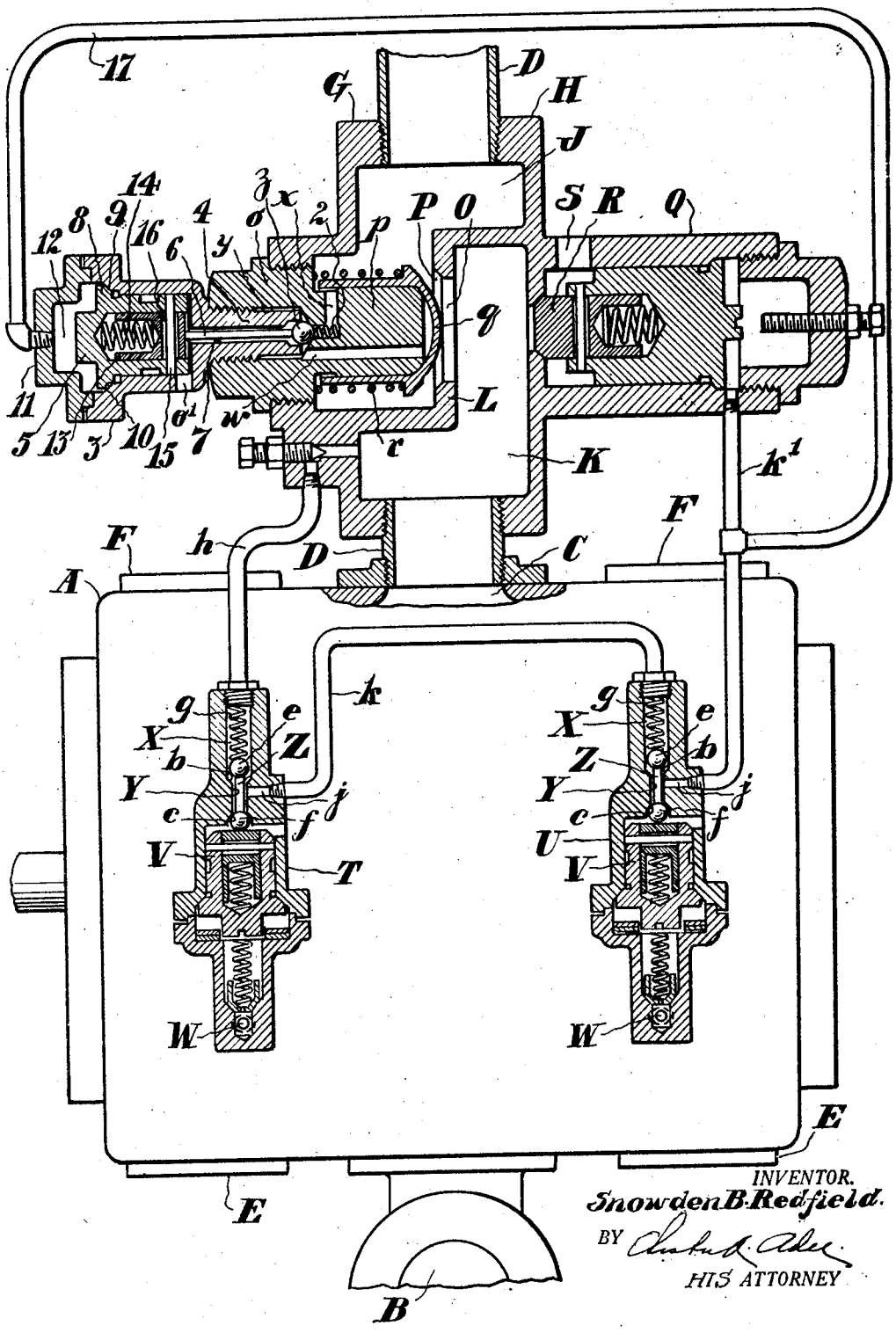
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DAMPER FOR CHECK VALVES

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DAMPER FOR CHECK VALVES.

Application filed March 17, 1928. Serial No. 262,436.

This invention relates to compressors, but more particularly to a damper for check valves of the type used for controlling the flow of pressure fluid from the compressor cylinder into the discharge line of the compressor.

One object of the invention is to prevent chattering or pounding of the check valve. This is accomplished in the present instance by suitable pressure responsive means adapted to maintain the check valve closed during the starting, stopping and idle periods of the compressor and to enable the check valve to remain constantly open during the running period of the compressor.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention consists of the combination of elements and arrangement of parts having the general mode of operation substantially as hereinafter described and claimed and illustrated in the accompanying drawing, in which the figure is a longitudinal elevation of a portion of a compressor having the invention applied thereto.

Referring more particularly to the drawing, A designates a compressor cylinder having an inlet connection B and a discharge opening C in its upper side to which is connected a discharge line D. Inlet and exhaust valves E and F respectively are indicated for controlling the admission of air into the cylinder and the exhaust of the compressed fluid from the cylinder into the discharge line D.

Interposed in the discharge line D is an unloader G of the type described and illustrated in United States Patent No. 1,484,673 entitled Compressor unloader and granted to Snowden B. Redfield, February 26, 1924. The unloader G accordingly comprises a casing H divided into chambers J and K by a wall L having a port O which terminates at the end adjacent the chamber J in a valve seat P.

In a hollow extension Q forming part of the casing H is a relief valve R which controls communication between the chamber K and a vent S in the extension for maintaining the compressor cylinder A unloaded during the starting period of the compressor.

As in the aforesaid patent, the compressor cylinder A is provided at its ends with pilot valves T and U in which are disposed pistons V adapted to be actuated by pressure fluid entering the pilot valves T and U beneath said pistons V through openings W near the ends of the cylinder.

In the upper portions of the pilot valves T and U are passages X having restricted portions Y to receive plungers or rods Z. The upper and lower ends of the restricted portions Y terminate in valve seats *b* and *c* respectively to accommodate ball valves *e* and *f* which are held in spaced relation with respect to each other by means of the rods Z. In the uppermost portions of the passages X are disposed springs *g* exerting a constant pressure on the ball valves *e*.

As may be ascertained by referring to the aforesaid patent, the function of the pilot valves T and U is to relieve the pressure on the opposite sides of the compressor piston during the stopping and starting of the compressor and also to control the admission of pressure fluid into the hollow extension Q for maintaining the relief valve R closed during the time the compressor is loaded.

The pressure fluid utilized for actuating the relief valve R is conveyed from the chamber K of the casing H through a pipe *h* connected to the top of the pilot valve T. Such pressure fluid may pass into the passage X and through the restricted portion Y of the pilot valve T, thence through a port *j* and through a pipe *k* connected at its opposite end to the passage X of the pilot valve U. The pressure fluid flowing through the passage X in the pilot valve U and the restricted portion Y may flow therefrom through a port *j* and through a pipe *k'* into the outer end of the hollow extension Q for the purpose described.

Suitable means are provided for controlling communication between the chambers J and K of the unloader in order to prevent the return of pressure fluid from the storage receiver (not shown) into the compressor. To this end a valve guide *o* is threaded into

the side of the casing H and has an extension p on which is slidably disposed a check valve q adapted to cooperate with the seat P for controlling the port O. A spring r may be disposed on the check valve to return the check valve q to the seat P.

In accordance with the present invention, means are provided for preventing an objectionable chattering or pounding of the check valve q, particularly during the running of the compressor. Such chattering of the valve is caused by the pressure fluid discharged into the chamber K acting against the end of the valve and raising it off the seat P and by the pressure fluid acting against the opposite side of the check valve q which again returns the valve to its seat during the suction stroke of the compressor. To this end the valve guide o is provided with a pair of passages w and x. The passage x is in constant communication with the chamber J of the unloader and opens into a recess y in the valve guide o. The passage w also communicates at one end with the recess y and extends through the extension p to the front end thereof.

Communication between the passages x and w is controlled by a ball valve z seated in this instance on the outlet opening of the passage x. A spring 2 is disposed in the passage x and in the absence of pressure on the valve z tending to maintain it in closed position, said spring will raise the valve z to permit the flow of pressure fluid from the chamber J through said passages into the check valve q to maintain it on the seat P.

The actuation of the valve z is preferably effected automatically and at the time of starting and stopping of the compressor. In order to induce such movement of the ball valve z a cylinder 3 having an extension 4 which is threaded into the recess y is provided with a piston 5 adapted to maintain the valve z closed, pressure of the piston 5 being transmitted to the valve z through the medium of a rod 6 which extends through a hole 7 formed in the extension 4, said hole 7 preferably being of considerably greater cross sectional area than the rod 6. A vent o' in the cylinder affords communication between the hole 7 and the atmosphere.

The piston 5 is of the differential type and accordingly has an enlarged head 8 on the inner side of which is a tapered portion 9 adapted to cooperate with a correspondingly tapered seat 10 in the cylinder for preventing leakage of pressure fluid along the piston 5. A cover 11 on the cylinder 3 forms a closure therefor and has a chamber 12 into which pressure fluid may be admitted for actuating the piston 5.

In order to enable both the tapered portion 9 of the piston 5 and the valve z to be tightly pressed to their respective seats a plunger 13 is disposed in the piston 5 with respect to which it is capable of limited longitudinal movement. A spring 14 is disposed in the piston to act against the plunger for the purpose of forcing said plunger in the direction of the ball valve z. Preferably a pin 15 seated with its ends in the piston 5 extends through a transverse slot 16 in the plunger to limit such movement of the plunger in the piston.

The pressure fluid utilized for actuating the piston 5 is in this instance conveyed to the chamber 12 by a pipe 17 which is connected at one end to the cover 11 and at its other end to the pipe k' leading to the hollow extension Q of the unloader.

The operation of the device is as follows: During the time when the compressor is operating under normal conditions, that is, when it is operating at the maximum speed, a portion of the pressure fluid discharged from the cylinder A into the chamber K will flow through the pipe k, the pilot valve T and the pipe k into the pilot valve U, thence through the pipe k' into the hollow extension Q for maintaining the relief valve R closed against the pressure in the chamber K.

Inasmuch as the cylinder 3 is connected to the pipe k' by means of the pipe 17 pressure fluid will therefore also flow through the said pipe 17 into the chamber 12 and, acting against the piston 5, will press said piston against the tapered seat 10. Such movement of the piston 5 will be transmitted to the ball valve z by means of the rod 6 and the ball valve z will be held in closed position to prevent the admission of pressure fluid from the chamber J into the check valve q. The check valve q is therefore free to move outwardly on the extension p of the valve guide for opening the port o.

Due to the rapid reciprocations of the compressor piston while operating at maximum speed sufficient pressure will be maintained beneath the pistons V of the pilot valves to hold said pistons in their uppermost positions. Inasmuch as the movement of the valves e and f is directly dependent upon the movement of the pistons the ball valves e and f will also be maintained in their uppermost positions, that is, the valves f will bear against their seats c and the valves e will be raised from the seats b. In these positions of the valves e and f there is a direct and uninterrupted communication between the source of pressure fluid supply and the chamber 12 of the cylinder 3, as well as with the hollow extension Q of the unloader.

During the stopping of the compressor as the speed of the compressor piston gradually decreases the average pressure beneath the pistons V of the pilot valves T and U also decreases. When such pressure fluid reaches a certain value the pistons V will

reciprocate in the pilot valves in step with the stroke of the compressor piston. This movement of the pistons V will of course result in a corresponding movement of the ball valves *e* and *f* so that on each suction stroke of the compressor piston one ball valve *e* will return to its seat while the other ball valve *e* will be raised from its seat. Such movement of the ball valves will permit the pressure fluid utilized for holding the relief valve R and the ball valve *z* closed to escape to the atmosphere through the pipes connecting these elements with the pilot valves.

After sufficient pressure fluid has been exhausted from the chamber 12 to enable the spring 2 and the pressure fluid acting against the valve *z* to retract the piston 5 and raise the ball valve *z* pressure fluid will flow through the passage *x* into the recess *y*, thence through the passage *w* into the check valve *q* and hold the check valve *q* closed.

The check valve *q* will be held closed by pressure fluid during the stopping and idle periods as well as during the starting period of the compressor. After the compressor is again set in operation a portion of the fluid compressed in the ends of the cylinder A will again be exhausted into the pilot valves T and U.

While the compressor piston is reciprocating slowly, the pressure fluid acting against the pistons V of the pilot valves will cause reciprocation of said pistons in step with the compressor piston so that on each compression stroke the valves *e* and *f* will be raised and lowered.

Until the reciprocations of the compressor piston take place in such rapid succession that a sufficiently high average pressure may be maintained beneath the pistons V said pistons will of course reciprocate as will also the ball valves *e* and *f*. During this period pressure fluid will be discharged into the chamber K and a portion thereof will flow through the pipe *h* into the pilot valves T and U due to the throttling action of the relief valve R. Owing to the reciprocatory movement of the ball valves *e* and *f* however such pressure fluid will be exhausted directly to the atmosphere from the pilot valves T and U.

When the movement of the compressor piston is accelerated the pressure beneath the pistons V will become of sufficient value to maintain the pistons V in their uppermost position and thus also to maintain the valves *f* against the seats *c* and the valves *e* unseated. When the valves *e* and *f* occupy these positions pressure fluid may flow from the chamber K through the elements connecting said chamber with the hollow extension Q into said hollow extension and into the chamber 12. Pressure fluid will then maintain the relief valve R closed and will also depress the piston 5. This movement of the piston is transmitted through the rod 6 to the ball valve *z* to close said ball valve and cut off the supply of pressure fluid to the interior of the check valve *q*. After the ball valve *z* is closed the pressure fluid in the check valve *q* may escape through the passage *w* and the hole 7 into the front end of the cylinder 3 from whence it may escape to the atmosphere through the vent *o'*.

After the ball valve *z* is closed the interior of the check valve will be subjected only to atmospheric pressure so that said check valve may be readily opened and maintained in an open position by the pressure fluid existing in the chambers J and K, unaffected by any back flow of pressure fluid through the port O. By enabling the check valve *q* to constantly remain open during the normal operation of the compressor the objectionable noise hereinbefore referred to will be entirely eliminated as the check valve contacts with its seat only after each period of operation and remains closed until the compressor again approaches its normal speed.

I claim:

1. In a compressor, the combination of a cylinder and a discharge line, a check valve controlling communication between the cylinder and the discharge line, and pressure actuated means to maintain the check valve closed during the accelerating, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

2. In a compressor, the combination of a cylinder and a discharge line, a check valve controlling communication between the cylinder and the discharge line, and pressure actuated means for controlling the admission of pressure fluid into the check valve to maintain said check valve closed during the accelerating, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

3. In a compressor, the combination of a cylinder and a discharge line, a check valve controlling communication between the cylinder and the discharge line, and pressure actuated means for controlling the admission of pressure fluid from the discharge line into the check valve to maintain said check valve closed during the accelerating, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

4. In a compressor, the combination of a cylinder and a discharge line, a valve casing interposed in the discharge line, a valve guide in the casing, a check valve on the guide to control the flow of pressure fluid

through the discharge line, and pressure actuated means supported by the valve guide and adapted to admit pressure fluid from the discharge line into the check valve to maintain said check valve closed during the starting, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

5. In a compressor, the combination of a cylinder and a discharge line, an unloader for the compressor connected to be actuated by pressure fluid from the cylinder, a check valve controlling the flow of pressure fluid through the discharge line, and pressure actuated means communicable with the unloader for controlling the admission of pressure fluid into the check valve to hold said valve closed during the starting, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

6. In a compressor, the combination of a cylinder and a discharge line, an unloader for the compressor connected to be actuated by pressure fluid from the cylinder, a check valve controlling the flow of pressure fluid through the discharge line, and pressure actuated means communicable with the unloader for controlling the admission of pressure fluid from the discharge line into the check valve to maintain said check valve closed during the starting, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

7. In a compressor, the combination of a cylinder and a discharge line, a valve casing interposed in the discharge line, a valve guide in the casing having a pair of passages, a check valve slidable on the guide to control the flow of pressure fluid through the discharge line, and pressure actuated means supported by the valve guide for controlling the flow of pressure fluid from the discharge line through the passages into the check valve to hold said check valve closed during the starting, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

8. In a compressor, the combination of a cylinder and a discharge line, a valve casing interposed in the discharge line, a valve guide in the casing having a pair of passages, a check valve on the guide to control the flow of pressure fluid through the casing into the discharge line, a pressure actuated valve in the guide controlling communication between the passages for admitting pressure fluid from the discharge line into the check valve to maintain the check valve closed during the starting, stopping and idle periods of the compressor and to enable said check valve to remain constantly open during the running period of the compressor.

9. In a compressor, the combination of a cylinder and a discharge line, a valve casing interposed in the discharge line, a valve guide in the casing having a pair of passages, a check valve on the guide to control the flow of pressure fluid through the casing into the discharge line, a cylinder connected to the valve guide, a piston in the cylinder, a valve controlling communication between the passages, a rod for transmitting movement of the piston to the valve, a spring for opening the valve to permit the flow of pressure fluid from the discharge line into the check valve for maintaining the check valve closed during the starting, stopping and idle periods of the compressor, and a pipe for conveying pressure fluid into the last said cylinder to actuate the piston and hold the valve closed during the normal operation of the compressor.

10. In a compressor, the combination of a cylinder and a discharge line, a valve casing interposed in the discharge line, a valve guide in the casing having a threaded recess and a pair of passages communicating with the recess, a cylinder having a stem threaded into the recess, a hole in the stem, said cylinder having a vent, a piston in the cylinder, a valve in the recess controlling communication between the passages, a rod in the hole for transmitting the movement of the piston to the valve, a spring to open the valve to admit pressure fluid from the discharge line into the check valve for holding said check valve closed during the starting, stopping and idle periods of the compressor, and a pipe for conveying pressure fluid into the last said cylinder to actuate the piston and close the valve during the normal operation of the compressor, thus permitting the pressure fluid in the check valve to escape through the said hole and the vent to the atmosphere and permit the check valve to open during the running period of the compressor.

11. In a compressor, the combination of a cylinder and a discharge line, a valve casing interposed in the discharge line, a valve guide in the casing having a pair of passages, a check valve on the valve guide to control the flow of pressure fluid through the discharge line, a valve in the valve guide to control communication between the passages, a cylinder supported by the valve guide, a piston in the cylinder connected to actuate the valve, a spring for opening the valve, and pilot valves on the first said cylinder for relieving the pressure in the ends of the cylinder on stopping of the compres-

sor, said pilot valves being connected in series with each other and with the casing and the second said cylinder to admit pressure fluid to the cylinder to act against the piston for maintaining the valve closed during the normal operation of the compressor and for exhausting such pressure fluid from the cylinder, thereby enabling the spring to open the valve for admitting pressure fluid into the check valve and hold said check valve closed during the starting, stopping and idle periods of the compressor.

In testimony whereof I have signed this specification.

SNOWDEN B. REDFIELD.