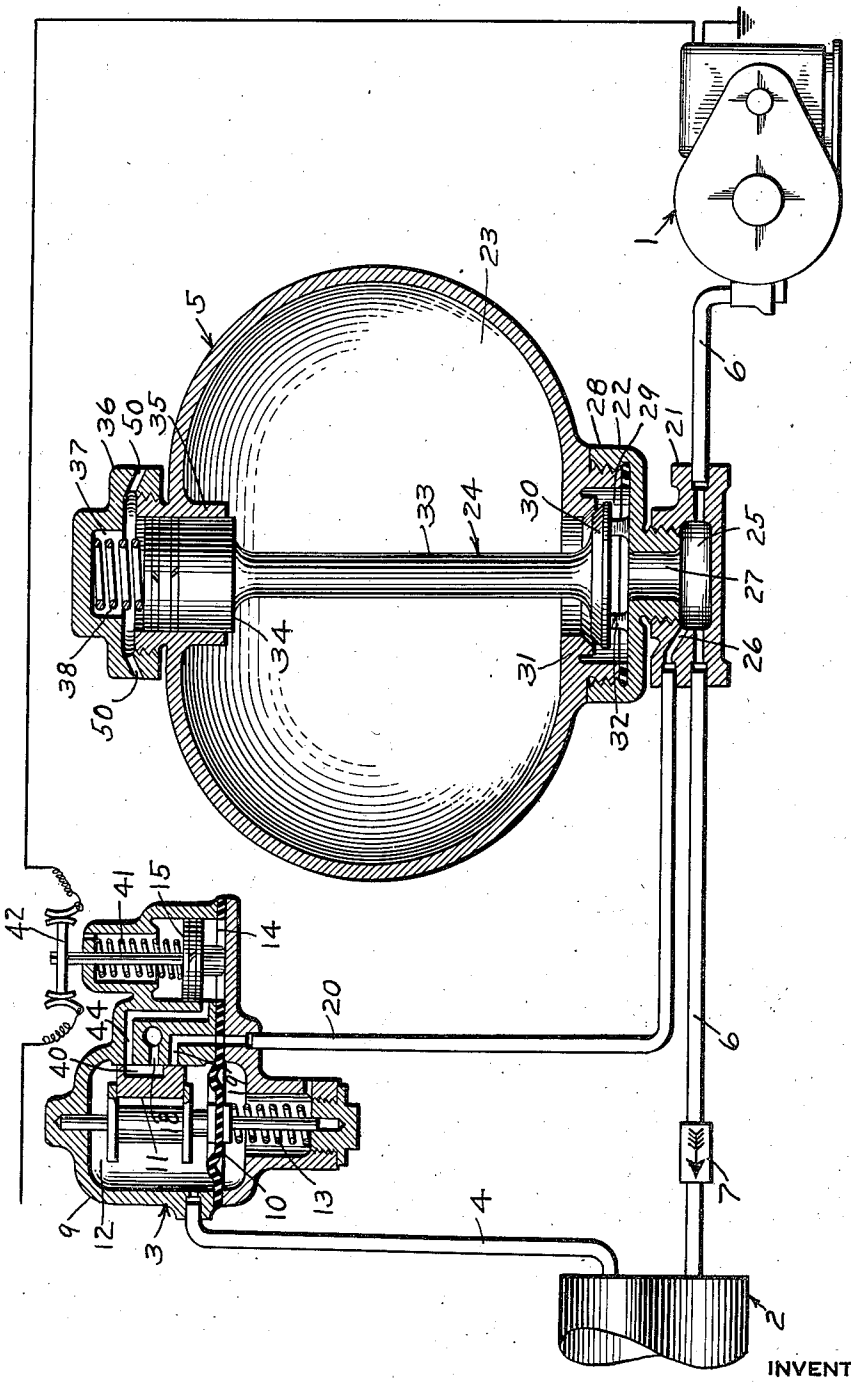
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COMPRESSOR CONTROL MEANS

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COMPRESSOR CONTROL MEANS

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This invention relates to fluid compressor systems and more particularly to that type of system employing means, including an unloading or primary reservoir, for relieving the compressor of load in starting, due to back pressure of fluid previously stored in the main reservoir of the system, and, though adapted to general use has special reference to systems in which the compressor is driven by an electric motor.

In the aforementioned class of compressors, it is usual to employ a governor subject to the pressure of fluid compressed by the compressor for controlling the opening and closing of an electric switch in the motor circuit, whereby the pump is periodically operated to maintain a certain predetermined fluid pressure in the main reservoir and associated parts of the system. The compressor in starting is of course subject to the pressure in the system, and consequently the motor starts under a considerable load, thereby consuming a corresponding heavy current which sometimes causes damage to the motor.

As shown in E. H. Dewson Patent No. 1,060,588, issued May 6, 1913, it has been proposed to obviate this difficulty by compressing the fluid into an unloading or primary reservoir or receptacle connected to the usual storage reservoir and system through a non-return check valve, and by providing means for releasing fluid from the primary reservoir when the motor is cut out and the pump stops, so that, when the motor is started, the pump operates under a light load while the speed of the motor is increasing to normal. In this arrangement the supply of fluid to the main reservoir is by way of the primary reservoir, therefore the primary reservoir must be charged with fluid to the pressure of the main reservoir. This has been found objectionable in that it wastes air and requires the pump to operate longer than necessary. This objectionable feature was recognized, for in the patent a modification is disclosed in which the primary reservoir will be maintained partially charged so as to conserve air, but in doing this the compressor will, in starting, be subjected to considerable load, which is of course objectionable.

The principal object of the invention is to provide a fluid compressor system of the above mentioned type in which the unloading or primary reservoir will be cut out of communication with the compressor when a predetermined low pressure, i. e., when a pressure lower than the main storage reservoir pressure, is built up in the primary reservoir, thereby conserving air and at the same time hastening the inflow of fluid from the compressor to the main reservoir.

In the accompanying drawing, the single figure is a diagrammatic view, partly in section, of a fluid compressor system embodying the invention.

According to the drawing, the fluid compressor system may comprise an electrically driven air compressor 1, a storage reservoir 2 and an electric compressor governor 3 connected to the storage reservoir by a pipe 4.

According to the invention, a compressor unloading apparatus 5 is interposed in the usual conduit 6 which leads from the outlet port of the compressor to the main storage reservoir 2, which apparatus is located at a point between the compressor and a non-return check valve device 7 interposed in the conduit 6 to prevent back flow of fluid from the storage reservoir to the unloading apparatus and the compressor.

The electric compressor governor 3 may, in many respects be quite similar in construction to any ordinary form of electric compressor governor. As shown, this governor comprises a casing 9 containing a regulating diaphragm 10 for actuating a control slide valve 11. The diaphragm is subject to the opposing pressures of fluid in a chamber 12 and that exerted by a control spring 13, the chamber 12 being in constant open communication with the storage reservoir 2 by way of pipe 4. The slide valve 11 is operative at one time to admit fluid under pressure from chamber 12 to a chamber 14, which chamber contains an actuating piston 15 of a motor control switch, hereinafter more fully described, and at the same time connects an exhaust port 18, leading to the atmosphere, with a port 19 connected to a pipe 20 leading from the unloading apparatus 5. This valve is operative at another time to vent fluid under pressure from the chamber 14 to the exhaust port 18.

The unloading apparatus 5 comprises a casing which may consist of a pipe connector 21, a pipe bracket 22, an unloading or primary reservoir 23 and an unloading valve mechanism 24.

The pipe connector 21 is interposed in the conduit 6 and is provided with a passage 25 which forms a part of the conduit. This passage is in constant communication with a passage 26 leading to the pipe 20.

The pipe bracket 22 has screw threaded connection with the pipe connector 21 and is provided with a passage 27 which is constantly open at one end to the passage 25 in the pipe connector. This bracket is provided with an annu-

lar portion 28 to which the casing of the unloading reservoir is removably secured by means of cooperating screw threads on the casing portion. The pipe bracket and the casing define a chamber 29 which is constantly open to the passage 27.

Contained in chamber 29 is an unloading valve 30 which constitutes a part of the unloading valve mechanism 24, and which is operative into and out of sealing engagement with a valve seat 31 formed on the casing for controlling communication between the chamber 29 and the unloading or primary reservoir 23. The pipe bracket is provided with stop lugs 32 which, when the valve is unseated, maintains the outer face of the valve head spaced away from the passage 27, so as to at all times ensure the free flow of fluid to or from the chamber 29.

The unloading valve is provided with a stem 33 which extends across the interior of the unloading reservoir 23 and at its end is provided with an actuating piston 34 which is operatively mounted in a cylinder 35 formed in the casing of the reservoir. Exteriorly of said casing there is adjustably secured to the outer end of the cylinder, by means of screw threads, a cap 36 which, together with the outer face of the piston, define a chamber 37 which is constantly open to the atmosphere by way of ports 50 provided in the cap.

Contained in the chamber 37 and interposed between and operatively engaging the outer face of the piston and an inner surface of the cap is a relatively light spring 38 which biases the piston in its valve unseating direction.

Operation

Assuming that the fluid under pressure in the storage reservoir 2 and in the connected governor chamber 12 is depleted to some pressure below the opposing pressure of the control spring 13, the various operating parts of the governor 3 will be in the position shown in the drawing, since the diaphragm 10 and connected slide valve chamber 11 will be maintained in this position by the control spring 13. Under these conditions a cavity 40 in the slide valve 11 will establish communication between chamber 14 and the atmospheric port 18, so that fluid under pressure in chamber 14 will be vented to the atmosphere, and a spring 41, forming part of the motor control switch mechanism, will move the switch actuating piston 15 to its lowermost position, in which position switch 42 closes the electrical circuit from the source of electrical energy, not shown, to the compressor driving motor.

At the same time, the operating parts of the unloading apparatus 5 will be in the positions shown in the drawing, since the spring 38 holds the valve 30 unseated.

Now with the motor circuit closed, the motor operates to drive the compressor so as to supply fluid under pressure to the compressor discharge conduit 6. Fluid under pressure supplied to conduit 6 flows from passage 25 of the pipe connector 21, through passage 27 of the pipe bracket to chamber 29, from whence it flows past unseated valve 30 to the unloading or primary reservoir 23. The flow of fluid under pressure to reservoir 23 continues until the pressure of fluid therein acting on the piston 34 is sufficient to overcome the opposing force of spring 38, at which time the piston acts to move the unloading valve 30 into engagement with the seat 31, thereby cutting off the flow of fluid under pressure from chamber 29 to the unloading reservoir 23. The value of the spring 38 may be such that when the pressure of reservoir 23 has been increased, to approximately ten pounds it will yield to the action of the piston 34. It should here be mentioned that the diameter of the inner seated area of the valve and the diameter of the actuating piston are substantially equal and that while the valve is open the pressure on the opposite sides of the valve will be equal.

The compressor 1 continues to operate to supply fluid under pressure to conduit 6 so that the pressure in the conduit is now quickly built up to a degree in excess of the opposing pressure of fluid in the storage reservoir 2, thus ensuring flow of fluid through the check valve device 7 to the storage reservoir, thereby increasing the pressure in the storage reservoir and consequently the pressure of fluid in chamber 12 until the pressure in this chamber is sufficient to overcome the opposing action of the control spring 13, at which time diaphragm 10 will be deflected downwardly thereby moving slide valve 11 to its lower position.

It will be here noted that the pressure of fluid in chamber 29 acting on the outer face of the valve 30 will now maintain the valve seated even though the pressure of fluid in the unloading or primary reservoir 23 should be reduced by leakage of fluid past the piston 34 to the atmosphere.

With the slide valve 11 in its lower position it establishes communication between chambers 12 and 14 by way of a port 44 which has been uncovered by the valve 11. With this communication established fluid under pressure flows from chamber 12 to chamber 14 and acts on the piston 15 in opposition to the force of the spring 41. When the fluid pressure is sufficient to overcome the opposing force of the spring the piston 15 is caused to move upwardly, operating the switch 42 to its circuit opening position, thus bringing the motor to a stop.

Further, with the slide valve 11 in its lower position the cavity 40 in the valve establishes communication between the exhaust port 18 and port 19 so that fluid under pressure in pipe 8, chamber 25, connected chamber 29 and adjacent portion of the discharge conduit 6 are vented to the atmosphere, check valve 7 preventing back flow of fluid under pressure from the storage reservoir 2 to the conduit 6. When the pressure of fluid in chamber 29 has been reduced to a pressure lower than the value of spring 38, that is to say below ten pounds, the spring acting through the medium of piston 34 and stem 33 moves valve 30 away from its seat 31, thereby connecting the unloading or primary reservoir 23 to chamber 29, so that fluid under pressure in the unloading reservoir 23 is also vented to the atmosphere.

When the pressure in the reservoir 2 and connected chamber 12 is reduced to a predetermined degree, the diaphragm 10 and connected slide valve 11 is moved under the influence of the force of the spring 13 to the position shown in the drawing. With the slide valve 11 in this position communication between chambers 12 and 14 and between port 19 and atmospheric port 18 is disestablished and communication between chamber 14 and the atmosphere is established by way of port 44, cavity 40 in the slide valve 11 and exhaust port 18, thus venting fluid under pressure from chamber 14. Upon the venting of fluid under pressure from chamber 14, spring 41 acts

to move piston 15 to the position shown in the drawing thereby closing the electrical circuit to the compressor motor, so that the compressor will again operate to supply fluid under pressure to the reservoir 2.

It will be noted, that upon starting there is substantially no resistance to the operation of the compressor since the pressure in the discharge conduit 6 on the compressor side of the check 7, unloading or primary reservoir 23 and pipe 8 have been maintained vented during the rest period of the compressor as hereinbefore described. This permits the compressor, therefore, to take up its load gradually, and in fact, to start without imposing an overload on the driving motor.

It will be understood that the unloading or primary reservoir 23 is of such a size as to permit the driving motor of the compressor to reach its normal speed before the heaviest load is imposed thereon.

From the foregoing description it will now be seen that the apparatus functions to cause the compressor to operate in an unloaded state until the full running speed is attained. It will also be seen that since the pressure obtained in the unloading or primary reservoir is limited to some low degree, such for instance ten pounds, the air loss due to unloading is reduced to a minimum.

While one embodiment of the improved unloading valve means has been illustrated and described in detail, it should be understood that the invention is not limited to the exact details of construction disclosed and that numerous changes and modifications may be made without departing from the scope of the following claims.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a pressure control apparatus, the combination with a compressor and a compressor governor subject to the pressure of fluid discharged by the compressor, of an unloading receptacle into which said compressor compresses fluid, means independent of said governor and subject to the pressure of fluid discharged by said compressor for limiting the pressure of fluid supplied to said receptacle, and other means operated by a moving part of said governor for effecting operation of said means to effect the release of fluid under pressure from said receptacle.

2. In a pressure control apparatus, the combination with a compressor, a storage reservoir into which said compressor compresses fluid, and a compressor governor subject to storage reservoir pressure, of an unloading device interposed between the compressor and said reservoir comprising a chamber into which said compressor compresses fluid, said device including valve means independent of said governor for limiting the pressure of fluid supplied to said chamber, and means operated by a moving part of said governor for effecting operation of said valve means to effect the release of fluid under pressure from said chamber.

3. In a pressure control system, the combination with a compressor, a main storage reservoir charged with fluid discharged by said compressor, a conduit through which fluid discharged by said compressor is supplied to said storage reservoir, a check valve located in said conduit and interposed between the storage reservoir and the compressor for preventing back flow of fluid from said storage reservoir to the compressor, a governor subject to variations in pressure in said reservoir, said governor having one position for effecting the cutting in and another position for effecting the cutting out of said compressor, of a primary reservoir connected to said conduit intermediate the check valve and the compressor, and charged with fluid discharged by said compressor to a lower pressure than the pressure in said storage reservoir, means for cutting off the discharge of fluid from said compressor to said primary reservoir upon an increase in pressure therein to said lower pressure, and valve means operated upon movement of said governor to cut-out position for effecting operation of said means to effect the release of fluid under pressure from said primary reservoir.

4. In a compressor unloading apparatus, the combination with a compressor, a compressor governor for cutting the compressor into or out of action and a receptacle for receiving fluid supplied by the compressor to permit the compressor to start operating without load, of a valve mechanism separate from said governor for controlling the supply of fluid to and the release of fluid from said receptacle, said mechanism comprising a valve having a cut-off position for cutting off the supply of fluid from the compressor to the receptacle, and means operative by fluid in the receptacle for actuating said valve to its cut-off position, and other means for rendering the first mentioned means effective to actuate said valve to its cut-off position upon a predetermined increase in the pressure of fluid supplied to said receptacle.

5. In a compressor unloading apparatus, the combination with a compressor, a compressor governor having a cut-in position for cutting the compressor into action and a cut-out position for cutting the compressor out of action, and a receptacle for receiving fluid supplied by the compressor to permit the compressor to start operating without load, of a valve mechanism for limiting the supply of fluid to said receptacle, said mechanism comprising a valve operative to cut-off the flow of fluid from the compressor to the receptacle, a spring, and a movable abutment subject to the opposing pressure of fluid in the receptacle and said spring, for actuating said valve to its cut-off position, and valve means controlled by said governor, and operative in the cut-in position thereof, for rendering said abutment operative upon a predetermined increase in the pressure of fluid supplied to said receptacle to actuate said valve to its cut-off position.

6. In a pressure control apparatus, the combination with a compressor and a compressor governor, of an unloading reservoir into which said compressor compresses fluid to permit the compressor to take up its load gradually, of a valve mechanism separate from the governor and interposed between the compressor and the unloading reservoir for limiting the supply of fluid to said reservoir, said mechanism comprising a valve having a cut-off position for cutting off said supply, and means subject to the pressure of fluid in said reservoir for actuating said valve to said cut-off position, and other means operated by a moving part of said governor for conditioning said means.

7. In a pressure control system, the combination with a storage reservoir charged with fluid to a predetermined maximum pressure, a compressor for supplying fluid under pressure to said reservoir, means subject to the maximum pressure of fluid in the storage reservoir for cutting the compressor out of action and operative upon a certain reduction in the storage reservoir pres-

sure for cutting the compressor into action, an unloading reservoir for receiving fluid supplied by the compressor to permit the compressor to start operating without load, of a valve operative to cut off the flow of fluid from the compressor to the unloading reservoir, and means operative by fluid in the unloading reservoir at a pressure lower than the reduced pressure of the storage reservoir for actuating said valve to its cut-off position.

8. In a pressure control system, the combination with a storage reservoir charged with fluid to a predetermined maximum pressure, a compressor for supplying fluid under pressure to said reservoir, means subject to the maximum pressure of fluid in the storage reservoir for cutting the compressor out of action and operative upon a certain reduction in the storage reservoir pressure for cutting the compressor into action, an unloading reservoir for receiving fluid supplied by the compressor to permit the compressor to start operating without load, of a valve having a cut-off position for opening communication between the compressor and the unloading reservoir and a cut-in position for closing communication between the compressor and the unloading reservoir, means for actuating said valve, said means comprising a movable abutment subject to the opposing pressures of fluid under pressure in said unloading reservoir and a spring and operative upon an increase in the pressure of fluid therein to a pressure lower than the reduced pressure of the storage reservoir for actuating said valve to its cut-off position and operative upon a decrease in the pressure of fluid acting on said compressor to a value below the value of said spring for actuating said valve to its cut-in position, said first mentioned means effecting a release of fluid under pressure acting in said compressor when subject to the maximum pressure of fluid in the storage reservoir.

9. In a pressure control system, the combination with a storage reservoir charged with fluid to a predetermined maximum pressure, a compressor for supplying fluid under pressure to said reservoir, a governor comprising a valve mechanism subject to the maximum pressure of fluid in the storage reservoir for cutting the compressor out of action and operative upon a certain reduction in the storage reservoir pressure for cutting the compressor into action, a conduit through which fluid is supplied from said compressor to the storage reservoir, of a chamber forming a part of said conduit, a fluid conducting communication for releasing fluid under pressure from said chamber, said valve mechanism being operative when subject to maximum pressure of fluid in the storage reservoir to open said communication and operative upon said reduction in the storage reservoir pressure to close said communication, an unloading reservoir for receiving fluid supplied by said compressor to permit the compressor to take-up its load gradually, a valve for controlling communication between the chamber and the unloading reservoir, means for actuating said valve, said means being operative to close said valve and thereby cut-off the flow of fluid from said chamber to said unloading reservoir when the pressure of fluid supplied to the unloading reservoir has been increased to a pressure considerably lower than the reduced pressure in the storage reservoir and to open said valve and thereby permit the flow of fluid from the unloading reservoir to the chamber upon a predetermined reduction in the pressure of fluid in said chamber when the pressure of fluid in the storage reservoir has been increased to said maximum degree, and a check valve located in said conduit between said storage reservoir and said chamber for preventing back flow from said storage reservoir to said chamber.

10. In a pressure control system, the combination with a storage reservoir, of a compressor unloading reservoir, a compressor for supplying fluid under pressure to both of said reservoirs, said unloading reservoir being interposed between said storage reservoir and the compressor, a governor subject to a chosen maximum fluid pressure in the storage reservoir for cutting the compressor out of action and operative upon a certain reduction in the storage reservoir pressure for cutting the compressor into action, and means for isolating the unloading reservoir from the compressor and storage reservoir, said means comprising a valve mechanism operative upon an increase in the pressure of fluid in the unloading reservoir prior to obtaining the maximum pressure in said storage reservoir.

11. In a pressure control system, the combination, with a storage reservoir normally charged with fluid to a maximum chosen pressure, of a compressor unloading reservoir normally at atmospheric pressure, a compressor for supplying fluid under pressure to said storage reservoir, said unloading reservoir being interposed between said storage reservoir and the compressor and being normally in open communication with the compressor, a compressor governor subject to the pressure of fluid in the storage reservoir for normally cutting the compressor out of action and connecting said unloading reservoir with the atmosphere, said compressor governor being operative upon a reduction in the pressure of fluid in the storage reservoir for cutting the compressor into action and for closing the atmospheric communication from the unloading reservoir to the atmosphere, and means operative upon a predetermined increase in the pressure of fluid supplied by the compressor to said unloading reservoir for cutting off the communication between the compressor and the unloading reservoir.

12. An unloading mechanism for a fluid compressor system of the type which permits the compressor in starting to take up its load gradually, said mechanism comprising an unloading chamber for receiving fluid supplied by the compressor, a valve operative to cut off the flow of fluid from the compressor to the chamber, and means subject to a chosen increase in the pressure of fluid in said chamber for actuating said valve to its cut-off position.

13. An unloading mechanism for a fluid compressor system of the type which permits the compressor in starting to take up its load gradually, said mechanism comprising an unloading chamber for receiving fluid supplied by the compressor, a valve operative to cut off the flow of fluid from the compressor to the chamber, and means disposed in said chamber subject to a chosen increase in the pressure of fluid in said chamber for actuating said valve to its cut-off position.

14. An unloading mechanism for a fluid compressor system of the type which permits the compressor in starting to take up its load gradually, said mechanism comprising an unloading chamber for receiving fluid supplied by the compressor, a valve operative to cut off the

flow of fluid from the compressor to the chamber, and means comprising a movable abutment disposed in said chamber subject to a chosen increase in the pressure of fluid in said chamber and an opposing pressure for actuating said valve to its cut-off position.

15. An unloading mechanism for a fluid compressor system of the type which permits the compressor in starting to take up its load gradually, said mechanism being adapted to be interposed in the system between the compressor and a storage reservoir and comprising a chamber for receiving fluid supplied by the compressor, a valve having a cut-off position for cutting off the supply of fluid to said chamber, a spring, a movable abutment mounted in said chamber subject to the opposing pressures of fluid in the chamber and that of said spring and being operative upon a chosen increase in the pressure of fluid in the chamber for actuating said valve to its cut-off position.

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