

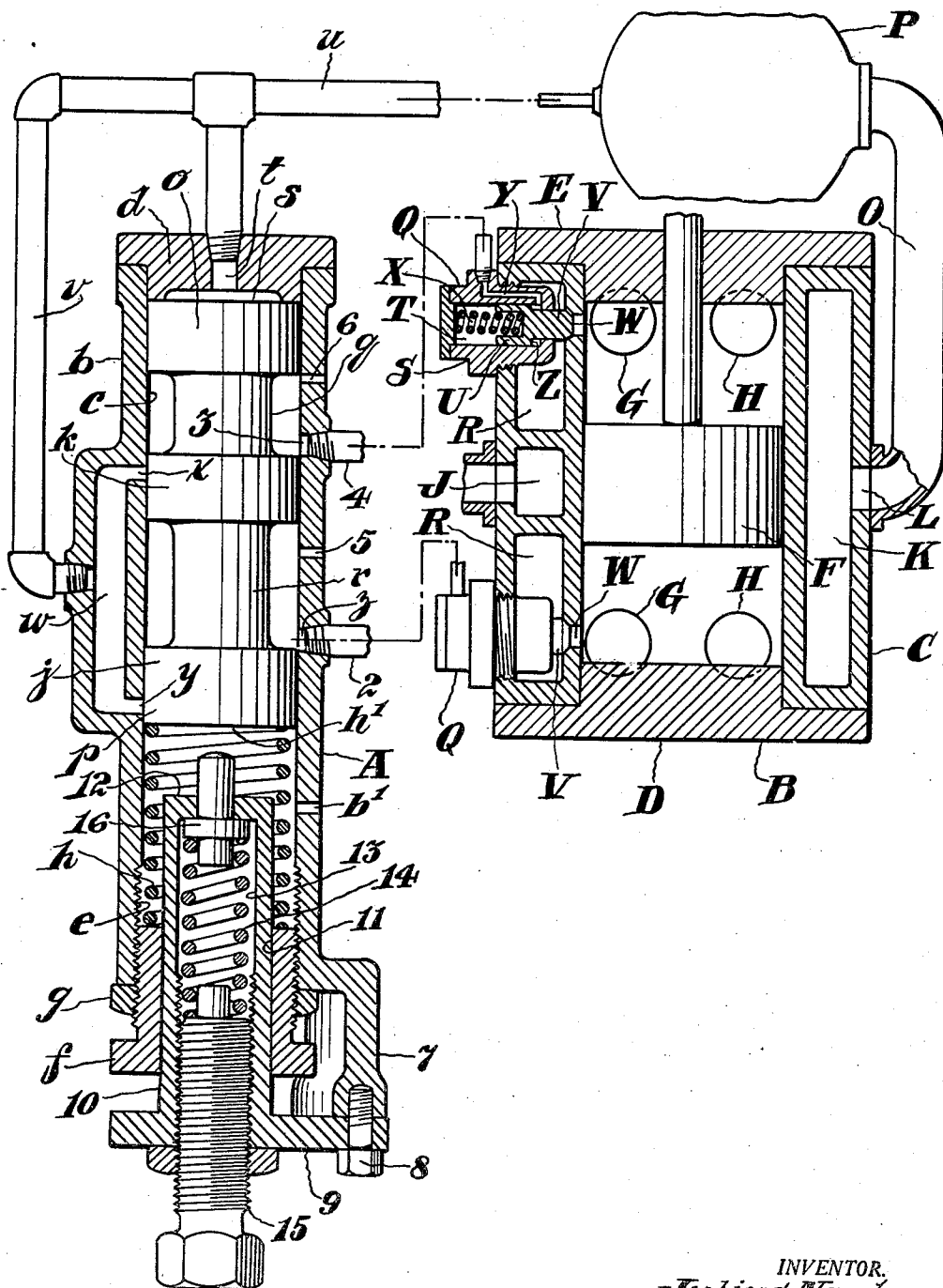
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CONTROL VALVE

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UNITED STATES PATENT OFFICE

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CONTROL VALVE

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This invention relates to valves, but more particularly to a control valve adapted to control the action of regulating devices of compressors and the like.

5 One object of the invention is to effect a step-by-step unloading of a compressor wherewith the valve is associated.

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

10 The drawing accompanying this specification and forming a part thereof is a longitudinal sectional view of a valve constructed in accordance with the practice of the invention and showing it applied to a compressor illustrated in sectional plan view.

15 Referring more particularly to the drawing, the control valve which is designated in general by A is shown applied to a compressor B comprising a cylinder C and end heads 20 D and E.

The compressor B may as shown be of the double acting type wherein the working substance is compressed in the opposite ends of the cylinder by a piston F reciprocable therein. Each end of the cylinder C is provided 25 with inlet and discharge valves G and H respectively for controlling the admission of fluid into the cylinder and the discharge of the compressed fluid from the cylinder.

30 The medium intended to be compressed may be conveyed to the inlet valves G by an inlet passage J in the cylinder C. Upon being compressed in the cylinder the pressure fluid passes through the discharge valves H into a discharge chamber K, also in the cylinder C. 35 The discharge chamber K is provided with an outlet opening L through which the compressed fluid flows into a conduit O leading to a storage receiver P.

40 Usually compressors of the type illustrated are provided with regulating means for maintaining the receiver pressure at a predetermined value. Such means may be associated with the inlet or discharge valves of the compressor or may consist, as shown, of clearance 45 control valves Q adapted to control communication between the ends of the cylinder C and clearance pockets R in or adjacent the cylinder C. The clearance 50 pockets for each end of the cylinder may

consist of any desired number, depending upon the steps of unloading which it may be desired to obtain, and may be suitably proportioned to effect either partial or complete unloading of the cylinder ends.

55 The form of clearance valve Q, selected for illustrative purposes, comprises a casing S threaded into the wall of the cylinder C and extending into the clearance pocket wherewith it is associated. Within the casing S is a chamber T to receive a head U of a valve V adapted to control a port W which affords communication between the clearance pocket R and the end of the cylinder C. 60 Within the chamber T is a spring X to normally maintain the valve V in the closed position, and in the casing S is a passage Y through which pressure fluid flows into the inner end of the chamber T to act against an actuating surface Z at the juncture of the 70 head U and the valve V.

The control valve A, constructed in accordance with the practice of the invention, comprises a casing b having a valve chamber c which extends longitudinally therethrough. 75 A closure is provided for one end of the valve chamber c by a head d, and in the opposite end of the valve chamber c is a threaded portion e to accommodate a threaded plug f having a lock nut g thereon which may seat 80 against the end of the casing b to retain the plug f securely in any position in which it may be placed.

The plug f serves in part as a seat for an end of a spring h disposed in the chamber c 85 to act against a valve j for normally maintaining the valve j seated against the head d.

The valve j, which is of the reciprocatory type, comprises an intermediate flange k and end heads o and p connected to the flange k 90 by reduced stems q and r. The spring h acts against a seating surface h' on the head p and which seating surface is in constant communication with the atmosphere through a vent b' in the casing b. The opposite or outer 95 end of the valve constitutes an actuating surface s which is constantly exposed to pressure fluid. The pressure fluid thus acting against the actuating surface s is introduced into the end of the chamber c through a port t 100

in the head *d* and a pipe *u* leading from the storage receiver P.

The pipe *u* has an extension *v* which is connected to an intermediate portion of the casing *b* and opens into a supply passage *w* in the wall of the casing *b*. The supply passage *w* extends longitudinally of the casing *b* and has a pair of ports *x* and *y* which, when the valve *j* is seated against the head *d*, are closed by the flange *k* and the head *p*, respectively, of the valve.

In the casing *b* and at a point intermediate the outlet openings *x* and *y* is an outlet port *z* into which is threaded an end of a pipe 2 connected to a clearance valve mechanism Q for introducing pressure fluid into its passage Y. Similarly, at a point between the outlet port *z* and the head *d* is a second outlet port 3 to which is connected a pipe 4 leading to the passage Y of a second valve mechanism Q. The ports *z* and 3 are so located that they will at all times lie between adjacent enlarged portions of the valve *j*, such as the heads *o* and *p*, and the flange *k*.

In order to communicate the outlet ports *z* and 3 with the atmosphere the casing *b* is provided with vents or exhaust ports 5 and 6 located between their associated outlet ports and the head *d*. Preferably the port 6 is located closely adjacent the head *o* of the valve so that upon movement of the valve *j* under the influence of pressure fluid acting against the actuating surface *s* the port 6 will immediately be closed by the head *o*, and the exhaust port 5 is so located that it will be closed by the flange *k*, whereby it is controlled, prior to the uncovering of the outlet port *y* by the head *p*.

On the end of the casing *b* adjacent the threaded portion *e* is an arm 7 to which is secured, as by means of a screw 8, a flange 9 that lies across the end of the casing *b*. The flange 9 carries a cylindrical extension 10 which extends through a bore 11 in the plug *f* and the free end 12 of the extension lies in the path of the valve *j* to act as a fixed stop for said valve. Within the extension 10 is a bore 13 for the accommodation of a spring 14 which seats with one end against a screw 15 threaded into the extension 10. The opposite end of the spring 14 bears against a plunger 16 slidable in the end 12 of the extension 10 to serve as a yieldable stop for the valve *j*.

The operation of the device is as follows: With the plug *f* and the screw 15 adjusted to tension the springs *h* and 14 to pressures corresponding to predetermined receiver pressures at which it is intended to effect partial or full unloading of the compressor, pressure fluid will flow from the storage receiver P through the pipe *u* into the end of the valve chamber *c* and into the supply passage *w*.

When the pressure of the fluid acting against the actuating surface *s* reaches that

value for which the spring *h* is adjusted to yield, the valve *j* will be actuated in the direction of the stop members 12 and 16. Immediately upon starting of the valve in this direction the head *o* will cover the exhaust port 6. Upon further movement of the valve in the same direction the port *x* will be uncovered by the flange *k* and pressure fluid then flows through the valve chamber, the port 3, the pipe 4 and the passage Y into the inner end of the chamber T and will act against the actuating surface Z to open the valve V. In this way the one end of the cylinder C will be placed in communication with the clearance pocket R associated therewith and the compressor will, in consequence, be partially unloaded.

During the subsequent operation of the compressor the valve *j* may continue to move in the direction described until the head *p* contacts with the spring-plunger 16 whereby it will be retained immovable until the pressure fluid acting against the actuating surface *s* reaches a value in excess of the combined pressures exerted by the springs *h* and 14.

When this further predetermined higher pressure is attained in the receiver P the valve *j* will be further actuated in the direction of the stop members. During this movement of the valve, the flange *k* covers the exhaust port 5 and upon further slight movement of the valve in the same direction the head *p* uncovers the port *y*, thus admitting pressure fluid through the associated passages into a second clearance valve mechanism Q for effecting additional unloading of the compressor.

About the time the valve *j* uncovers the port *y* it will seat against the fixed stop 12 which is so located that, in this position of the valve *j*, the port *x* will be in full communication with the outlet port 3 and the port *y* with the outlet port *z*. Both ends of the compressor cylinder C may then be unloaded in accordance with the capacities of the clearance pockets R associated therewith.

If, during further operation of the compressor and due to the consumption of pressure fluid the receiver pressure drops below that exerted by the springs *h* and 14 the said springs will actuate the valve *j* in the direction of its initial position. During the movement of the valve in this direction the port *y* will first be closed. Thereafter the port 5 will be uncovered by the flange *k* so that the pressure fluid in the clearance valve mechanism Q associated with that portion of the valve chamber *c* will be exhausted to the atmosphere, thus again loading that end of the cylinder C.

Upon a further reduction of the value of the pressure fluid in the receiver P the spring *h* will actuate the valve against the head *d*

thus cutting off the port *x* and communicating the port 3 with the exhaust port 6. In this way the pressure fluid in the second clearance valve mechanism *Q* will be exhausted to the atmosphere, thereby allowing its spring *X* to close the valve *V* and again load that end of the compressor cylinder *C*.

As will be readily understood, whenever it may be desired to have the valve *j* act for loading or unloading the several ends of the cylinder *C* at various predetermined pressures in the storage receiver the springs *h* and 14 may be tensioned accordingly by adjusting the plug *f* and the screw 15 or, should it be desired to simultaneously effect unloading of both ends of the cylinder, the plug *f* and the screw 15 may be adjusted to enable the valve *j* to move uninterruptedly against the stop member 12.

I claim:

1. A control valve comprising a casing having a chamber and inlet and outlet ports for the chamber, a valve in the valve chamber, an actuating surface on the valve constantly exposed to pressure fluid, a spring seat on the valve exposed to atmospheric pressure, a spring acting against the spring seat and being adapted to yield to a predetermined pressure acting against the actuating surface for establishing communication between an inlet port and an outlet port, and a spring-pressed stop member adapted to engage the spring seat and to yield upon a further increase in the value of the pressure fluid acting against the actuating surface to establish communication between a second inlet port and a second outlet port.

2. A control valve comprising a casing having a chamber and inlet and outlet ports for the chamber, a reciprocable valve in the valve chamber having an actuating surface constantly exposed to pressure fluid tending to actuate the valve for establishing communication between the inlet and outlet ports, a spring seat on the valve exposed to atmospheric pressure, and a plurality of yieldable stop

means acting successively against the spring seat to hold the valve in different positions along the length of the chamber and being adapted to yield to predetermined pressures against the actuating surface for communicating the inlet ports with the outlet ports.

3. A control valve comprising a casing having a chamber and inlet and outlet ports for the chamber, a reciprocable valve in the chamber having an actuating surface constantly exposed to pressure fluid, a spring seat on the valve exposed to atmospheric pressure, a spring acting against the spring seat to hold the valve closed and being adapted to yield to a predetermined pressure against the actuating surface to establish communication between an inlet port and an outlet port, and a spring-pressed stop member adapted to engage the spring seat and being adapted to yield to a higher predetermined pressure against the actuating surface to communicate a second inlet port with a second outlet port.

4. A control valve comprising a casing having a chamber and inlet and outlet ports for the chamber, a reciprocable valve in the chamber and having an actuating surface constantly exposed to pressure fluid, a spring seat on the valve exposed to atmospheric pressure, a spring acting against the spring seat to hold the valve in one limiting position in the chamber and being adapted to yield to a predetermined pressure against the actuating surface for communicating one inlet port with an outlet port, a spring-pressed stop member positioned to engage the spring seat and being adapted to yield to a higher predetermined pressure against the actuating surface to enable the valve to communicate a second inlet port with a second outlet port, and a fixed stop member for limiting the travel of the valve and for guiding the spring-pressed member.

In testimony whereof I have signed this specification.

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