Jan. 11, 1944. A. A. MARKSON 2,339,024

PNEUMATIC POWER CYLINDERS AND MEANS FOR PREVENTING OVER-TRAVEL OF THEIR PISTONS

Filed May 26, 1943 2 Sheets-Sheet 1

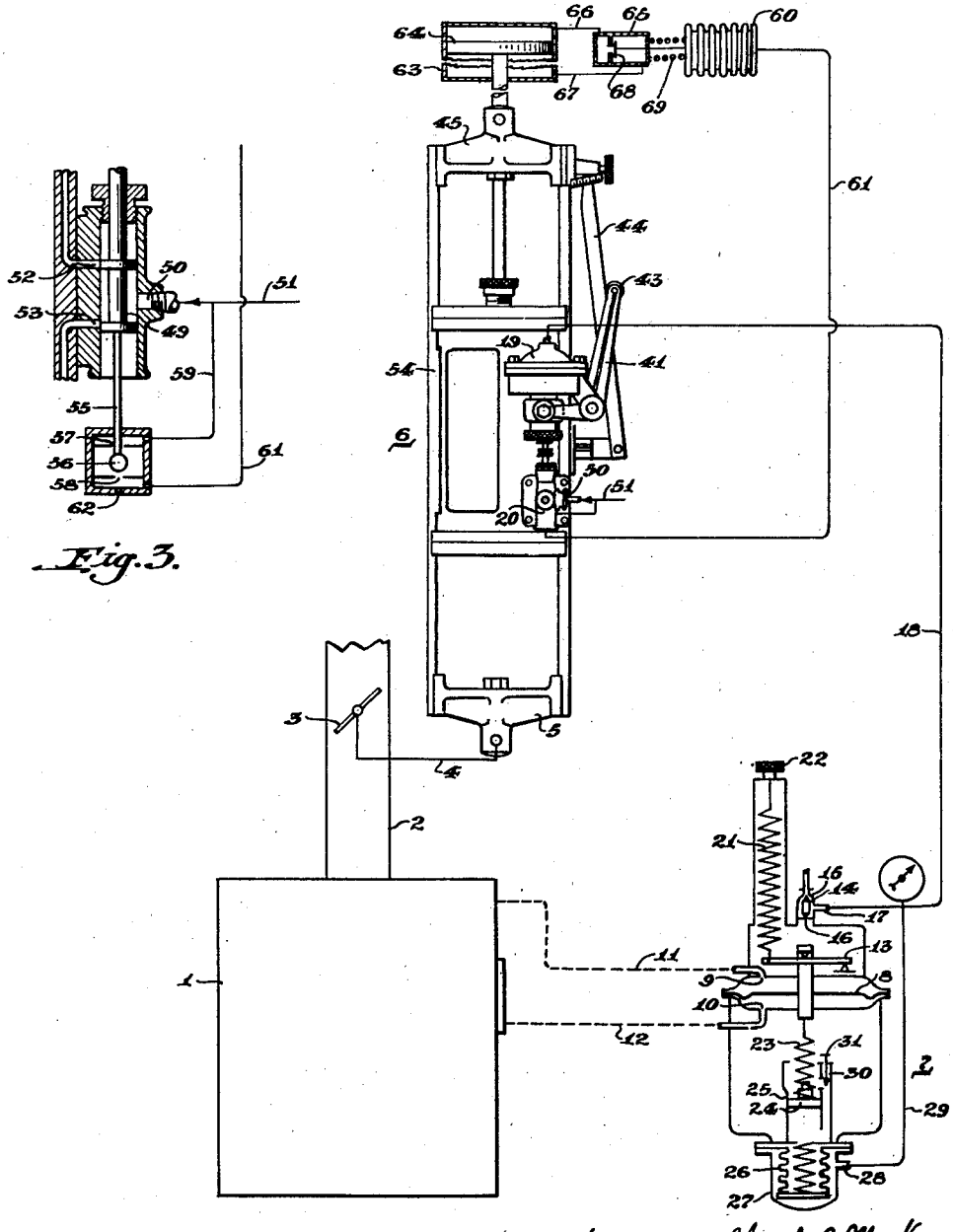


Fig. 3.

Fig. 1.

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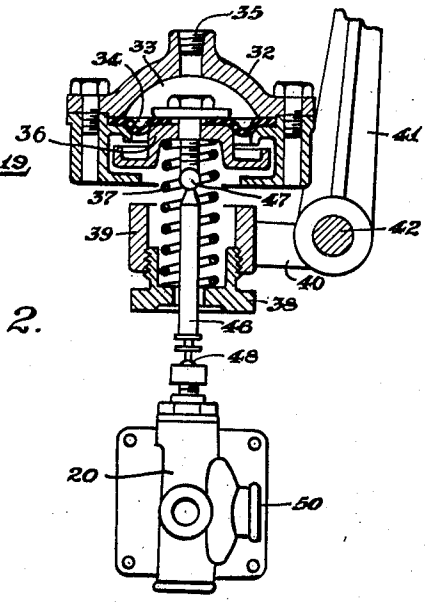


Fig. 2.

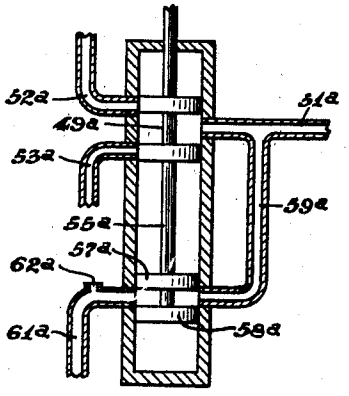


Fig. 4

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UNITED STATES PATENT OFFICE

2,339,024

PNEUMATIC POWER CYLINDER AND MEANS FOR PREVENTING OVER-TRAVEL OF ITS PISTON

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Application May 26, 1943, Serial No. 488,479

6 Claims. (Cl. 121—40)

This invention relates to regulators of the reciprocating piston type for operating valves, dampers or the like in response to pressure-sensitive controllers. More particularly, the invention is directed to the use of piston regulators as prime movers capable of operation under heavy loads, embodying means that adapt them to quick and accurate response to a control pressure and which shall embody means for preventing over-travel of the piston regulator after movement thereof has been initiated.

In the use of piston regulators for operating valves or dampers, sufficient power must be developed to overcome the inertia mass and static friction of the load, but once movement thereof is initiated there is a tendency to over-travel due to the compressibility of the air used for actuating the operating piston.

A reciprocating piston type regulator that is subject to over-travel or hunting under conditions above stated is disclosed in Patent No. 2,044,936 granted June 23, 1936, and while suitable for the purpose of setting valves and dampers and for maintaining constant operation of such control members in response to a pressure sensitive device, may nevertheless be subject to over-travel if the load on the regulator is such as to require the application of high initial pressures.

It is among the objects of the present invention to adapt piston type regulators to heavy duty operation by the provision of means for effectively braking or locking the regulator in any set position while maintaining such regulator operative in response to a pressure sensitive device or controller.

It is a further object of the invention to provide a piston type regulator that is preloaded by fluid means controllable by operation of the regulator control valve.

It is a further object of the invention to provide piston regulators of the reversing type operating as prime movers which are operated by fluid pressure through a control valve in response to a pressure sensitive device, and which is provided with fluid pressure means for locking or braking the piston member when the control valve is in the neutral position and for releasing the operating piston when the control valve is in either forward or reverse operating position. It is also the object of this invention to provide means for varying the amount of braking in accordance with the displacement of the control valve from the neutral position.

These and other objects of the invention will become more apparent from a consideration of the accompanying drawings constituting a part hereof in which like reference characters designate like parts and in which:

Fig. 1 is a front elevational view of apparatus for controlling and operating an industrial furnace by a piston type regulator and pressure-sensitive device embodying the principles of this invention;

Fig. 2 a vertical cross-sectional view partially in elevation of a portion of the piston regulator shown in Fig. 1;

Fig. 3 a cross-sectional view of the piston regulator control valve and an auxiliary valve; and

Fig. 4 a similar view of a modified form of regulator valve.

With reference to Fig. 1 of the drawings, the numeral 1 designates a furnace having a stack 2 controlled by damper 3 that is operated by a lever 4 connected to the yoke 5 of a piston regulator generally designated by the numeral 6. The regulator 6 is operated in response to a pressure sensitive device generally designated by the numeral 7, having a sensitive diaphragm 8 exposed through openings 9 and 10 to furnace pressure by being connected to conduits 11 and 12, respectively, leading from the furnace 1.

The upper side of the diaphragm 8 is connected to furnace pressure and the lower side of the diaphragm to atmospheric pressure, thus causing the diaphragm 8 to respond to a pressure differential in the lines 11 and 12, or in other words a pressure change occurring between the points in the chamber of the furnace 1 at which pipes 11 and 12 are connected.

Diaphragm 8 is suspended from a pivoted balance beam 13 to which is attached an escapement valve 14 controlling orifices 15 and 16, orifice 15 being connected to a constant source of pressure designated by the arrow and the orifice 16 vents to the atmosphere. The chamber of the escapement valve 14 is connected at 17 to a loading line 18 that communicates with the diaphragm chamber 19 of the piston regulator control valve 20.

The pivoted balance beam 13 is regulated by a loading spring 21, tension of which is adjustable by the hand wheel 22 and a spring 23 is connected to the lower side of diaphragm 8 and to a piston 24 disposed in an oil cylinder 25.

A bellows 26 is provided in a closed housing 27 that is connected at 28 to the loading pressure line 18 by conduit 29, and pressure on the bellows 26 raises the body of oil and causes piston 24 to rise, thereby relieving the pull on diaphragm 8.

A by-pass 30 is provided with a regulating valve 31 to provide adjustment to meet the requirements of the system to be controlled.

The piston regulator 6 operates damper 3 in response to pressure changes in the furnace 1 which renders the pressure sensitive device 7 operative to transmit a loading pressure to the diaphragm operator 19 of the regulator control valve 20. As shown in Fig. 2, the diaphragm operator consists of a dome 32 forming a chamber 33 with a diaphragm 34, the outlet 35 being connected to the sending line 18. Diaphragm 34 is seated on a circular support 36 that is recessed to receive a coil spring 37, one end of which rests on a collar 38 that is in screw thread engagement with a collar 39 of a forked arm 40 that is movable by a lever 41 pivoted at 42.

As shown in Fig. 1, arm 41 is provided with a roller 43 that rides on an angling bar 44 secured to the end of the piston yoke 45 for purpose to be hereinafter stated.

Diaphragm 34 is connected to control valve 20 by a link 46 pivoted at 47 and 48 to make it self-aligning. Movement of diaphragm 34 actuates the valve 49, Fig. 3, to control the application of pressure through inlet 50 from a constant source 51 to the ports 52 and 53, respectively, leading to the upper and lower ends of the operating cylinder 54 of the piston regulator.

A stem 55 having a spherical valve 56 at the end thereof is attached to the valve 49 to be operated thereby and controls the flow of pressure fluid through orifices 57 and 58 from the pressure source 51 through line 59 and to a bellows 60 through line 61, an orifice 62 being provided to vent the valve housing.

A cylinder 63 is mounted in alignment with the yoke 45 of the piston regulator and a piston 64 is connected to the piston regulator to be operative thereby. Cylinder 63 is filled with liquid such as oil and is connected at opposite sides of piston 64 by lines 66 and 67 to a valve 65, the valve 65 having an orifice controlled by a plunger 68 movable to closed position by the bellows 60 and retractible by a coil spring 69.

In the modified form of control valve shown in Fig. 4, the bellows 60 is connected by conduit 61*a* to a port in the valve housing opposite a port connected by conduit 59*a* to the source of air supply 51*a*. Control valve 49*a* has an extension 55*a* on which a pair of glands are spaced to straddle the pressure fluid port of supply line 59*a* and the port of line 61*a*. An orifice 62*a* is provided to vent line 61*a*.

The operation of the above-described piston regulator is briefly as follows.

Assuming a change in pressure in the chamber of furnace 1 which requires resetting of the stack damper 3, the pressure sensitive device 7 will transmit an increased or decreased loading pressure from the source 15 through line 18 to the diaphragm chamber 33. Diaphragm 34 will depress or lift the link 46 and operate valve 49 to open the port 52 or 53, as the case may be, to the source of pressure 51.

Pressure fluid will then be delivered to operating cylinder 54 to move the piston that carries the double-yoke frame 5 and 45 to which the damper arm 4 is connected. As the double-yoke frame moves, the angle bar 44 will cause the lever arm 41 to move, which lifts or lowers the yoke 40 carrying the collar 39, causing springs 37 to counteract the pressure on diaphragm 34 to return valve 49 to its neutral position.

If the pressure in the furnace continues to increase or decrease, greater or lesser loading pressure is transmitted to diaphragm 34, which causes valve 49 to be operated in the direction to make the proper adjustment of the damper, as the case may be, and travel of the yoke frame operating lever 41 restores pressure on diaphragm 34 to again return valve 49 to neutral or shut-off position. In this manner, the piston regulator may continue operation in increments, but by steady movements as described in the hereinbefore mentioned patent.

So much of the operation as has been described is not claimed as part of this invention, which resides in the control of the movement of the piston regulator through the loading cylinder 63, which operates as follows:

As the control valve 49 is subjected to its controlling movements, valve 56 will move from the neutral position shown in Fig. 3 in either an up or down direction to close either of the orifices 57 or 58 so as to cut off the pressure from source 61 to the bellows 60, which leaves valve 68 open to permit circulation of the fluid from one end of the piston 64 to the opposite side through the conduits 66 and 67 of valve 65, as the case may be. When, however, valve 49 reaches the neutral or off position, which means that the piston regulator has stopped its movement, valve 56 is in the neutral position, as shown in Fig. 3, allowing the pressure from source 51 to pass through the valve housing to the line 61 to compress the bellows 60, which closes valve 68 and locks the fluid in the cylinder 63, thereby instantly locking the piston regulator against further movement.

Similarly, in the form of valve shown in Fig. 4, the bellows 60 is exposed to the air pressure of line 51*a* through line 59*a* which is in communication with line 61*a* when valve 49*a* is in "off" or closed position. When the latter is operated to supply pressure fluid from line 51*a* to either gland 52*a* or 53*a* of the operating cylinder 54, the gland 57*a* or 58*a* will cut off the air pressure to the bellows to open valve 68 and permit free circulation of the fluid from one end to the other of the brake cylinder 63.

In this manner, over-travel of the piston regulator is prevented and there can be no hunting of the valve operating mechanism, which would affect the pressure in the furnace chamber and continue the operation of the damper control.

It is evident from the foregoing description of this invention that by means of the fluid pressure brake or fluid lock on the piston regulator, the regulator piston will complete its travel but over-travel of the operating piston is positively prevented, which adapts the piston regulator to the handling of heavy loads without over-travel, while retaining the sensitivity, which is a well-known characteristic of the piston type pressure responsive regulator.

It is further evident that the braking cylinder need not be connected to the regulator but may be elsewhere located to be operated by linkage connected to and actuated by the regulator.

Although one embodiment of the invention has been herein illustrated and described, it will be evident to those skilled in the art that various modifications may be made in the details of construction and in the application of my invention to various uses without departing from the principles herein set forth.

I claim:

1. A fluid brake for fluid pressure regulators comprising a cylinder, a valve connected to both ends of the cylinder, a piston in said cylinder

connected to be operated by the fluid pressure regulator, a pilot valve for said regulator connected to a source of constant pressure and to opposite sides of the pressure regulator actuator, and pressure means operative by said pilot valve for actuating the brake cylinder valve to stop circulation of fluid from one end to the other of said brake cylinder when the pilot valve is set to actuate the regulator.

2. A fluid brake for fluid pressure regulators comprising a cylinder, a valve connected to both ends of the cylinder, a piston in said cylinder connected to be operated by said regulator, a pilot valve for said regulator connected to a source of constant pressure and to opposite sides of the pressure regulator actuator, and pressure means including a valve attached to the pilot valve for actuating the brake cylinder valve to stop circulation of fluid from one end to the other of said brake cylinder when the pilot valve is set to actuate the regulator.

3. In a fluid pressure actuated regulator, in combination with a pilot valve for directing pressure fluid to the regulator of a fluid brake comprising a cylinder, a piston operative therein and connected to be actuated by said regulator, said cylinder having a fluid connection at each end with a valve housing, a valve controlling the circulation of the fluid from one side of the piston to the other, pressure responsive means for closing said valve to lock the fluid in said cylinder, a source of pressure fluid connected to said pilot valve and to the pressure responsive means of said fluid brake control valve, and means operative by the pilot valve to cut-off the pressure fluid to the fluid brake control valve when the pilot valve is in position to actuate the regulator.

4. A fluid brake for fluid pressure regulators comprising a cylinder, a valve connected to both ends of the cylinder, said valve being normally biased to open position, a bellows for closing said valve to stop circulation of the fluid in said cylinder, a source of constant pressure fluid for said bellows, a piston in said brake cylinder connected to be operated by said regulator, a pilot valve for said regulator connected to a source of constant pressure and to opposite sides of the pressure regulator actuator, and valve means operated by movement of the pilot valve for disconnecting the bellows from its source of pressure fluid when the pilot valve is set to actuate the regulator.

5. A fluid brake for fluid pressure regulators comprising a cylinder, a valve connected to both ends of the cylinder, said valve being normally biased to open position, a bellows for closing said valve to stop circulation of the fluid in said cylinder, a source of constant pressure fluid for said bellows, a valve controlling the application of the pressure fluid to said bellows comprising a valve housing having a pair of parallel partitions in spaced relation with an orifice in each partition and a valve disposed between said partitions to close the orifice of one partition in one direction of its movement and the orifice of the other partition in the opposite direction of its movement, the valve housing being connected to the pressure source on one side of said pair of partitions and to the bellows on the opposite sides of said pair of partitions whereby when the valve is in neutral the pressure fluid is connected to the bellows; and the bellows is disconnected from the pressure source when the valve has shut off one of the orifices of said partition members, a piston in said cylinder connected to be operated by said regulator and a pilot valve for said regulator connected to a source of constant pressure and to opposite sides of the pressure regulator actuator, said pilot valve being connected to actuate said bellows pressure controlling valve.

6. In a pressure regulator system, a pressure regulator, a fluid pressure operator therefor comprising a piston type regulator having a pilot valve for directing the operating fluid to either side of the operating piston, a pressure sensitive regulator connected to the atmosphere to be regulated, a source of constant pressure fluid controlled by said pressure sensitive regulator to regulate the loading pressure to the piston operator pilot valve, a fluid brake having a piston connected to the piston operator to be actuated thereby and having a cylinder with flow connections from opposite sides of the piston to a valve chamber, a valve controlling the flow of fluid from one end to the other of said brake cylinder, a pressure responsive actuator for said valve connected to a constant source of pressure fluid to close the brake cylinder valve to lock the fluid therein, and means operative by the pilot valve of the piston operator to disconnect the bellows from the pressure source when the pilot valve is set to operative position.

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