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G. T. McCLURE

2,765,811

DIAPHRAGM SUPPORT

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Fig. 2

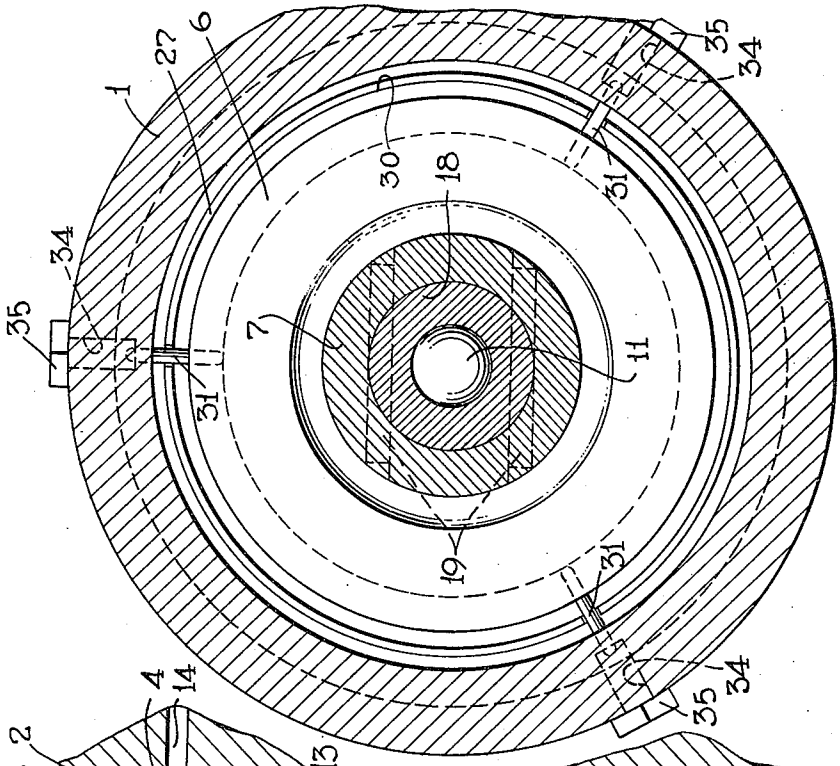
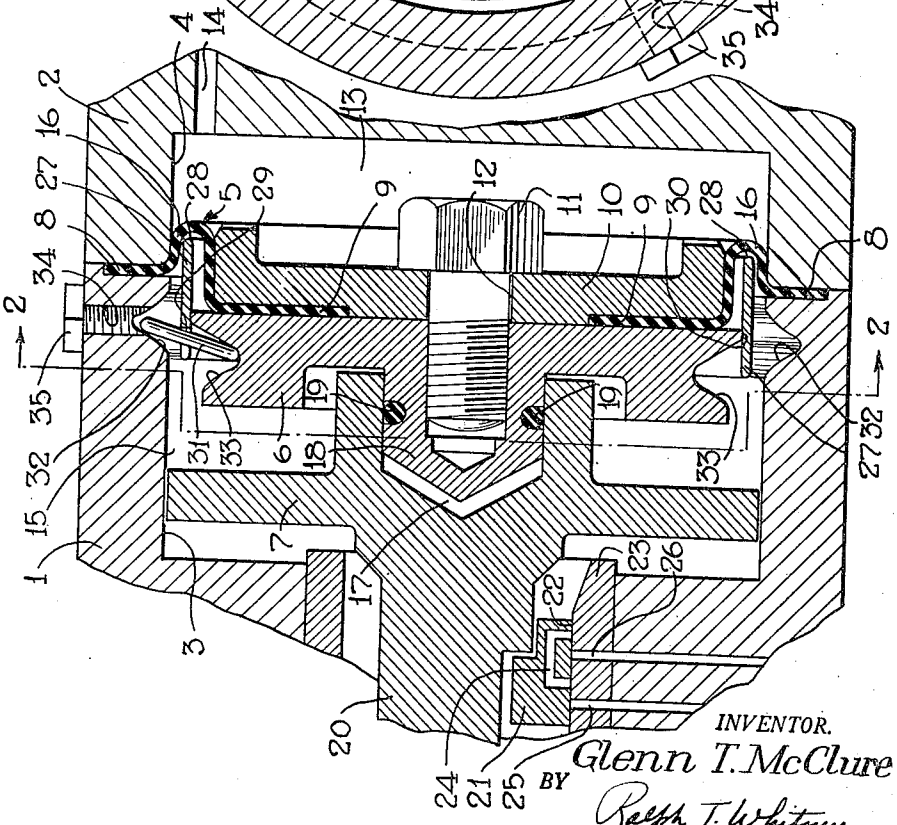


Fig. 1



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DIAPHRAGM SUPPORT

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This invention relates to flexible diaphragm supports for fluid pressure equipments and more particularly to means for supporting the annular corrugation or fold of a flexible diaphragm to prevent the reversal thereof due to fluid pressure acting thereon.

Flexible diaphragms of the type having an annular corrugation or fold formed therein and usually employed with a follower adapted to be actuated by said flexible diaphragm are subject to the disadvantage that under ordinary operating conditions the fold thereof may reverse itself due to the fluid pressure force acting thereon, which reversal in certain cases may be objectionable.

The principal object of my invention is to provide means for preventing the annular fold of a flexible diaphragm from being reversed by fluid pressure acting thereon during operation.

Other objects and advantages of my invention will be apparent from the detailed description given hereafter when read in connection with the accompanying drawings, in which

Fig. 1 is a fragmental sectional view of a device embodying the invention, and

Fig. 2 is a view, taken on the line 2—2 of Fig. 1.

For illustrative purposes only, I have shown my invention as being embodied in a fluid pressure controlled valve device having casing sections 1 and 2 which may be secured together in the usual manner. Formed in the casing section 1 is a bore 3 coaxially arranged with a bore 4 in the casing section 2.

Contained in the bores 3 and 4 is a movable abutment comprising a flexible diaphragm 5, a follower 6, and a guide disc 7.

The flexible diaphragm 5 has a flat outer edge portion 8 clamped between the casing sections 1 and 2 and a flat central portion 9 clamped to the follower 6 by means of a plate 10 and a screw 11, said screw 11 extending through a central opening 12 of the plate 10 and a central opening in the diaphragm 5 and having a screw-threaded connection with the follower 6. Formed at the one side of diaphragm 5 is a chamber 13 which may be in communication with a supply of fluid under pressure by way of a passage 14 in the casing section 2, and formed at the other side thereof is a chamber 15.

The portion of the diaphragm 5 which is intermediate the flat portion 8 and 9 and which is adapted to be subjected to a flexing action, is in the form of an annular corrugation or fold 16.

The guide disc 7 is slidably mounted in the bore 3 and is suitably secured to the follower 6 in any desired manner, as by having a cavity 17 in which a central extension or stem 18 of the follower 6 is received and locked by two transversely and parallel-extending pins 19, as shown in Fig. 2. The disc 7 also has a stem 20 which is adapted to operate a member, such as a slide valve 21.

The slide valve 21 may operate on a flat slide valve seat 22 formed on the inner surface of a sleeve or bushing 23 secured within the casing section 1. Formed in the slide valve 21 is a passage 24 adapted to connect a

passage 25 formed in seat 22 and casing section 1 with a passage 26 also formed in seat 22 and casing section 1.

According to my invention, an annular diaphragm-fold back-up element or ring 27 is slidably mounted about the periphery of the follower 6 and has at one of its ends a supporting surface 28 formed thereon which extends into the hollow of the fold 16 and is in adjacent relationship with the inside crown of said fold 16, and has at its other end, equally spaced about the circumference thereof, a plurality of slots 29. The diaphragm support ring 27 rides upon a guiding surface or peripheral edge 30 of the follower 6, said surface 30 extending radially approximately halfway across the span of the fold for maintaining said ring 27 substantially in the middle of the fold 16.

The ring 27 is maintained in axial alignment partly by the edge 30 of the follower 6 and partly by three pins 31, each of which is inserted into one of the slots 29 in such a manner that each end of the pin 31 extends an equal distance from slot 29, and that one end of said pin 31 is pivotally disposed in an annular recess or groove 32 which encircles the inside circumference of the casing section 1 and the other end of said pin 31 is pivotally disposed in an annular recess or groove 33 encircling the periphery of the follower 6, said grooves 32 and 33 being substantially V-shaped in cross section.

The three pins 31 may be introduced into their respective slots 29 by way of a plurality of tapped openings 34 which are equally spaced about the outside circumference of the casing section 1 and which open into the bottom of the groove 32. Each of the tapped openings 34 is sealed by means of a screw plug 35, each plug having a screw-threaded connection with its respective tapped opening 34 and each plug 35 having its end flush with the curved surface at the bottom of groove 32.

With the construction of the invention, as hereinbefore described, it will readily be seen that when the pressure of fluid, supplied to chamber 13 by way of passage 14, becomes great enough the fold 16 will flex in a left-hand direction, as viewed in the drawing, even though the follower 6 does not move, until the fold 16 operably engages the supporting surface 28 of the ring 27 and thereby causes movement of said ring 27 axially into engagement with the outer pins 31. Pins 31 will thereby prevent further movement of the ring 27 due to the opposite ends of the pins 31 contacting the walls of the grooves 32 and 33. As the diaphragm supporting ring 27 will thus be prevented from moving in a left-hand direction, prior to movement by the follower 6, the supporting surface 28 will resist the urging of the fold 16 to reverse itself due to fluid pressure acting thereon.

When the pressure of fluid in chamber 13 becomes great enough to move the follower 6 in a left-hand direction, as viewed in the drawing, movement of the follower 6 will effect corresponding axial movement of the ring 27 in the same direction. This results from the fact that the pins 31 are rocked through an arc proportion to the travel of the follower 6, by reason of the shifting of the groove 33 in the follower 6 relative to the stationary groove 32 in the casing section 1. The fluid pressure of the chamber 13 thus acts on the fold 16 to move the ring 27 in a left-hand direction keeping the inner edges of the slots 29 in constant engagement with the pins 31 as they are rocked through an arc. The supporting surface 28 of ring 27 will thus be maintained in adjacent relationship with the inside crown of fold 16 thereby preventing it from being reversed.

When the fluid pressure differential acting on the diaphragm 5 reverses, as when the pressure of fluid in chamber 15 becomes greater than the pressure of fluid in chamber 13, the follower 6 will move in a right-hand direction, as viewed in the drawing. The movement of the

follower 6 will rock the pins 31 reversely due to the shifting of groove 33 relative to groove 32, and the pins 31 will engage the inner edge of slot 29 of ring 27 to correspondingly shift the ring 27 in a right-hand direction for maintaining the supporting surface 28 thereof in adjacent relationship with the inside crown of the fold 16 thereby preventing it from being reversed.

Although in the construction shown, the ring 27 moves approximately one-half the distance of the movement of the follower 6, it will be seen that the construction may be modified without invention to provide any desired ratio of relative movements between the ring 27 and follower 6, whereby to maintain the support ring 27 in close relation at all times to the inside crown of the fold 16 on the diaphragm.

It will accordingly be seen that I have provided a novel arrangement for guarding against reversal of the annular fold of a flexible diaphragm of the type hereinbefore described.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The combination of a casing, a follower contained and movable within said casing, a flexible diaphragm operatively connected to said follower and having an annular corrugation formed therein to permit movement of said follower responsively to subjection of said diaphragm to pressure of fluid, a movable ring with an annular end thereof projecting into the annular hollow formed within said annular corrugation, and means actuated by said relative movement of said follower and said casing for controlling axial movement of said ring relative to said follower so that said annular end thereof will be constantly effective to prevent reversal of said annular corrugation due to fluid pressure acting thereon.

2. The combination of a hollow cylindrical casing, a circular follower movable coaxially within said casing, a flexible diaphragm having an annular corrugation interposed coaxially between said casing and follower and responsive to fluid pressure acting thereon to move said follower axially relative to said casing, a cylindrical member having one of its annular ends projecting coaxially into the annular hollow formed by said annular corrugation and movable axially relative to said follower, and rigid means operably engaging said cylindrical member and rocked by relative movement of said follower and said casing for controlling axial movement of said cylindrical member relative to said follower so that said annular end will be constantly effective to prevent reversal of said annular corrugation due to fluid pressure acting thereon.

3. The combination of a casing, a follower contained and movable within said casing, a flexible diaphragm having an annular corrugation interposed between said casing and follower and responsive to fluid pressure acting thereon to move said follower in one or the other direction with respect to said casing, said casing having an annular groove on the inner wall thereof surrounding said follower, said follower having an external annular groove thereon, a plurality of rigid members having their opposite ends extending into said grooves so that said rigid members are rocked correspondingly with movement of the follower relative to the casing, and an annular member extending into the hollow formed by the said corrugation so as to provide a support therefor, said rigid members cooperating with said annular member so as to shift same correspondingly with movement of the follower relative to the casing.

4. The combination of a casing, a follower contained and movable within said casing, a flexible diaphragm having an annular corrugation interposed between said casing and follower and responsive to fluid pressure acting thereon to move said follower in one or the other direction with respect to said casing, said casing having an annular groove on the inner wall thereof surrounding said follower, said follower having an external annular groove thereon, a plurality of rigid members having their opposite ends extending into said grooves so that said rigid members are rocked correspondingly with movement of the follower relative to the casing, and an annular member extending into the hollow formed by the said corrugation so as to provide a support therefor, said rigid members cooperating with said annular member so as to control the position of the annular member relative to the follower in correspondence with the movement of the follower relative to the casing so as to maintain the annular member in immediate supporting relation to the inner crown of the corrugation of the diaphragm at all times as the crown changes position with respect to the follower.

5. The combination as set forth in claim 3 further characterized in that said casing is provided with a plurality of openings extending inwardly from its exterior into intersection with the groove therein to permit insertion of said rigid members, and including removable means for closing said openings.

6. The combination of a casing, a follower contained and movable within said casing, a flexible diaphragm having an annular fold interposed between said casing and follower and responsive to fluid pressure acting thereon to move said follower relative to said casing, a movable fold back-up element in the path of travel of the fold, and means actuated by relative movement of said follower and said casing for shifting said back-up element relative to said follower so as to be in position effective to prevent reversal of said annular fold due to fluid pressure acting thereon.

7. The combination of a casing, a follower contained and movable within said casing, a flexible diaphragm having an annular fold interposed between said casing and follower and responsive to fluid pressure acting thereon to move said follower relative to said casing, a ring in the path of travel of the fold and movable axially relative to said follower, and means actuated by relative movement of said follower and said casing for controlling axial movement of said ring relative to said follower so that said ring will be constantly effective to prevent reversal of said annular corrugation due to fluid pressure acting thereon.

8. The combination of a casing, a follower contained and movable axially within said casing, a flexible diaphragm having an annular fold formed by two spaced inner and outer concentric wall portions connected by a curved crown portion, the outer wall portion of which is in fluid pressure sealed attachment with said casing and the inner wall portion of which is in fluid pressure sealed attachment with said follower, said diaphragm being responsive to fluid pressure acting thereon to move said follower relative to said casing in an axial direction, an annular fold back-up element extending between the inner and outer wall portions into supporting engagement with the inside of the crown portion of said fold and being movable by said fold axially relative to said follower, and means positioned according to follower movement and cooperable with said back-up element to control its movement relative to said follower for continuing support of the inside of the crown of said fold during its movement and without interference to diaphragm travel.

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