Feb. 29, 1944. M. H. GROVE ET AL 2,342,659

LOADING REGULATOR

Filed Dec. 11, 1939

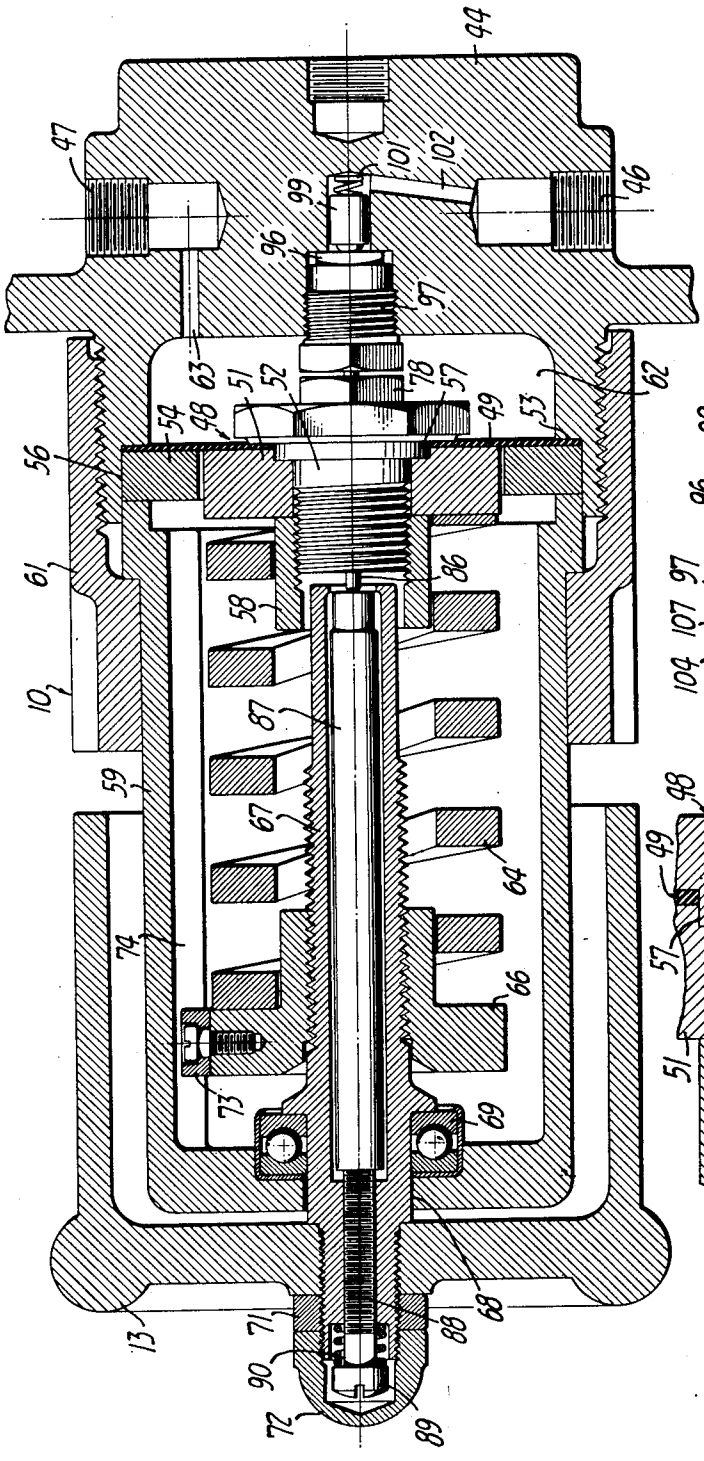


FIG. 1

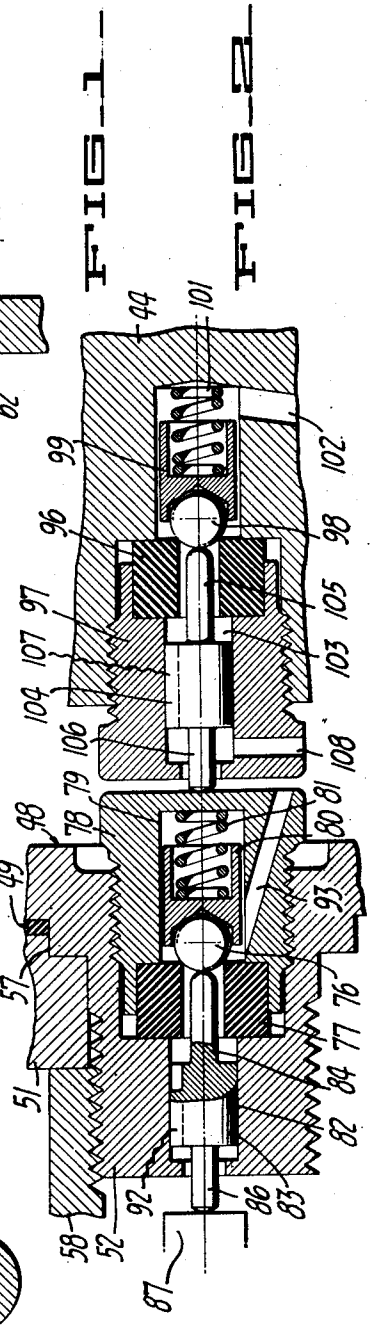


FIG. 2

INVENTORS
MARVIN H. GROVE
DOUGLAS H. MANNIN
BY Paul O. Teale
ATTORNEY

Patented Feb. 29, 1944 2,342,659

UNITED STATES PATENT OFFICE

2,342,659

LOADING REGULATOR

Marvin H. Grove, Piedmont, and Douglas H. Annin, Oakland, Calif.; said Annin assignor, by mesne assignments, to Fluid Control Engineering Co., a copartnership consisting of Marvin H. Grove and Julia E. Grove, both of Piedmont, Calif.

Application December 11, 1939, Serial No. 308,622

2 Claims. (Cl. 50—23)

This invention relates generally to apparatus for the purpose of controlling flow of various fluids. More particularly it relates to flow regulators capable of maintaining a desired gas pressure in a closed or substantially closed pressure system.

In the operation of various fluid flow control equipment, such as fluid pressure regulators and pressure relief valves, it is frequently desirable to provide a loading pressure with provision for adjusting the same over a predetermined range. For example a loading pressure from an external source can be applied to a regulator such as shown in Grove Patent No. 2,047,101, to control operation of the same. Such a regulator must be capable of supplying gas at a selected pressure, and also must have means for venting gas when the pressure rises beyond a desired value. In the past small sized regulators for this purpose, capable of simple adjustment over a wide range, have not been available.

It is an object of the present invention to provide a simple loading regulator suitable for the service described above, and which can be adjusted over a wide range of pressures by turning a single operating member.

Another object of the invention is to provide an improved construction for a loading regulator of the above character, and which lends itself to simplified control and adjustment.

Additional objects of the invention will appear from the following description in which the preferred embodiment of the invention has been set forth in detail in conjunction with the drawing.

Referring to the drawing—

Figure 1 is a side elevational view in cross section, illustrating a loading regulator incorporating the present invention.

Figure 2 is an enlarged cross sectional view showing the valve element incorporated in the regulator of Figure 1.

The loading regulator 10 illustrated in Figure 1 has been constructed primarily for the control of gas. It includes a body 44 having the inlet and outlet passages 46 and 47. Within the body there is a diaphragm assembly 48 which includes the flexible diaphragm element 49, an overlying diaphragm disc 51, and a clamping stud 52 which extends through disc 51 and through the central portion of the diaphragm. The outer peripheral edge portion of flexible diaphragm element 49 is gripped between an annular shoulder 53 formed on the valve body and the lower side of a stationary ring 54 which is accommodated within the annular recess 56 formed in the body. The inner peripheral edge portion of diaphragm element 49 is clamped between an annular shoulder 57 formed on fitting 52 and the adjacent face of the disc 51. That portion of fitting 52 which extends through disc 51 is threaded and engaged by the nut 58.

In conjunction with the body 44 there is a shell 59, one end of which is clamped upon ring 54 by the ferrule 61. The chamber or space 62, in one side of the diaphragm assembly, is in communication with the outlet side of the loading regulator, as by means of a duct 63. In order to form an adjustable loading force acting upon the other side of the diaphragm assembly, there is a spring 64, one end of which is seated upon the disc 51. The other end of the spring is seated upon a follower 66 which is threaded upon the hollow rod 67. One end of rod 67 terminates near the diaphragm assembly, and the other end extends through a central opening 68 provided in the shell 59. A thrust bearing 69, in the form of a ball bearing assembly, is interposed between the rod 67 and the shell 59, whereby the shell 59 takes the thrust of spring 64. The outer end of rod 67 carries the manual operating member 13 which is in the form of a cup or cap. For the attachment of cup 13 to rod 67, the outer end of the rod is threaded to receive the clamping nut 71 and the closure cap 72. Upon turning the member 13, the rod 67 is turned so that the follower 66 moves longitudinally of the rod to vary the tension upon the compression spring 64. In order to prevent rotation of follower 66, it carries a roller 73 which extends into a longitudinal guide track or groove 74 formed within the shell 59.

The diaphragm assembly 48 carries valve means serving to vent gas from the outlet side when the gas in chamber 62 moves the diaphragm against spring 64. This valve means preferably consists of a ball 76 engaging a seat ring 77 formed of suitable material such as hard rubber. The ball 76 is carried within a plug 78 threaded into fitting 52, and this plug also serves to clamp against and retain the seat ring 77. An inner bore 79 in plug 78, in which ball 76 is accommodated, also accommodates a follower 80 and a light compression spring 81. The follower 80 is adapted to seat upon the ball 76 and may move freely within the bore 79. Spring 81 retains the ball normally closed upon its seat. On the other side of the seat 77, the fitting 52 is provided with a bore 82 within which there is a sliding piston or plunger 83. A pin 84 extends from the outer end of this plunger to a point in engagement with the ball 76. Another pin 86 extends from the opposite

end of plunger 83 and is adapted to engage one end of a fixed rod 87. This rod forms an abutment, the position of which may be adjusted. It is accommodated within the hollow rod 67, and the end which is remote from the diaphragm assembly is provided with a threaded portion 88 which extends through and is threaded within the outer end of rod 67. The outer end of threaded portion 88 is provided with a slotted head 89, whereby upon removing clamp 72, rod 87 can be rotated to change its setting. Compression spring 90 below the head 89 affords sufficient friction to properly retain a given setting.

Piston 83 has a small groove or duct 92 for the passage of gas flowing through the valve seat 77, when the ball 76 is moved from its seat. Plug 78 is also provided with a duct 93, whereby the pressure of gas in chamber 62 is applied to the ball 76.

Additional valve means is carried by the body 44 and serves to control flow of gas between the main inlet and outlet openings. This valve means includes a seat ring 96 held in place within the body by the threaded plug 97. The seat ring is engaged by a ball 98 which is urged towards the ring by the follower 99 and spring 101. The space in the body occupied by ball 98 communicates with the inlet passage 46 through the duct 102. On the other side of the seat ring 96, plug 97 is provided with a bore 103 within which the piston 104 is fitted. Pin 105 extends from one end of this piston to engage the ball 98, and pin 106 extends from the opposite end of the plunger to a position for engagement with the outer face of plug 78. Plunger 104 has a groove 107, and plug 97 has a duct 108, so that when ball 98 is opened gas flows from the inlet passage 46 through duct 102, through the valve seat 96, and thence through duct 107 and 108 to chamber 62.

It will be apparent from the foregoing that when the diaphragm assembly 48 moves a slight amount to the left as viewed in Figure 1, the ball 76 is unseated with the result that gas is vented to the atmosphere from chamber 62 and from the outlet passage 47. Likewise, when the diaphragm moves a small amount to the right, as viewed in Figure 1, under the urge of the loading spring 64, ball 98 is unseated with the result that gas from the inlet passage 46 flows through the valve seat 96 into the chamber 62, and from thence through duct 63 to the outlet passage 48. Since the gas pressure in chamber 62 represents the outlet pressure, the diaphragm will be moved whereby opening and closing of valve ball 98 maintains a substantially constant pressure upon the outlet side 47. Should the pressure upon the outlet side increase beyond a predetermined value, then movement of the diaphragm assembly causes opening of valve ball 76 to vent gas to the atmosphere, thus reducing the outlet pressure within definite limits.

The margin between the pressure at which valve ball 98 is unseated, and the pressure at which valve ball 76 is unseated to vent gas, can be relatively small as, for example, in the neighborhood of ten pounds per square inch for pressures on the outlet side of the order of 500 pounds per square inch. This margin between minimum and maximum outlet pressures can be varied by changing the setting of the abutment 87, as by applying a suitable tool to the head 89. Retracting the abutment with respect to the diaphragm assembly serves to increase the margin between minimum and maximum outlet pressures, while moving the abutment closer to the diaphragm tends to reduce the margin.

Turning the operating member 13 serves to change the force exerted by the loading spring 64, with the result that the outlet pressure is adjusted. Because of the manner in which the two different valve means are coordinated together, a change in the setting of operating member 13 changes not only the minimum pressure maintained on the outlet side, but the maximum pressure as well. In other words, if member 13 is operated to change the outlet pressure to from 400 to 600 pounds per square inch, such a change not only changes the pressure at which ball 98 is unseated to permit flow of gas from the inlet to the outlet side, but in addition simultaneously varies the maximum pressure at which ball 76 is unseated to permit venting of gas to the atmosphere.

It will be evident from the foregoing that the regulator described can be used for a variety of purposes. For example it can have its low pressure side connected to the dome of a regulator such as shown in Grove Patent No. 2,047,101 in order to maintain a substantially constant loading pressure of a selected valve, irrespective of temperature changes or possible leakage.

We claim:

1. In pressure regulating apparatus, a body having inlet and outlet passages, a diaphragm carried by the body, the body providing a fluid chamber on one side of the diaphragm in communication with the outlet side of the regulator, valve means carried by the body and movable between closed and open positions to control flow of fluid between the inlet and outlet passages, said valve means including a stationary seat and a movable valve member, a second valve means carried by the diaphragm, said second valve means likewise including a valve seat and an associated movable valve member, means whereby movement of the diaphragm assembly in one direction from an intermediate position against the pressure in said chamber serves to operate the first named valve means from closed position to permit flow of fluid between the inlet and outlet passages, said means comprising a part fixed to the diaphragm and forming an abutment surface immovable relative to the diaphragm for engaging and applying motion to the first named movable valve member, a coiled compression spring disposed upon the other side of the diaphragm and having one end of the same seated upon the diaphragm, a member manually rotatable about an axis aligned with the center of the diaphragm and at right angles thereto, journal means serving to mount said member with respect to the body for rotation about said axis, without movement in a direction toward or away from the diaphragm, means acting between said rotatable member and said compression spring, whereby the compression of said spring is adjusted by rotation of said member to adjust the loading force upon the diaphragm, means serving to open said second valve means to thereby vent fluid from the outlet side of the regulator when the diaphragm is flexed from said intermediate position responsive to pressure of fluid in said chamber, said last means including an abutment extending axially through said rotatable member and adapted to be engaged by the valve member of the diaphragm carried valve means, and means carried by said member for adjusting the position of said abutment in a direction toward or away from the diaphragm assembly, both said valve means being closed when said diaphragm is in said intermediate position.

2. In a pressure regulator, a body having inlet and outlet passages, a circularly contoured flexible diaphragm carried by the body to form a fluid chamber therewith, said chamber being in communication with the outlet side of the body, a shell carried by the body and serving to generally enclose the space upon the other side of the diaphragm, a diaphragm carried valve assembly extending through the central portion of the diaphragm and secured to the same, said assembly comprising a movable valve member cooperating with an associated valve seat, opening movement of the valve member of said assembly serving to vent fluid from said chamber, a second valve assembly carried by said body, the valve means of said last named assembly including a valve member movable between open and closed positions and serving when opened to permit flow of fluid from the inlet to the outlet passages, a member extending through one wall of the shell and rotatable about an axis at right angles to the diaphragm assembly and aligned with the center of the same, a compression spring within the shell and surrounding said member, one end of the spring being seated upon the diaphragm, means forming a thrust bearing between said member and said shell, whereby said member can be rotated about its axis without movement toward or away from said diaphragm, a follower threaded upon said member and engaging the other end of the compression spring, whereby upon rotation of said member said follower is moved to vary the compression of said spring and thus adjust the loading upon the diaphragm, a valve operating abutment extending axially through said member, the inner end of the abutment being disposed to be engaged by the valve member of the diaphragm carried valve assembly when the diaphragm moves in one direction from an intermediate position, means for adjusting said abutment in a direction longitudinally of the axis of rotation of said member, and a part fixed to the diaphragm and forming an abutment for engaging and applying motion to the valve member of the body carried assembly when the diaphragm is moved in an opposite direction from said intermediate position, both said valve means being closed when said diaphragm is in said intermediate position.

MARVIN H. GROVE.
DOUGLAS H. ANNIN.