April 23, 1935. L. A. MAXSON 1,998,553

PILOT VALVE

Filed Dec. 30, 1929

Fig. 1.

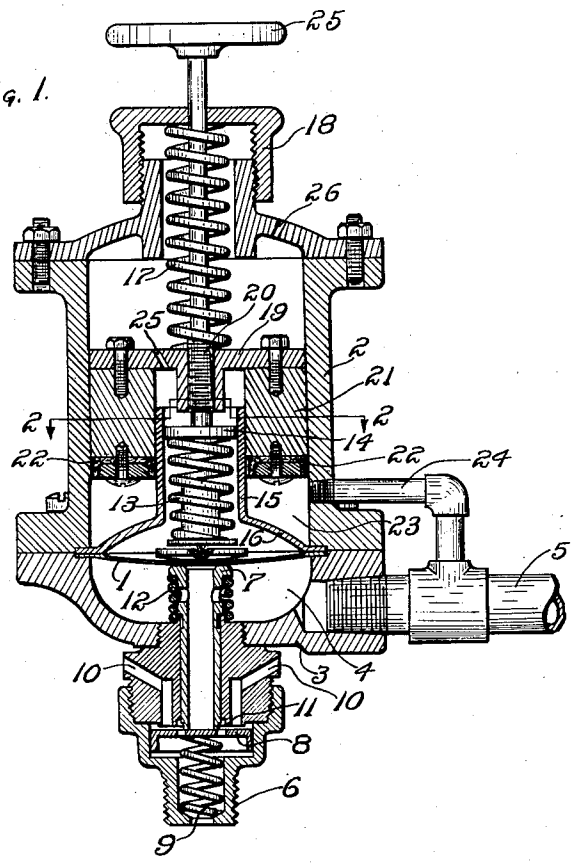
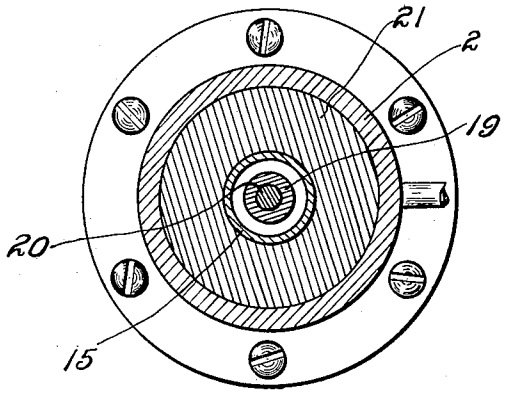


Fig. 2.



INVENTOR

Louis A. Maxson.

Patented Apr. 23, 1935 1,998,553

UNITED STATES PATENT OFFICE

1,998,553

PILOT VALVE

Louis A. Maxson, Claremont, N. H., assignor to Sullivan Machinery Company, a corporation of Massachusetts

Application December 30, 1929, Serial No. 417,275

14 Claims. (Cl. 137—153)

This invention relates to fluid controlling mechanisms, and more particularly to a pilot valve mechanism for controlling the loading and/or unloading, for instance, of a compressor.

One object of my invention is to provide an improved fluid pressure controlling device, and more specifically, a device which will permit relatively close regulation without the usual difficulties attendant thereto, such as fluttering of the valve member, small differential areas, etc. A further object is to accomplish this close regulation by operating certain of the parts with forces, whether fluid pressure or otherwise, of such magnitude that the movable elements will be positively controlled and yet will permit a satisfactory degree of regulation between relatively close pressure limits, thereby permitting the parts to be manufactured without that degree of precision and nicety which has been necessary in prior attempts to obtain close regulation. A further and more specific object of my invention is to reduce the range of the pilot valve operating forces which without my improved means would be present, and thus obtain a close pressure regulation. Other objects and advantages of my invention will be apparent from the following description.

In the accompanying drawing I have shown one form which my invention may assume in practice.

In this drawing,

Fig. 1 is a vertical section of the pilot valve control mechanism.

Fig. 2 is a transverse section thereof taken on line 2—2 of Fig. 1.

While my invention is specifically shown as a pilot valve most suitable for controlling the loading and unloading of, say, a compressor, it will of course be understood that the same may have various applications wherein it is desired to control the pressure in, for instance, any receptacle or pipe line which is supplied from a suitable source of fluid pressure and which source would in turn be controlled by my improved mechanism.

In the illustrative embodiment thereof, my improved arrangement comprises a diaphragm 1 clamped between a cylinder 2 and a lower casing 3 to form a pressure chamber 4, to which fluid pressure is supplied, through a suitable connection 5 leading from the air receiver, pipe line, or other pressure fluid containing means, and from which fluid pressure may be supplied through a suitable connection 6 to the means for controlling the source of pressure for the receiver.

In the particular embodiment, fluid pressure may be supplied through the connection 6 to either an intake, inlet, or exhaust valve type of compressor unloading mechanism to unload the compressor, and the fluid thus supplied is exhausted through the connection 6 when the compressor is loaded, these operations being usual and well understood. The pilot valve for thus controlling the flow of fluid from the chamber 4 and the venting of fluid from the connection 6 is specifically shown as of the well known Judson type, which, briefly, consists of a movable hollow valve stem 7 adapted to be closed at its lower end by a perforated flanged disc 8 by the action of a spring 9 holding the members in engagement when the diaphragm 1 is in its lowermost position. During this position, which is had when the receiver pressure is below a predetermined minimum, the connection 6 will be vented through passages 10 suitably connected with the chamber in which the valve member 8 is disposed. On the other hand, when the receiver pressure has reached a predetermined maximum so that the diaphragm 1 is moved upwardly by pressure in chamber 4, the valve stem 7 likewise will move upwardly away from disc 8 when the latter engages an annular seat 11 disposed outside of the perforations in the disc 8, whereupon fluid pressure may flow from the chamber 4 through suitable openings in the valve stem 7 and the perforations in disc 8 through the connection 6 to the unloading or other controlling mechanisms. During this time communication of the vent passages 10 with the disc chamber is closed, while an auxiliary spring 12 holds stem 7 away from disc 8.

The means for pressing the diaphragm towards loading position comprises a spring 13 interposed between a suitable disc resting against the diaphragm and a collar 14 which is slidably mounted or guided within a cylindrical extension 15 of a closure member 16 suitably clamped with the diaphragm 1 between the cylinder 2 and casing 3. A second spring 17, placed in series with spring 13, is held between a removable cover 18 and a piston 19, which in turn bears upon a small projection on disc 14 through an adjustable screw 20. Any suitable means may be provided to prevent rotation of piston 19 while screw 20 is being adjusted, e. g. a splineway and spline, a guide rod, or the like.

The piston 19 comprises a head plate removably attached to an annular body 21, the bore of which slidably receives the cylindrical extension 15, while a suitable annular flexible cup packing

22 prevents leakage when pressure is supplied to chamber 23 from the receiver conection 5, as by a passage 24. Any leakage that might occur past the packing and into the inner piston chamber is vented to the atmosphere through ports 25 and 26.

Be it assumed that the receiver pressure is below the desired minimum value. The parts will then be in the position shown, in which diaphragm 1 and pilot valve stem 7 are in their lowest position, thus causing venting of connection 6 to atmosphere, thereby causing loading of the compressor or causing any other source of supply to replenish, or deliver fluid to, the receiver. While receiver pressure is building up to a predetermined maximum it acts on the lower sides of diaphragm 1 and also upon piston 19. The piston will thus gradually be moved and compress spring 17, thereby relieving the tension of spring 13 by an amount which will permit the diaphragm 1 to be moved upwardly far enough to effect loading, by a unit pressure in diaphragm chamber 4 less than that which would be required if the force of spring 13 were not varied by the intervention of the force on piston 19. The upward movement of diaphragm 1 is accompanied by a corresponding movement of valve stem 7 and pilot valve disc 8, until the latter engages seat 11, after which further upward movement of stem 7 permits fluid pressure to flow from chamber 4 through the connection 6 to operate the unloading mechanism and thus unload the compressor. The pressures exerted by springs 13 and 17 must, of course, be adjusted to permit each to yield suitably during the period between loading and unloading.

It will be noted that were the abutment 14 stationary at all times, there would be required say n units of pressure increase to move the diaphragm from loading to unloading position. Because upward movement of piston 21 occurs too while the diaphragm 1 is being pressed upwardly, less than n units of pressure increase in chamber 4 will permit unloading. Therefore a closer regulation is obtained.

While I have in this application specifically described one form which my invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. A fluid pressure controlling device comprising a valve mechanism, means for forming a fluid pressure chamber including a movable fluid pressure operated element forming in all positions thereof a wall of said chamber and cooperating with said valve mechanism to move the same, said chamber having communication with the pressure to be controlled irrespective of the position of the valve mechanism, means for holding said fluid operated element and valve mechanism in one direction by a predetermined force, and means automatically operative during pressure variations on said element and governed by pressure which rises and falls simultaneously with the pressure in said chamber for varying the force with which said valve mechanism is held whereby the upper limit of pressure regulation of the pressure within said chamber is of lower value than would be obtained by said holding means acting alone.

2. A fluid pressure controlling device comprising a movable element, structurally distinct, fluid pressure actuated means for moving the same in one direction, means for moving the same in the opposite direction including a plurality of yieldable elements placed in series with each other and having similar ranges of yielding and each increasingly stressed on movement of said element in the first direction, and means interposed between said elements whereby the force normally transmitted from one to the other may be varied.

3. The combination set forth in claim 2 further characterized by the provision of means interposed between said series elements for adjusting the force of said elements.

4. A fluid pressure controlling device comprising a casing, a diaphragm associated therewith to form a fluid pressure chamber, a pilot valve unloading mechanism associated with said diaphragm and moved in one direction in accordance with the fluid pressure in said chamber, and means for moving said diaphragm in the opposite direction including a pair of springs placed substantially in axial alinement, a piston interposed between the adjacent ends of said springs, and means for supplying fluid pressure to said piston whereby said diaphragm may be moved in a direction against said springs with a force less than that created by said springs without the action of said piston.

5. A pilot valve unloading mechanism comprising a casing, a diaphragm disposed therein for forming a closed fluid pressure chamber to which fluid pressure is supplied from a suitable source of pressure to be controlled, a valve mechanism controlled by said diaphragm and adapted to permit flow of fluid from said chamber to permit control of the source, a pair of springs acting together to hold said diaphragm and valve mechanism in one position, a fluid operated piston associated with said springs, and means for operating said piston by fluid pressure supplied from said source whereby upon a predetermined maximum fluid pressure said piston is moved substantially simultaneously with movement of said diaphragm to vary the spring force acting upon said diaphragm.

6. A pilot valve mechanism comprising a casing having a cylindrical bore, a diaphragm disposed therein transversely of one end of said bore to provide a fluid pressure chamber, a pilot valve mechanism controlled by said diaphragm and having a passage adapted to be connected to unloading mechanism, an enclosure member disposed within said casing bore and having a cylindrical extension, a piston also disposed within said bore and slidably engaging the walls thereof and being provided with a bore with which said cylindrical extension has slidable telescopic engagement, controlling means associated with said piston including a spring interposed between said diaphragm and the end of said piston, and means for supplying fluid pressure to said diaphragm chamber and one side of said piston.

7. The combination set forth in claim 6 further characterized in that said means which is associated with the piston also includes a spring interposed between said piston and the end of said casing opposite to that in which said diaphragm is disposed.

8. The combination set forth in claim 6 further characterized in that the fluid pressure for said diaphragm chamber and piston is supplied from a common source.

9. The combination set forth in claim 6 further characterized in that said spring which is interposed between said diaphragm and the piston is

disposed within said enclosure element while the interior of the latter and the bore of said piston are vented to atmosphere.

10. An unloading pilot valve control comprising a casing having a cylindrical bore, a diaphragm disposed therein transversely of one end of said bore to provide a fluid pressure chamber, a pilot valve mechanism controlled by said diaphragm and having a passage adapted to be connected to unloading mechanism, an enclosure member disposed within said casing bore and having a cylindrical extension, a piston also disposed within said bore and slidably engaging the walls thereof and being provided with a bore in which said cylindrical extension is telescopically arranged, said piston having a portion extending across its bore, means associated with said piston including a spring interposed between said piston portion and said diaphragm, means for supplying fluid pressure to said diaphragm chamber and one side of said piston, and a second spring interposed between said piston portion and the end of said casing opposite to that of said diaphragm.

11. A pilot valve control comprising a casing having a cylindrical bore, a diaphragm disposed therein transversely of one end of said bore to provide a fluid pressure chamber, a pilot valve mechanism controlled by said diaphragm and having a passage adapted to be connected to unloading mechanism, an enclosure member disposed within said casing bore and having an extension, a piston also disposed within said bore and slidably engaging the walls thereof and being provided with a bore in which said cylindrical extension is telescopically arranged, said piston having a head extending across its bore, means associated with said piston including a spring interposed between said head and diaphragm, a second spring interposed between said piston head and the end of said casing opposite to that of said diaphragm, and means for supplying to said diaphragm chamber and one side of said piston fluid pressure which is to be regulated while the other side of said piston is subjected to constant fluid pressure.

12. In a pump pilot valve mechanism, a valve movable to control loading and unloading, and controlling means therefor including coaxial pump discharge pressure pressed members and serially acting resilient means respectively compressed by movement in the same direction of each of said members.

13. In a valve mechanism, a controlling valve and means for regulating the position of said valve substantially exclusively in accordance with the pressure at the supply side of said valve whereby said valve may upon the attainment of a predetermined pressure at the supply side thereof effect substantial equalization of pressure at its opposite sides, said regulating means including a member movable by supply side pressure and means for controlling movement of said member by said pressure including yielding means opposing said movement, a yielding abutment against which said yielding means reacts in opposing such movement, and means subjected to a pressure which bears a constant relation to the supply pressure for varying the resistance opposed by said yielding abutment.

14. In a valve mechanism, a controlling valve and means for regulating the position of said valve substantially exclusively in accordance with the pressure at the supply side of said valve whereby said valve may upon the attainment of a predetermined pressure at the supply side thereof effect substantial equalization of pressure at its opposite sides, said regulating means including a member movable by supply side pressure and means for controlling movement of said member by said pressure including yielding means opposing said movement, an abutment against which said yielding means reacts in opposing such movement, yielding means against which said abutment reacts during the opposing of such movement, and means subjected to a pressure which bears a constant relation to the supply pressure acting in opposition to the resistance offered by said second mentioned yielding means.

LOUIS A. MAXSON.