

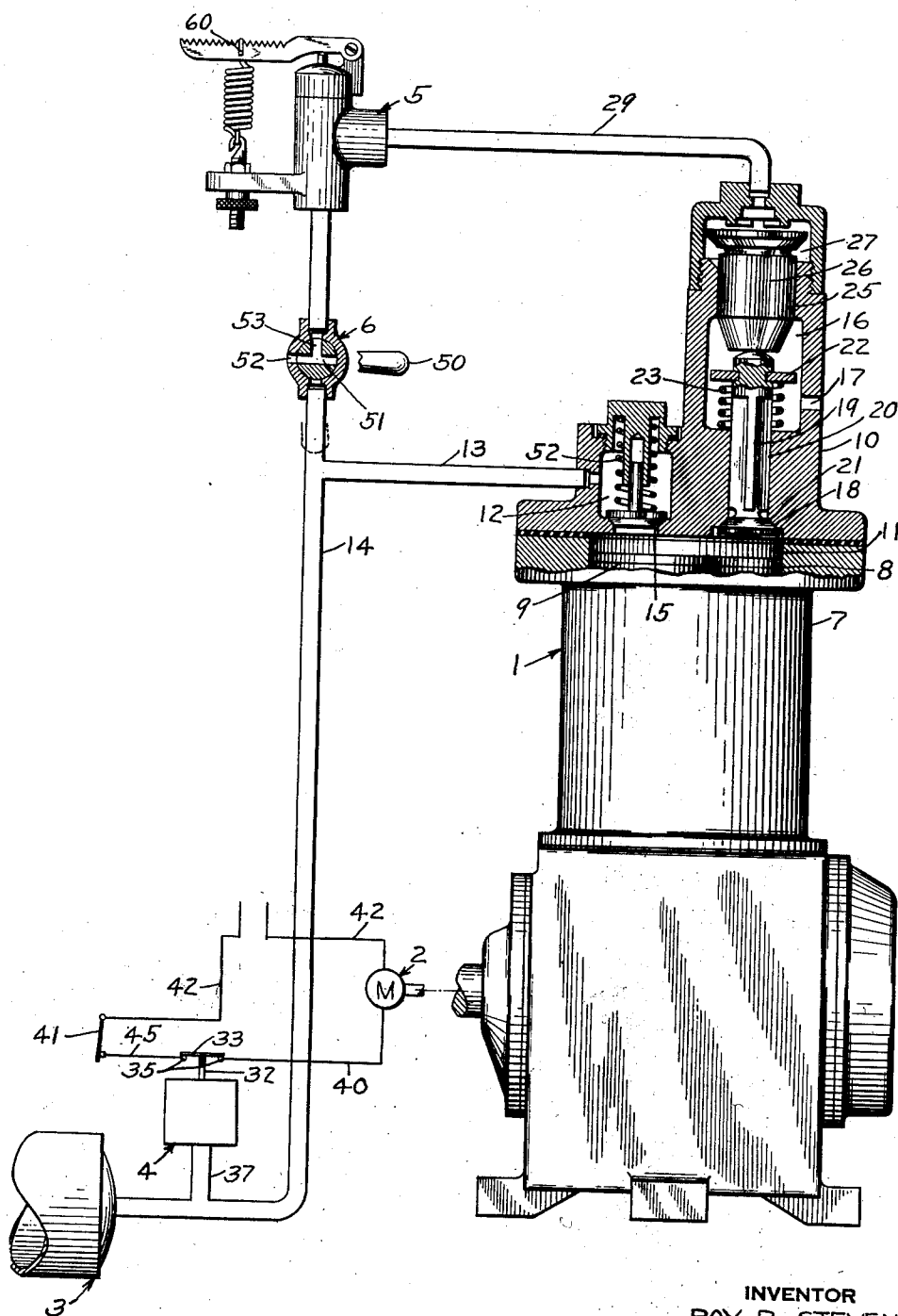
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COMPRESSOR CONTROL SYSTEM

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COMPRESSOR CONTROL SYSTEM

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This invention relates to fluid compressor systems and more particularly to improved control means for automatically controlling the operation of the compressor thereof.

As is well known in the compressor art, it is desirable to automatically regulate the output of the compressor in accordance with the fluid pressure requirements. It is also well known that when the demand for fluid pressure is definitely intermittent, that is, when the normal use of fluid under pressure is spasmodic, an automatic start and stop compressor control method is quite generally employed. With this type of control the usual practice is to employ a fluid pressure actuated switch which is responsive to the pressure of fluid in the storage reservoir, which switch is operative to start the compressor when the pressure of the fluid in the storage reservoir drops to some predetermined pressure and operative to automatically stop the compressor when the pressure in the reservoir is raised to some predetermined higher pressure.

It is also well known that in fluid compressor systems where the demand for fluid under pressure is relatively constant, that is, where the normal fluid pressure requirement approaches the capacity of the compressor, a continuous operating compressor control method is usually employed. With this type of control the compressor operates continuously and is provided with an unloading mechanism responsive to the pressure of fluid in the reservoir, which mechanism is arranged to load the compressor when the demand for fluid under pressure continues and to unload the compressor when the demand for fluid under pressure falls off momentarily.

It is the principal object of the invention to provide a fluid compressor system having a control system for the compressor adapted to be conditioned to impart different operating characteristics to the compressor.

Another object of the invention is to provide an improved control means for conditioning a fluid compressor system so as to selectively regulate the operation of the compressor by either the automatic start and stop method or by the continuous compressor operating method, according to the demand for fluid under pressure.

In the accompanying drawing the single figure is a diagrammatic view of the compressor system embodying my invention.

Referring to the drawing, the equipment illustrated comprises a fluid compressor 1, driven by

an electric motor 2, which compresses fluid under pressure into a reservoir 3.

The control system for imparting different operating characteristics to the compressor may include a fluid pressure controlled switch device 4, an unloading control valve device 5 and a cut out cock 6.

The compressor 1 may be of any well known construction and may comprise a cylinder body 7 having a bore 8 in which is mounted a reciprocating piston 9. The top of the bore 8 is closed by a cylinder head 10 thereby forming a compression chamber 11 at the face of the piston 9. The head 10 has formed therein a discharge chamber 12 which is connected to the reservoir 3 by means of a discharge pipe 13 and a connected pipe 14. Contained in this chamber is the usual discharge valve 15, for controlling communication from the compression chamber 11 to the discharge chamber 12.

The head 10 is also provided with an inlet chamber 16 which is in constant open communication with the atmosphere by way of a passage 17 and is connected to the compression chamber 11 through a bore 20. Surrounding the bore 20 at the end adjacent the compression chamber 11 is a valve seat 21. An inlet valve 18 having seating engagement with said seat is provided for controlling communication between the compression chamber 11 and inlet chamber 16. This valve has a fluted operating stem 19 which extends through the bore 20 into the chamber 16 and which carries at its end a spring follower 22 which is subject to the pressure of a coil spring 23 acting through said stem to urge the valve 18 to its seat.

The head is further provided with a bore 25 in which is mounted a piston valve 26, which is subject on one side to the pressure of fluid in a chamber 27, while the other face of the piston is engaged by the stem 19 of the inlet valve 18. The piston valve 26 has a seating face which is adapted to engage a seat formed on the head surrounding the bore 25 to cut off communication between chambers 16 and 27, the latter chamber being constantly connected to the unloading control valve device 5, by way of a pipe 29.

The unloading control valve device 5 is also connected to the reservoir 3 by way of the pipe 14 and operates in response to the pressure of the fluid in the reservoir 3 to control the supply of fluid under pressure from the reservoir 3 to the chamber 27, and to also control the release of fluid from the chamber 27.

The unloading control valve device 5 may be

of any well known construction, and one form of device which I have chosen to employ is shown in Patent No. 1,972,751, of B. S. Aikman.

The fluid pressure controlled switch device 4 may be of any well known construction comprising a stem 32 carrying, in insulated relation, a movable contact member 33 for connecting or disconnecting a pair of stationary contacts 35 and a pressure regulating portion adapted at predetermined pressures to effect operation of the switch portion, which pressure regulating portion is connected to the reservoir 3 by way of pipe 14 and a connected pipe 37.

One of the stationary contacts 35 is connected to the electric motor 2, by means of a conductor 40, and the other contact 35 is connected to a manually operated switch 41, by means of a conductor 45. The switch 41 is also connected to the motor 2 by means of a conductor 42 and is interposed in a circuit leading from a source of electrical energy, not shown.

The cut out cock 6 is provided for cutting in or cutting out the unloading control valve device 5 and is interposed in pipe 14 intermediate said valve device and the compressor discharge pipe 13. This cut out cock is of the usual plug type and has a through passage 51 in the plug adapted to be in open or closed position, and an atmospheric connection 52 is adapted to vent one side of the passage when the cock is closed.

Operation

Let it be assumed that it is desired to operate the compressor by the automatic start and stop control method. Under these conditions the handle 50 of the cock 6 will be positioned as shown in the drawing, in which position communication between the reservoir 3 and the unloading control valve device 5 will be cut off and communication between the unloading control valve device 5 and the atmosphere will be established. The communication from the control valve device 5 to the atmosphere is established by way of that portion of pipe 14 intermediate said valve device and the cut out cock 6, a passage 53 and connected passage 51, in the cock, which latter passage registers with the atmospheric port 52 in this position of the cock. With that portion of the pipe 14 intermediate the unloading control valve device and the cut out cock 6 vented, the unloading control valve device will operate in the usual manner to vent chamber 27, by way of pipe 29 and an atmospheric communication in said valve device.

With the chamber 27 connected to the atmosphere, the piston valve 26 will not exert any appreciable pressure on the stem 19 of the inlet valve 18, with the result that the spring 23 will hold the valve 18 seated and the piston valve 26 unseated, as shown in the drawing.

Since the compressor has not yet been caused to operate, the reservoir 3 is devoid of fluid under pressure and as a consequence the fluid pressure controlled switch device 4 acts through the medium of the stem 32 to maintain the contact member 33 in engagement with the stationary contacts 35. When it is desired to set the compressor in operation the switch 41 is manually moved to its circuit closing position, as shown in the drawing, thus closing the power circuit to the motor 2.

With the above circuit closed the motor operates to drive the compressor in the usual manner. On the suction stroke of the compressor piston 9, fluid under pressure is drawn into the

compression chamber 11 from the atmosphere, by way of passage 17, chamber 16, bore 20 and past inlet valve 18, which is moved away from its seat by the fluid being drawn in the compressor. On the compression stroke of the piston 9, the valve 18 is moved to the seated position by the spring 23. The fluid in the compression chamber 11 is compressed and moves the discharge valve 15 away from its seat against the pressure of a spring 52 to permit fluid under pressure to flow to the discharge chamber 12 and thence by way of discharge pipe 13 and connected pipe 14 to the reservoir 3. Fluid under pressure supplied to pipe 14 also flows through connected pipe 37 to the fluid pressure controlled switch device 4.

When the pressure of fluid supplied by the compressor to the reservoir 3 and to the connected switch device 4 has increased to a predetermined degree, for instance to around 82 pounds, the fluid pressure controlled switch device 4 operates to effect upward movement of the stem 32 and attached movable contact member 33. This movement will cause separation of the contact member 33 from the stationary contacts 35, thus the motor circuit is opened and, as a consequence, the motor and compressor come to a stop.

When the pressure of fluid in the reservoir 3 and in the connected fluid pressure controlled switch device 4 decreases to some predetermined value, for instance to around 62 pounds, the fluid pressure switch device operates to effect downward movement of the stem 32 and attached movable contact member 33. This movement causes the movable contact member to move into engagement with the stationary contacts 35, so that the electrical circuit to the driving motor 2 is closed as hereinbefore described. The compressor now operates to compress fluid into the reservoir 3.

From the foregoing it will be understood that when the compressor is controlled by the automatic start and stop control method, the operating range between cutting-out and cutting-in pressure will be determined by the setting of the fluid pressure controlled switch device 4, in the usual manner.

When it is desired to operate the compressor by the continuous compressor operating method all that is necessary to do is to rotate the handle 50 of the cut-out cock 6 to the position indicated in dotted lines in the drawing.

With the handle of the cut-out cock in this position communication between that portion of pipe 14 intermediate the cock and the unloading control valve device 5 and the atmosphere is cut off, and communication between the reservoir 3 and the unloading control valve device 5 established. This latter communication is established by way of pipe 14, passage 51 in the cock 6 and that portion of pipe 14 intermediate the cock and the control valve device.

Assuming that the system is devoid of fluid under pressure, the unloading control valve device 5 will be in a condition to connect valve chamber 27 to the atmosphere. The adjusting mechanism 60 of the unloading control valve device 5 will be adjusted so as to operate to unload the compressor before the pressure in the reservoir 3 is increased to that required to operate the pressure controlled switch device 4, and will operate to load the compressor at some predetermined lower pressure.

Now when the manually operated switch 41 is

moved to its circuit closing position as shown, the compressor will be caused to operate to supply fluid under pressure to the reservoir 3 by way of discharge pipe 13 and pipe 14. Fluid under pressure thus supplied to pipe 14 also flows to the fluid pressure controlled switch device 4 by way of pipe 37. Fluid under pressure also flows from pipe 14 to the unloading control valve device 5, by way of passage 51 in the cut-out cock 6 and that portion of pipe 14 intermediate the cock 6 and the control valve device 5.

When the pressure of fluid supplied to the reservoir 3 and to the unloading control valve device 5 has been increased to around 78 pounds the device will function to cut-off communication between chamber 27 and the atmosphere and establish communication between reservoir 3 and chamber 27, by way of pipe 14, passage 51 in the cut-out cock 6, the control valve device 5 and pipe 29.

With this communication established fluid under pressure at reservoir pressure flows to chamber 27 and causes the piston valve 26 to move downwardly into seating engagement with its seat, thus preventing loss of fluid from the chamber 27 to the atmosphere past piston valve 26, inlet chamber 16 and passage 17. Movement of the piston valve 26 to this position causes the inlet valve 18 to move to its unseated position, through the medium of the stem 19. Upon movement of the inlet valve 18 to its unseated position, the compression chamber 11 is connected to the atmosphere by way of bore 20, inlet chamber 16 and passage 17, so that the compressor operates without compressing fluid into the reservoir 3.

When the pressure of fluid in the reservoir 3 and acting in the unloading control valve device 5 has decreased to around seventy pounds the device functions to cut-off communication between chamber 27 and the reservoir and open communication between chamber 27 and the atmosphere. Upon establishing this latter communication fluid under pressure in chamber 27 will be vented to the atmosphere and the spring 23 will act to return the piston valve 26 to its unseated position and the inlet valve 18 to its seated position. When this occurs the compressor operates as hereinbefore described to compress fluid into the reservoir 3.

It will here be noted that since the reservoir pressure cannot be increased above seventy-eight pounds, the fluid pressure controlled switch device 4, which responds only to a higher pressure (eighty-two pounds) to open the motor circuit, will remain in its circuit closing position during the time the equipment is conditioned for the continuous operation of the compressor.

From the foregoing it will be obvious that either one or the other of the two described control methods may be employed to control the operation of the compressor without interference from the other.

It will also be noted that this type of dual control system provides a safety feature, in that should the continuous operating compressor control method fail to unload the compressor at the desired pressure, the fluid pressure controlled switch device 4 will function to stop the compressor upon an increase in the pressure of fluid in the reservoir 3 to eighty-two pounds, the cutting-out setting of the device, thereby causing the compressor to come to a stop before the reservoir pressure is increased to an undesired excessive degree.

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

1. In a fluid compressor system, in combination, a reservoir, a fluid compressor for supplying fluid under pressure to said reservoir, means for driving the compressor, control means responsive to variations in the pressure of fluid in said reservoir for loading or unloading the compressor, a fluid pressure discharge communication leading from the compressor, a fluid conducting passage connected to said communication, through which fluid under pressure is supplied from said compressor to said reservoir and to said control means, switch means interposed in said passage intermediate said reservoir and said discharge communication and responsive to fluid in the reservoir for automatically controlling said driving means to start or stop the compressor, and manually operated valve means interposed in said passage, said means having one position in which the passage between the reservoir, the compressor and the control means is open to permit variations in pressure acting on said control means to load or unload the compressor and having another position in which said passage is closed at a point intermediate the control means and the compressor and reservoir for effecting the operation of said control means to load the compressor and to render the switch means operative to start and stop the compressor.

2. In a fluid compressor of the type having a storage reservoir, a fluid compressor for supplying fluid under pressure to said reservoir, in combination, automatically operative means to effect the loading and unloading of the compressor including a chamber adapted to be connected to said reservoir, said means being operative to load said compressor upon a drop in the pressure of fluid in said reservoir and thereby said chamber to some predetermined pressure and operative to unload the compressor upon an increase in the pressure of fluid in said reservoir and thereby said chamber to some predetermined higher pressure, automatically operative means responsive to the pressure of fluid in said reservoir to effect the starting and stopping of said compressor, said means being operative to start the compressor upon a drop in the pressure of fluid in said reservoir to some predetermined pressure below that at which the first mentioned means loads the compressor and operative to stop the compressor upon an increase in the pressure of fluid above that at which the first mentioned means unloads the compressor, and means operative for rendering either the means for loading and unloading or the means for starting and stopping the compressor effective, said means having one position for establishing communication between said reservoir and said chamber for rendering said loading and unloading means effective and another position for cutting off communication between said reservoir and said chamber and for venting fluid under pressure from said chamber to effect loading of said compressor and for rendering said starting and stopping means effective.

3. In a fluid compressor system of the type having a storage reservoir and a fluid compressor for supplying fluid under pressure to the reservoir, in combination, unloading means responsive to an increase in fluid under pressure for unloading the compressor and responsive to a decrease in fluid under pressure for loading the compressor, regulating means responsive to var-

iations in fluid under pressure in said reservoir for controlling the supply of fluid under pressure to and the release of fluid under pressure from said unloading means, said regulating means being operative to release fluid under pressure from said unloading means to effect loading of the compressor upon a drop in the pressure of fluid in said reservoir to some predetermined pressure and operative to supply fluid under pressure to said unloading means to effect unloading of the compressor upon an increase in the pressure of fluid in said reservoir to some predetermined higher pressure, pneumatically operated switch means responsive to the pressure of fluid in said reservoir to effect the starting and stopping of said compressor, said switch means being operative to start the compressor upon a drop in the pressure of fluid in said reservoir to some predetermined pressure below that at which the regulating means operates to release fluid under pressure from the unloading means to effect load-

ing of the compressor and operates to stop the compressor upon an increase in the pressure of fluid above that at which the regulating means operates to supply fluid under pressure to the unloading means to effect unloading of the compressor, and valve means having one position for establishing communication between the reservoir and the regulating means to permit variations in the pressure of fluid in the reservoir to effect operation of the regulating means to supply or release fluid under pressure from the unloading means and having another position in which communication between the reservoir and the regulating means is cut off and communication between the regulating means and the atmosphere is established to effect operation of the regulating means to release fluid under pressure from the unloading means to effect loading of the compressor and to render the switch means operative to start and stop the compressor.

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