filed July 5, 1938.

One of the objects of my invention is to provide an improved shut-off valve for the intake of a compressor which will automatically close the intake when the pressure in the compressor receiver reaches a maximum predetermined value and which will permit the intake to be automatically reopened when the pressure of the fluid in the receiver drops to a predetermined minimum value.

Another object of my invention is to so combine with a shut-off valve mechanism of the type referred to, means for positively causing the valve to be opened and thereby permit the compressor to operate each time fluid under pressure is used from the receiver by a fluid pressure-actuated system associated therewith.

Still another object of my invention is to so construct a shut-off valve mechanism that the compressor will be prevented from excessively overcharging the receiver when the valve is caused to be positively held open during a long period of time by a continued use of fluid under pressure from the receiver.

Still another object of my invention is to so construct a shut-off valve mechanism that the valve when moved to closed position will be held closed by a pressure greater than that necessary to move it to closed position.

Other objects of my invention will become apparent from the following description taken in connection with the accompanying drawing in which Figure 1 is a view showing how my improved valve mechanism is associated with the compressor, the receiver, and the fluid pressure system; and Figure 2 is a longitudinal cross-sectional view of the valve mechanism showing the details thereof.

Referring to the drawing in detail, the air compressor 1, with which I have illustrated my shut-off valve mechanism as being associated, is of the rotary type having a stator 2 and an eccentrically mounted rotor 3 provided with a plurality of blades 4 (one only being shown). The stator has an intake port 5 and an outlet port 6, the latter opening into an oil dome 7 which is connected to a pressure tank 8 by means of a conduit 9, the oil dome and pressure tank being considered as the receiver of the compressor. The outlet of the compressor has associated therewith a check valve 10 for preventing back flow of the compressed fluid and also associated with the outlet of the dome is another check valve 11. The pressure tank 8 is shown as connected by a conduit 12 with a fluid motor 13 which may be employed to operate any mechanism desired, as for example, a braking mechanism. The fluid pressure employed to actuate the fluid motor is controlled by a valve 14 in conduit 12, this valve being shown as a hand valve but it is understood that other valve mechanisms such as a foot control valve may be employed if desired.

In compressors of the type described which are of well-known construction it is desirable to prevent the compressor from compressing fluid after the fluid in the receiver has been placed under a predetermined maximum pressure. This is best accomplished by shutting off the intake port so that the air or other fluid which is being compressed is not permitted to enter the compressing chamber. It is also desirable that the intake port not only be automatically closed at the proper time but that it also be reopened whenever the pressure in the receiver drops.

In accordance with my invention I have provided an improved valve mechanism 15 which is associated with the compressor intake and also the compressor oil dome and the fluid pressure system whereby the desired opening and closing of the compressor intake is accomplished. The valve mechanism comprises a casing 16 having an inlet passage 17 and an outlet passage 18, the former having associated therewith a suitable air cleaner 19 and the latter communicating with the intake port 5 of the compressor when the valve mechanism is mounted on the compressor.

The inlet and outlet passages are in communication with each other by means of a bore 20 and a chamber 21. The casing at the juncture of the chamber and the bore is formed with a valve seat 22 and cooperating with this seat is a movable valve member 23 in the form of a hollow piston carrying an annular rubber member 24 for engaging the seat to cut off communication between the inlet and outlet. The valve member is loosely mounted for reciprocable movement in a bore in a fitting 25 threaded in the end of chamber 21 of casing 16, this fitting being connected with dome 7 of the compressor by a conduit 26.

The head of the valve member 23 is provided with a passage 27 which has associated therewith a valve seat 28 for cooperation with a fluted valve element 29 slidably mounted in the bore of the piston. The connecting passage 30 between con-

duit 26 and the interior of fitting 25 also has associated therewith a valve seat 31 and cooperating with the valve seat is a fluted valve element 32. The valve elements 29 and 32 are in opposed relation to each other and interposed between them is a spring 33 which normally holds both valve elements on their respective seats. There is also provided a spring 34 lying in bore 20 and positioned between valve member 23 and a shoulder 35 which is of greater strength than spring 33 in order that the valve member may be normally biased toward its open position permitting communication between the inlet and outlet passages.

With the structure just described and with the parts positioned as shown in Figure 2, air is free to pass into the intake 5 of the compressor where it is compressed and forced into the oil dome and then into the receiver through conduit 9. The spring 33 is of such strength that when the valve member 23 is in open position as shown, it will hold the valve element 32 seated as long as the pressure in the dome is below a predetermined value, for example, one hundred pounds per square inch (the pressure in the receiver will be substantially the same as the pressure in the dome since the check valve 11 offers little or no resistance to flow of fluid under pressure from the dome to the receiver). When the pressure in the dome becomes slightly greater than one hundred pounds per square inch, the valve element 32 will be unseated, thus allowing fluid under pressure to pass into chamber 36 formed by fitting 25 and piston 23. When the pressure of the fluid in this chamber becomes great enough (only a small pressure being required) it will overbalance the spring 34 and begin to move valve member 23 toward a position where it engages seat 22, thereby closing the outlet 18 leading to the intake of the compressor and preventing any more air from being drawn into the compressor. Since spring 33 is acting on valve element 29, this element will be moved along with valve member 23. This movement of the valve element permits expansion of spring 33 and results in a decrease in the force with which the spring is biasing valve element 32 toward closed position. The spring is preferably so designed that as it expands, the valve element 32 can be unseated by a fluid pressure of about ninety pounds per square inch instead of one hundred pounds per square inch as is the case when valve member 23 is open. Thus it is seen that as valve element 23 is moved, a greater fluid pressure will be effective thereon resulting in a rapid movement of the valve member to its seat. This greater fluid pressure which is about ten pounds per square inch will be effective to hold valve member 23 on its seat. Also this added pressure effective on the valve member will prevent the valve member from "fluttering" on and off seat 22 as would be the case if only sufficient fluid pressure were present to just overbalance spring 33 and bring the valve member up against the seat. The fluid under pressure which leaks by the loosely fitted valve member 23 re-enters the compressor and is again forced into the dome.

If the pressure in the dome should fall below ninety pounds per square inch, as would be the case where fluid is used from the tank or leakage is present in either the dome, the tank or the connections therebetween, valve element 32 will become positively reseated under the action of spring 33. Since the valve member 23 has only a loose sliding fit in fitting 25, the pressure in chamber 36 will now drop quite rapidly due to leakage by the valve member. This loss of pressure in chamber 36 permits spring 34 to act on the valve member and move it to its open position. The inlet and outlet passages are now in communication with each other and air is free to pass into the compressor and the pressure in the dome and the tank restored to its original value of one hundred pounds per square inch. When this original pressure is again attained, the valve mechanism will operate in the manner already described to cause the valve member 23 to close communication between inlet passage 17 and outlet passage 18 leading to the compressor.

Under some conditions it has been found desirable to recharge the tank each time fluid under pressure is used therefrom and restore the pressure in the tank to its maximum value of one hundred pounds per square inch, even though the pressure drop is less than ten pounds per square inch, the drop necessary to cause the valve member 23 to move to its open position in a manner already described. I accomplish this result by associating with the valve mechanism a piston 37 and rod 38 for positively moving valve element 29 off its seat and thus relieve the pressure in chamber 36 whereby spring 34 can move valve member 23 to its open position. The piston 37 is slidably mounted with a loose fit in the bore of a fitting 39 which is threaded into bore 20 of valve casing 16. The bore of the fitting is connected by a conduit 40 to conduit 12 of the fluid pressure system at a point between the control valve 14 and fluid motor 13. One end of the piston is formed with an annular flange 41 which is adapted to engage a rubber element 42 carried by stop 35 when the piston is in its left-hand position, thereby insuring that the piston, when in this position, will not permit any leakage of fluid from the system through conduit 40.

From the structure just described, it is readily seen that each time the control valve 14 is operated to permit fluid under pressure to enter the fluid motor 13, fluid under pressure will also be effective on piston 37, thereby forcing the piston to the left. If the valve member 23 is in closed position when rod 38 is moved to the left, the valve element 29 will be engaged and moved off its seat, thereby freeing the air under pressure in chamber 36 and permitting spring 34 to move valve member 23 to open position whereby air may enter the compressor and the original pressure of one hundred pounds per square inch in the receiver restored. It is thus seen that if the pressure in the tank dropped only five pounds as a result of operation of the fluid motor, the pressure will be restored whereas such restoration would not otherwise take place until the drop in pressure in the dome and tank is more than ten pounds per square inch.

If the fluid motor 13 is placed in communication with the receiver during a long period of time, the valve member 23 will also be in its open position for the same period of time. Under these circumstances, however, it is impossible for the compressor to excessively overcharge the tank for as soon as the pressure increases to a value greater than one hundred pounds per square inch, valve element 32 will be forced open and the excess pressure will be sufficient to move valve member 23 away from the valve element 29 (held by rod 38) and air will then be free to pass through chamber 36 and out through the open passage 27 to the atmosphere through the air cleaner.

From the foregoing description of my improved

shut-off valve mechanism it is seen that the pressure in the receiver can never drop below a predetermined minimum value which in the particular construction described is ninety pounds per square inch. This great drop in pressure will only be present when no fluid is being used from the tank for a long period of time and leakage is present to cause the pressure drop. For example, if leakage should occur at the joint between pipe 9 and the tank and no fluid under pressure is used from the tank, then when the pressure in the tank drops to ninety pounds, the pressure in the dome will also be ninety pounds and the valve element 32 will close and permit valve member 23 to assume an open position, thereby permitting the compressor to restore the original one hundred pounds per square inch pressure. This feature of my invention is quite important since it permits the operator to know if there is a leak in the system. If no air is being drawn from the tank and the pressure in the receiver shown by a gauge tends to drop back to ninety pounds each time the compressor is unloaded, he is aware that a leak is present. When it is not desired to restore the pressure in the tank to a maximum value after each time fluid is used therefrom, piston 37, rod 38 and conduit connection 40 may be eliminated. Under such conditions there must be a definite drop of at least ten pounds in the receiver before the original maximum pressure will be restored by the compressor.

It is also to be noted that the valve mechanism just described is simple in construction and very easily manufactured. The valve member 23 and piston 37 both have a free sliding fit and therefor friction between sliding parts is reduced to a minimum. Also the construction is such that no packing cups are required which tend to cause increased friction and require replacement as a result of deterioration.

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 apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a fluid pressure-actuated system adapted to be operated by fluid pressure from the receiver, a casing having a passage communicating with the intake, valve means including a movable valve member for controlling said passage, a spring for biasing the valve member to open position, means for moving said valve member to closed position by fluid pressure when the fluid pressure in the receiver is a predetermined value, means forming a relief passage through the valve member, a valve for normally closing said passage, and means controlled by fluid pressure from the fluid pressure-actuated system for opening said last named valve and relieving the pressure acting on the valve member.

2. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a fluid pressure-actuated system adapted to be operated by fluid pressure from the receiver, a casing having a passage communicating with the intake, valve means including a movable valve member for controlling said passage, a spring for biasing the valve member to open position, means for moving said valve member to closed position by fluid pressure when the fluid pressure in the receiver is a predetermined value, means forming a relief passage through the valve member, a valve for normally closing said passage, a fluid motor, means for connecting said motor to the fluid pressure-actuated system, and means operable by the fluid motor when actuated by fluid pressure in said system for opening said last named valve and relieving the pressure acting on the valve member.

3. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a fluid pressure-actuated system adapted to be operated by fluid pressure from the receiver, a casing having a passage communicating with the intake, valve means including a movable valve member for controlling said passage, a spring for biasing the valve member to open position, means for moving said valve member to closed position by fluid pressure when the fluid pressure in the receiver is a predetermined value, means forming a relief passage through the valve member, a valve for normally closing said passage, a fluid motor comprising a cylinder and a loosely mounted piston therein, means for connecting said motor to the fluid pressure-actuated system, means operable by the piston of the fluid motor when actuated by fluid pressure in said system for opening said last named valve and relieving the pressure acting on the valve member, and means for sealing said piston to prevent leakage of fluid between it and the cylinder only when the piston is in a position to open the valve.

4. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a fluid pressure-actuated system adapted to be operated by fluid pressure from the receiver, a casing having a passage communicating with the intake, valve means including a movable valve member for controlling said passage, a spring for biasing the valve member to open position, means for moving said valve member to closed position by fluid pressure when the fluid pressure in the receiver is a predetermined value, means forming a relief passage for the fluid pressure acting on the valve member, a valve for normally closing said passage, a fluid motor comprising a cylinder and a loosely mounted piston therein means for connecting said motor to the fluid pressure-actuated system, means operable by the piston of the fluid motor when actuated by fluid pressure in said system for opening said last named valve and relieving the pressure acting on the valve member, and means for sealing said piston to prevent leakage of fluid between it and the cylinder only when the piston is in a position to open the valve.

5. In apparatus tof the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber and adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, pressure-controlled valve means associated with the conduit for permitting fluid to

enter said chamber from the receiver when the pressure in the receiver is above a predetermined value, and means operable by movement of the movable valve member for causing said valve means to admit fluid to the chamber at a lower pressure value.

6. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber and adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, a valve element associated with the conduit means, a spring for biasing said valve element closed and preventing fluid from entering said chamber except when the fluid pressure in the receiver is above a predetermined value, and means operable by movement of the valve member under the action of fluid pressure in the chamber for decreasing the pressure the last named spring exerts on the valve element.

7. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, a valve element for controlling the conduit, and a spring interposed between said valve element and valve member and opposing the first named spring, said last named spring being weaker than the first named spring but of sufficient strength to maintain said valve element closed and prevent fluid from entering the chamber except when there is a predetermined pressure in the fluid receiver.

8. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, a valve element for controlling the conduit, means forming a passage through the valve member, a valve element for said passage, said valve elements opening toward the chamber, and a coil spring interposed between the valve elements, said last named spring being weaker than the first named spring but of sufficient strength to prevent fluid from entering the chamber from the receiver except when it is above a predetermined value, said last named spring also being so associated with the valve member that when said valve member is moved to closed position the spring will be permitted to expand and allow fluid to enter the chamber at a lower pressure.

9. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a fluid pressure actuated system adapted to be operated by fluid pressure from the receiver, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, a valve element for controlling the conduit, means forming a passage through the valve member, a valve element for said passage, said valve elements opening toward the chamber, a coil spring interposed between the valve elements, said last named spring being weaker than the first named spring but of sufficient strength to prevent fluid from entering the chamber from the receiver except when it is above a predetermined value, said last named spring also being so associated with the valve member that when said valve member is moved to closed position the spring will be permitted to expand and allow fluid to enter the chamber at a lower pressure, and means operable by fluid pressure from the fluid pressure-actuated system for opening the valve element which controls the passage through the valve member.

10. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a fluid pressure actuated system adapted to be operated by fluid pressure from the receiver, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber adapted to control the passage, a spring for biasing the valve member to open position, means for moving said valve member to closed position by fluid pressure when the fluid pressure in the receiver is a predetermined value, means forming a passage from the chamber, valve means for controlling said last named passage, and means controlled by fluid pressure from the fluid pressure actuated system for opening said last named valve means and quickly relieving the pressure acting on the valve member.

11. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber and adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, pressure-controlled valve means associated with the conduit for permitting fluid to enter said chamber from the receiver when the pressure in the receiver is above a predetermined value, means operable by movement of the movable valve member for causing said valve means to admit fluid to the chamber at a lower pressure value, and means forming a bleed passage from said chamber for permitting the fluid under pressure in the chamber to slowly escape when fluid under pressure is prevented from entering said chamber through the pressure-controlled valve means.

12. In apparatus of the class described, a fluid compressor provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, a valve element for controlling the conduit, a spring interposed between said valve element and valve member and opposing the first named spring, said last named spring being weaker than the first named spring but of sufficient

strength to maintain said valve element closed and prevent fluid from entering the chamber except when there is a predetermined pressure in the fluid receiver, and means forming a bleed passage from said chamber for permitting the fluid pressure in the chamber to slowly escape when fluid under pressure is prevented from entering said chamber by the valve element controlling the conduit.

13. In apparatus of the class described, a fluid compressor, provided with an intake port and an exhaust port, a fluid pressure receiver connected to the exhaust port, a fluid pressure actuated system adapted to be operated by fluid pressure from the receiver, a casing having a passage communicating with the intake, means forming a chamber, a movable valve member in said chamber adapted to control the passage, a spring for biasing the valve member to open position, conduit means for connecting the chamber with the receiver, a valve element for controlling the conduit, a spring interposed between said valve element and valve member and opposing the first named spring, said last named spring being weaker than the first named spring but of sufficient strength to maintain said valve element closed and prevent fluid from entering the chamber except when there is a predetermined pressure in the fluid receiver, means forming a bleed passage from said chamber for permitting the fluid pressure in the chamber to slowly escape when fluid under pressure is prevented from entering said chamber by the valve element controlling the conduit, and means operable by fluid pressure from the fluid pressure actuated system for quickly relieving the pressure in said chamber.

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