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LEVER

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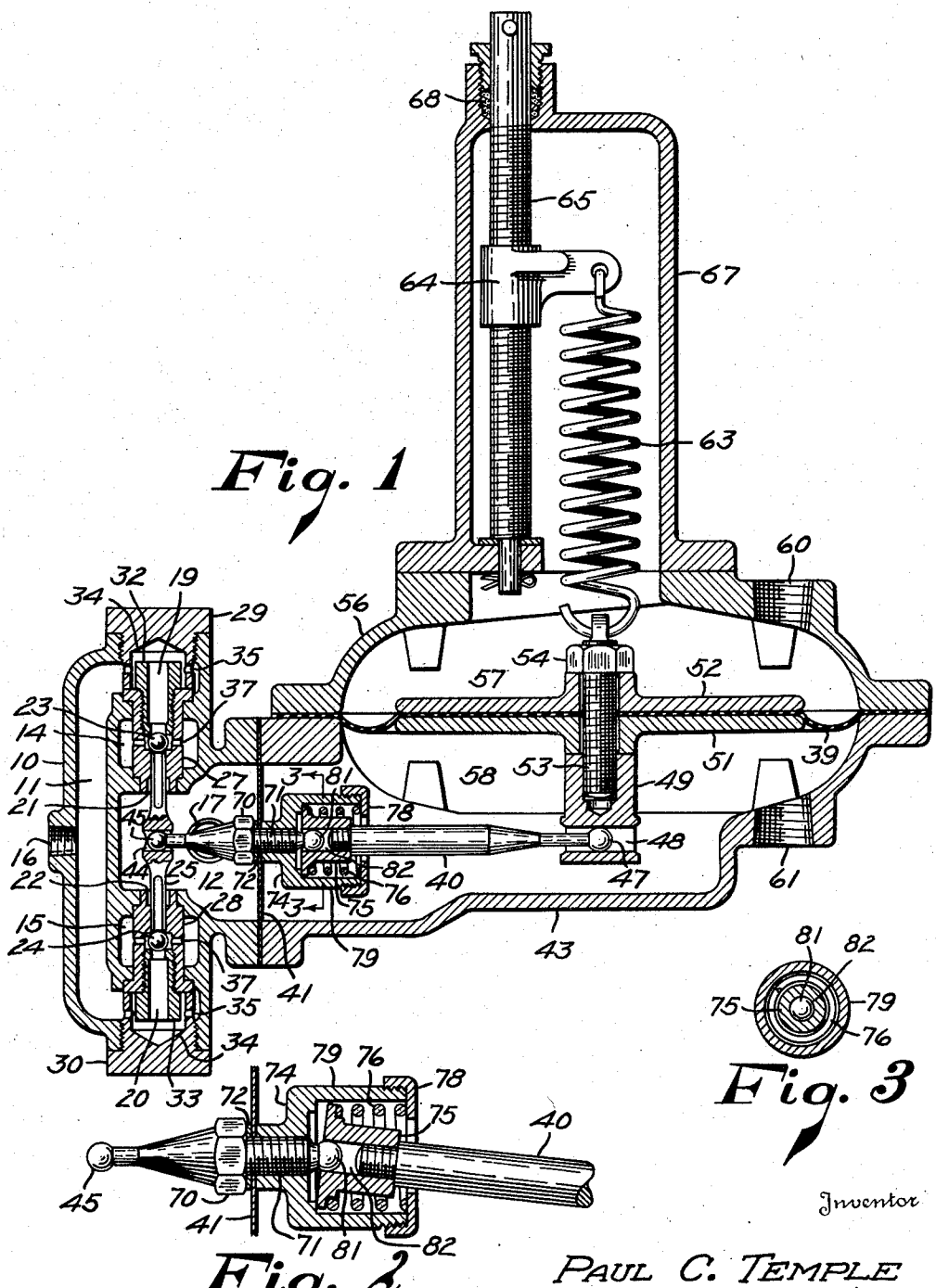


Fig. 1

Fig. 3

Fig. 2

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4 Claims. (Cl. 74—470)

This invention relates to levers, and more particularly to a lever suitable for transmitting movement from an automatic control device, such as a pressure responsive diaphragm, to a flow controlling valve. This application is a continuation in part of my prior application Serial No. 646,835, filed December 12, 1932, now Patent No. 1,992,048, granted February 19, 1935.

If the force transmitted by the lever in an apparatus of this type materially exceeds that necessary to effect the desired movement of the valve, there is danger of overloading some part of the mechanism and causing serious damage thereto. The valve may be of the seating type, and if it is jammed too tightly against its seat one or both of these parts will be injured, and the operation will be rendered unsatisfactory.

It is accordingly one object of the invention to provide a simple, inexpensive and compact lever which will yield upon application of an excessive force thereto.

It is a further object of the invention to provide an improved and compact construction for a lever which will yield upon application of an excessive force thereto in any direction.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawing illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a vertical section through the center of an automatic controller;

Fig. 2 is an enlarged view of a portion of Fig. 1, showing the lever in its flexed position; and

Fig. 3 is a section on the line 3—3 of Fig. 1.

The embodiment illustrated comprises a hollow valve body or casing 10 divided internally by suitable partitions into an inlet chamber 11, an outlet or exhaust chamber 12, and two intermediate chambers 14 and 15. The exhaust chamber is located between the intermediate chambers, and the inlet chamber is U-shaped and arranged with its end portions adjacent to the intermediate chambers. An inlet opening 16 leads directly into the inlet chamber 11, and an exhaust opening 17 leads directly from the exhaust chamber 12. Similar openings (not shown) communicate directly with the intermediate chambers 14 and 15.

Inlet ports or passages 19 and 20 connect the inlet chamber with the intermediate chambers 14 and 15 respectively, and exhaust ports or passages 21 and 22 connect the exhaust chamber with the intermediate chambers 14 and 15 respectively. In the preferred construction these ports 19, 20, 21 and 22 are arranged in direct axial alignment.

The flow of fluid through the casing 10 is controlled by two valves 23 and 24, which are preferably spherical in shape. Valve 23 is located between ports 19 and 21, and valve 24 is located between ports 20 and 22. These valves are controlled by a reciprocable valve stem 25 having its end portions slidable in the exhaust ports 21 and 22. If the fluid to be controlled is a liquid, such as water or oil, the valve stem is preferably made long enough to hold the valves slightly off the exhaust seats when the stem is in its central or neutral position. This is particularly desirable when the valve stem is arranged to be actuated by an automatic pressure responsive device, since it removes a large part of the unbalanced load on the valves and makes the controller more sensitive. However, if the fluid to be controlled is a gas, such as compressed air, the valve ports can be made much smaller and the unbalanced load will therefore become of little importance. In such a case the valve stem is preferably made slightly shorter, so that both valves will close against the exhaust seats when the valve stem is in its neutral position. This prevents any loss of fluid to the exhaust so long as the valve stem remains in this position. It will be understood that the valve stem is not fastened to the ball valves, but merely pushes against them. Hence any inaccuracy or misalignment which may occur in the actual construction will not prevent the valves from seating tightly.

In order that my improved four-way valve mechanism may be conveniently manufactured and assembled, I prefer to form the various inlet and exhaust ports in separate parts which are removably mounted in the casing 10. As illustrated, the exhaust ports 21 and 22 are formed in flanged hollow cylindrical members 27 and 28 respectively which are held firmly in position by means of plugs 29 and 30 screw-threaded to the casing 10. The plugs 29 and 30 are arranged in direct axial alignment with the members 27 and 28. The inlet ports 19 and 20 are formed in flanged cylindrical members 32 and 33 which are screw-threaded to the interior bore of the members 27 and 28. The plugs 29 and 30 are recessed axially as shown at 34 to clear the flanged ends of the inlet seat members 32 and 33, and radial openings 35 are provided to communicate with the recesses so that the fluid

flow to the inlet ports will not be obstructed. Radial openings 37 are provided in the exhaust seat members 27 and 28 to establish communication between the interior of these members and the adjacent intermediate chambers.

It will now be seen that if fluid is supplied under pressure to the inlet chamber 11, and the valve stem 25 is moved upwardly, valve 23 will close the inlet port 19. At the same time, the fluid pressure will force valve 24 upwardly to close the exhaust port 22. Fluid can therefore flow from the inlet chamber 11 to the intermediate chamber 15, and fluid can also flow from the intermediate chamber 14 to the exhaust chamber 12. If the valve stem is moved downwardly to its other extreme position, the inlet chamber will be connected with the intermediate chamber 14, and the intermediate chamber 15 will be connected with the exhaust chamber.

In the construction illustrated, the valve stem 25 is arranged to be actuated automatically by means of a fluid pressure responsive diaphragm 39 which is connected to the valve stem by means of a lever 40 of the first class. This lever is pivotally supported by means of a small flexible diaphragm 41 which serves both as a fulcrum for the lever and as one wall of the exhaust chamber 12. This diaphragm 41 is preferably formed from a thin flat plate of a suitable material, such as phosphor bronze, and it is clamped at its periphery between the valve casing 10 and a diaphragm casing 43, these parts being suitably fastened together. The intermediate portion of the valve stem 25 is enlarged and provided with a transverse opening 44 to receive the spherical end 45 of the short arm of the lever 40. The other end 47 of the lever, which is also preferably spherical, is positioned within a transverse opening 48 (preferably rectangular in cross-section) formed in a block 49 which is secured to the central portion of a lower pressure plate 51. The central portion of the main diaphragm 39 is clamped between the lower pressure plate 51 and an upper pressure plate 52, these plates being fastened together by a central stud 53 threaded into the block 49 and provided with a nut 54 at its upper end. The main diaphragm is clamped at its periphery between the diaphragm casing 43 and a flanged upper cover plate 56 which is fastened to the casing 43.

It will now be seen that the main diaphragm 39 divides the space enclosed by the casing 43 and the cover plate 56 into an upper chamber 57 and a lower chamber 58. The cover plate 56 is provided with an opening 60 leading to the chamber 57, and the casing 43 is provided with an opening 61 leading to the chamber 58. These openings are shown screw-threaded for convenience in connecting pipes thereto. A controlling fluid pressure may be applied to either or both of these chambers.

In order to support the main diaphragm against the controlling fluid pressure, I have shown a coiled tension spring 63 arranged in a vertical position above the center of the diaphragm with its lower end connected to the stud 53. The upper end of the spring is fastened to a nut 64 which is mounted on a vertical screw 65. This screw is rotatably supported in a housing 67 which is fastened to the cover plate 56, and which serves to enclose the spring. The upper end of the screw 65 extends through a stuffing box 68 at the top of the housing 67, so that the screw can be rotated to move the nut 64 vertically and thus vary the tension of the spring.

The controlling fluid pressure to which the main diaphragm is subjected may become large enough to cause an excessive load on the valve seats or fulcrum diaphragm. In order to prevent such excessive loading, I form the valve operating lever 40 with a flexible joint which is normally held rigid by a yieldable device.

In the preferred construction illustrated the short arm of the lever is provided with an hexagonal portion 70 forming a shoulder, and an externally screw-threaded stud 71 which extends through the fulcrum diaphragm 41. A small annular gasket 72 surrounds the stud 71 between the shoulder 70 and the diaphragm, and these parts are clamped firmly together by means of a flanged member 74 threaded to the stud. A flanged member 75 is screw-threaded to the adjacent end of the long arm of the lever, and the two members 74 and 75 provide plane cooperating surfaces which are perpendicular to the axis of the lever. These surfaces are normally held in contact by means of a coiled compression spring 76 surrounding the member 75. The spring 76 is supported by means of an annular cap or collar 78 screw-threaded to a cylindrical shell 79 integral with the flange 74. The shell 79 surrounds the member 75 and the spring 76. The cap 78 is provided with a central opening considerably larger than the portion of the lever extending therethrough, so that the cap will permit a substantial lateral pivotal displacement of one part of the lever relative to the other.

In order to maintain the correct alignment between the two parts of the lever, I provide them with interfitting portions which are nevertheless so shaped as to allow the desired flexing when necessary. For this purpose the end of the stud 71 is formed with a spherical projection 81 which fits closely within a centrally located cylindrical opening 82 in the flanged member 75.

The operation of the invention will now be apparent from the above disclosure. The diaphragm 39 moves in response to any change in the effective pressure thereon, and these movements are transmitted through the lever 40 and valve stem 25 to the ball valves 23 and 24. These valves control the admission of fluid from the inlet chamber 11 to the intermediate chambers 14 and 15, thus controlling the pressure in these chambers. This pressure may be used to move a double-acting piston in a power cylinder (not shown). In case the effective pressure on the diaphragm 39 materially exceeds that necessary to close either of the ball valves, the joint in the lever 40 will flex against the pressure of the spring 76, one part of the lever tipping laterally relative to the other part, as shown in Fig. 2, thus allowing the diaphragm to continue its movement without causing excessive pressure between the valve and its seat. The joint will provide the desired protection irrespective of the direction in which the excessive force is applied. Upon restoration of normal conditions, the spring 76 will expand and hold the flanged member 75 in contact with the member 74. The spherical projection 81 will prevent relative sliding movement between the contacting surfaces of the two parts of the lever, thus avoiding the undesirable effect which such movement would have upon the adjustment of the controller. The construction is simple and inexpensive to manufacture, and it is so compact and self-contained that it may be readily applied to any controller of the type having a valve-actuating lever.

Having thus described my invention, what I

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

1. A lever formed in two parts located in substantial alignment and shaped to provide plane cooperating surfaces perpendicular to the axis of the lever, a coiled compression spring surrounding one part of the lever and tending to maintain said surfaces in contact, and supporting means for the spring carried by the other part of the lever and shaped to permit a substantial lateral tipping of one part of the lever relative to the other, whereby the lever will yield upon application of an excessive force thereto.

2. A lever formed in two parts, each part of the lever having a flange thereon, a coiled compression spring surrounding one part of the lever and tending to maintain the corresponding flange in contact with the other flange, and an annular cap carried by the said other flange and arranged to support the spring, the cap having a central opening through which one of the lever parts extends and considerably larger than said lever part, whereby one lever part may be laterally displaced pivotally relative to the other part through a substantial angle.

3. A lever formed in two parts located in substantial alignment and shaped to provide plane cooperating surfaces perpendicular to the axis of the lever, one of said parts having a recess therein and the other part having a projection positioned within the recess to prevent relative sliding movement between said surfaces while allowing lateral tipping of one lever part relative to the other, and a coiled compression spring surrounding one part of the lever and tending to maintain said surfaces in contact, whereby the lever will yield upon application of an excessive force thereto.

4. A lever formed in two parts located in substantial alignment and shaped to provide plane cooperating surfaces perpendicular to the axis of the lever, one of said parts having a cylindrical recess therein and the other part having a spherical projection positioned within said recess, and a yieldable device tending to maintain the said surfaces in contact.

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