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2,772,574

STROKE CHANGING MECHANISM

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2 Sheets-Sheet 1

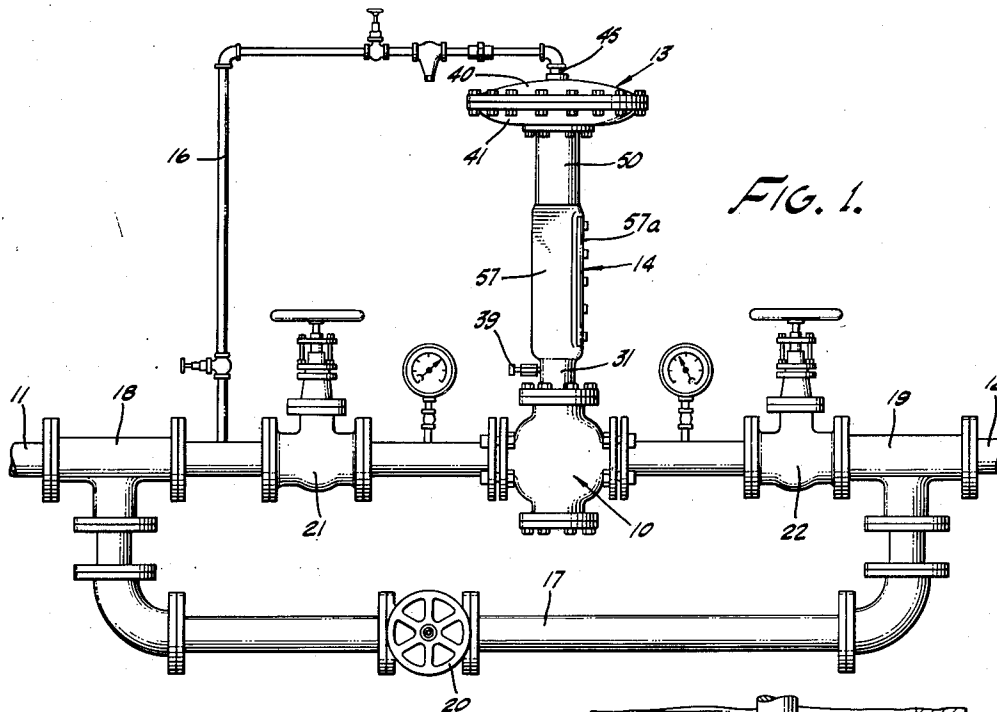


FIG. 1.

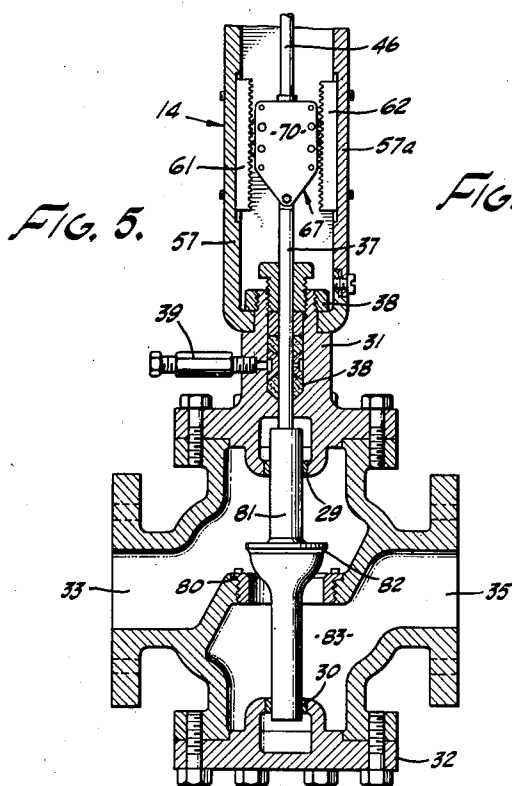


FIG. 5.

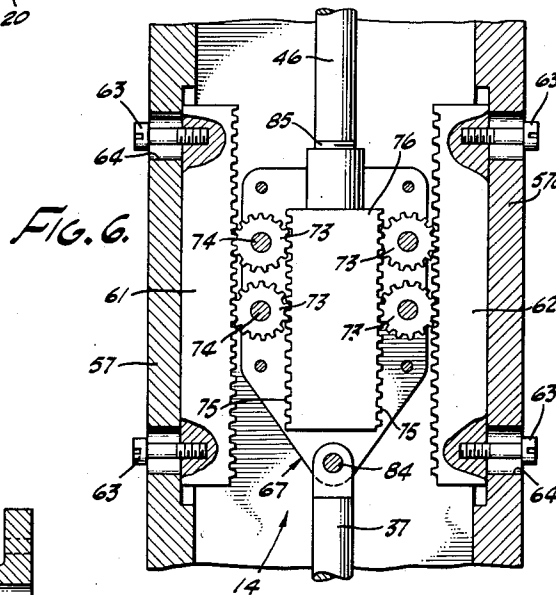


FIG. 6.

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2 Sheets-Sheet 2

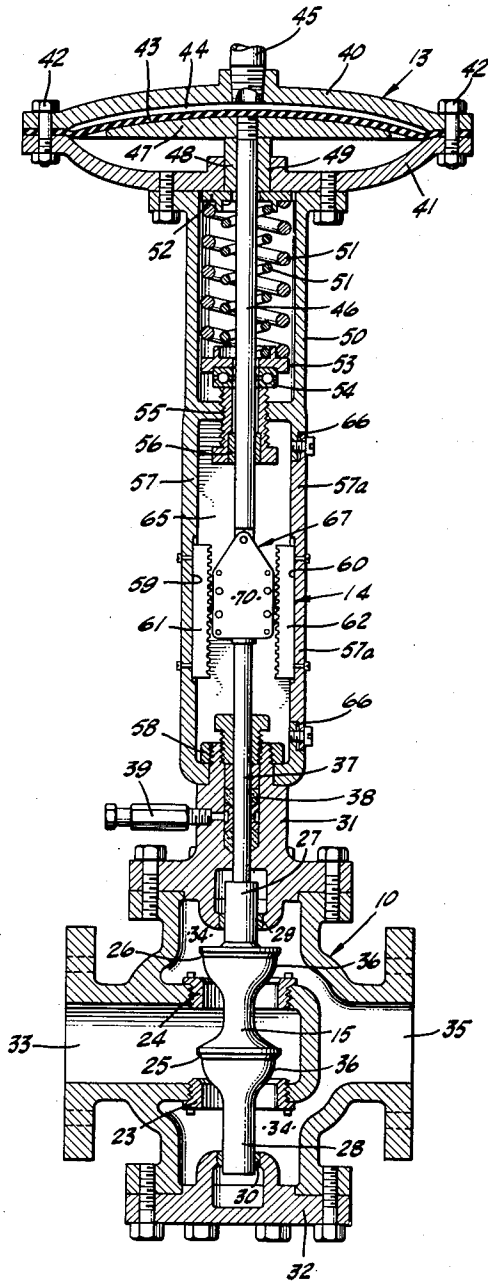


FIG. 2.

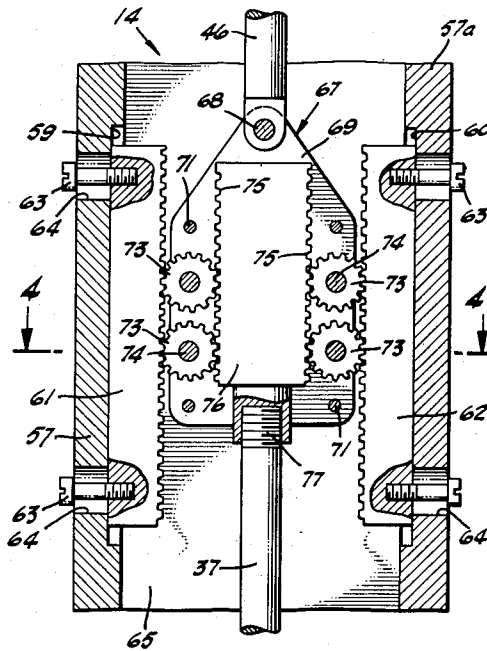


FIG. 3.

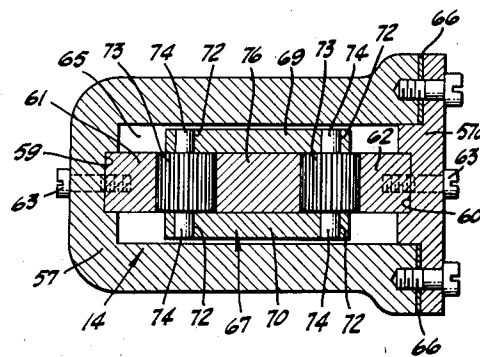


FIG. 4.

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STROKE CHANGING MECHANISM

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Application December 22, 1952, Serial No. 327,265

1 Claim. (Cl. 74—110)

This invention relates to flow controlling apparatus, and is particularly directed to improvements in power-operated flow regulating valves.

In my copending applications, Serial Numbers 307,974 and 307,975, both filed September 5, 1952, I have shown several types of stroke multiplying devices which enable a relatively small high pressure diaphragm to operate a control valve with a relatively long stroke. The present invention relates to the same general type of apparatus, but is directed to particular improvements therein.

One of the objects of the present invention is to provide a stroke increasing or decreasing mechanism adapted to be interposed between a power head and a flow controlling valve.

Another object is to provide a device of this type which employs a positive gearing for moving a valve element in either of two directions.

Another object is to provide a device of this type having an improved form of gearing which is self-centering in operation.

A more general object is to provide an improved form of stroke increaser or decreaser of the type described which is particularly adapted for economical manufacture on a quantity basis.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

Figure 1 is a side elevation showing a power-operated control valve assembly embodying my invention.

Figure 2 is a sectional elevation showing the stroke changing mechanism interposed between the power head and the control valve.

Figure 3 is a sectional elevation on an enlarged scale showing details of the stroke changing mechanism.

Figure 4 is a sectional plan view taken substantially on the lines 4—4 as shown in Figure 3.

Figure 5 is a sectional elevation showing a modified form of my invention.

Figure 6 is a sectional view showing a portion of Figure 5 on an enlarged scale.

Referring to the drawings, the control valve assembly, generally designated 10, is interposed between a supply line 11 and a controlled pressure line 12. A power head 13 is connected through the stroke changing device 14 to operate the control valve assembly 10. The control pipe 16 is connected to the power head 13 and to the supply line 11 upstream from the control valve assembly 10. A by-pass line 17 is connected to the supply line 11 at 18 and is connected to the controlled pressure line 12 at 19. The by-pass line 17 includes a shut-off valve 20. Other shut-off valves 21 and 22 are provided in the supply line 11 and controlled pressure line 12, respectively. During normal operation of the device, the shut-off valve 20 remains closed and the valves 21 and 22 remain open.

As shown in Figure 2, the control valve assembly 10 may be provided with a pair of axially spaced valve seats 23 and 24 for cooperation with the sealing faces 25 and 26, respectively, on the movable valve element 15. This

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valve element 15 is provided with integral guide parts 27 and 28 which are slidably received within guide bushings 29 and 30, respectively. The bushing 29 is carried on the valve bonnet 31, and the bushing 30 is carried on the removable closure 32. The construction just described constitutes a balanced valve assembly. When the sealing faces 25 and 26 engage the valve seats 23 and 24, respectively, the valve is closed and no flow occurs. When the valve 15 is in the open position shown in Figure 2, fluid flows through the inlet 33, through the seats 23 and 24, into the space 34, and out through the outlet 35. The curved shape of the outer surfaces 36 of the valve element 15 is designed to achieve optimum flow regulating characteristics for any position of the valve element 15.

A valve stem 37 fixed to the valve element 15 extends through a stuffing box 38. This stuffing box 38 is provided with a pressure fitting 39 for introducing lubricant under pressure.

The power head 13 includes a pair of upper and lower metallic dished members 40 and 41 connected by threaded fastenings 42. The members 40 and 41 serve to clamp a flexible diaphragm 43 therebetween along its outer periphery. The diaphragm 43 and upper member 40 cooperate to define a pressure chamber 44, and inlet fitting 45 is connected to the control pipe 16 and serves to introduce pressure fluid into the chamber 44.

A stem 46 has a disk or flange 47 fixed to its upper end, and this flange underlies a major portion of the lower surface of the diaphragm 43. The stem 46 extends through a bushing 48 which in turn slides within a guide opening 49 provided in the lower dished member 41. A spring housing 50 encircles a portion of the stem 46, and provides an enclosure for the compression springs 51. The upper ends of these springs engage the annular washer 52, and the lower ends engage the annular washer 53. The lower washer 53 rests on an antifriction bearing assembly 54 which is supported on the adjusting nut 55. The nut 55 carries a bushing 56 for sliding engagement with the stem 46.

In accordance with my invention, I provide the stroke changing device 14, which is operatively interposed between the power head 13 and the control valve assembly 10. When a balanced valve of the type shown in Figure 2 is employed, it is desirable to have a relatively long stroke in order to achieve optimum flow regulating characteristics. However, from the economical considerations, it is desirable to employ a relatively small short stroke power head 13. In order to meet these conflicting requirements, the stroke changing device 14 is designed to provide a long stroke for the valve element 15 and a short stroke for the diaphragm stem 46. As shown in Figures 2-4, the stroke changing device includes a frame or body 57 which connects the spring housing 50 with the valve bonnet 31. The upper end of the body 57 may be formed integrally with the spring housing 50, if desired, and the lower end may be connected to the valve bonnet by means of the nut 58.

The body 57 is provided with a removable closure plate 57a. A pair of axially extending parallel surfaces 59 and 60 are provided on the body 57 and closure plate 57a. A rack 61 is fixed to the surface 59, and a rack 62 is fixed to the surface 60. Cap screws 63 extend through axial slots 64 provided in the body 57 and serve to clamp the racks to the body in adjusted position. The racks completely cover the slots 64 in order to exclude foreign matter from the space 65 within the body. The racks are parallel and the spacing between them may be adjusted by means of the shims 66 interposed between the closure plate 57a and the body 57. The carrier 67 is pivotally secured at 68 to the lower end of the stem 46. This carrier 67 comprises a pair of slide plates 69 and 70 connected by transverse pins 71 and provided with

aligned openings 72. A plurality of gears 73 are each provided with axially extending trunnions 74 which are received within the openings 72. The gears 73 each mesh with one of the racks 61 or 62. Each of the gears 73 also meshes with one of the racks 75 provided on the follower member 76. This member 76 is secured to the upper end of the stem 37 by threads 77. The racks 75 are parallel and, if desired, may be formed integrally on the same block.

From this description it will be understood that downward movement of the stem 46 relative to the body 57 causes downward movement of the stem 37 in the same direction but with twice the stroke. Thus, as the carrier 67 moves downwardly for a distance of one inch, the axes of the gears 73 also move downwardly one inch, but the follower member 76 is moved downwardly two inches. Similarly, when the carrier 67 is raised, the follower 76 is also raised but travels twice the distance. This arrangement is particularly advantageous for use with a balanced valve, since very little force is required on the stem 37 to shift the valve, and, consequently, the force available on the short stroke rod 46 is sufficient to provide a long stroke for the valve.

The provision of gears 73 on both sides of the follower element 76 and in axially spaced relation eliminates the requirement for guides or sliding bushings between the carrier 67 and the follower 76. The device is thus self-centering and automatically distributes the clearances between the gear teeth so that binding and excessive friction are avoided. Tilting or canting of the parts 67 and 76 is avoided by provision of the longitudinally spaced pairs of gears 73.

In the operation of the device shown in Figures 1-4, fluid under pressure is carried in the supply pipe 11 and is delivered to the control valve assembly 10. The pressure of the fluid is reflected through the control pipe 16 and applied to the pressure chamber 44 within the power head 13. This pressure in chamber 44 tends to move the diaphragm 43 downwardly, and this motion is resisted by the compression springs 51. An increase in pressure in the supply line is reflected by an increase of force supplied to the diaphragm 43 with the result that the stem 46 moves downwardly against the action of the springs 51. The downward motion of the stem 46 is multiplied by the mechanism 14 with the result that the valve stem 37 is caused to move through a greater distance. When the pressure in the supply line falls, the force on the diaphragm 43 is reduced and the springs 51 raise the stem 46. The stroke changing device 14 then raises the valve stem 37 in a direction to open the valve. Very close pressure regulation is achieved because small increments of movement of the power-operated stem 46 reflect greater increments of movement of the valve element 15.

For certain flow controlling applications, a single seat valve may be superior to a double seat balanced valve. In Figure 5 I have shown a poppet type control valve having a single seat 80. The moving valve element 81 is guided within the bushings 29 and 30, as previously described, and is provided with a single sealing surface 82 for engagement with the seat 80. When the parts are in the open position shown in Figure 5, flow takes place through the inlet 33, through the seat 80, into the space 33, and out through the outlet 35. The constructions of the bonnet 31 and body 57 are substantially the same as described above. The stroke changing device 14, however, is

reversed end for end so that the valve stem 37 has a short stroke while the diaphragm operated stem 46 has a long stroke. This is accomplished by connecting the upper end of the stem 37 to the carrier 67 by means of pivot pin 84 and by connecting the lower end of the stem 46 to the follower 76 by means of the threads 85. The racks 61 and 62 remain in the same position as previously described. When the stem 46 moves downwardly, the gears 73 are caused to turn and thereby move the carrier 67 downwardly, but the travel of the carrier 67 is only one-half of the travel of the follower 76.

Since single seated poppet type valves are not balanced, considerable force may be required to maintain the valve element in the proper position to produce the desired flow regulating effect. The use of the stroke changing device as a force multiplier is, therefore, very desirable in connection with single seated poppet type flow regulating valves.

The operation of the stroke reducing device shown in Figures 5 and 6 is similar to that previously described, with the exception that the valve element 81 moves through a shorter stroke than the diaphragm operated stem 46. Greater force is thus applied to maintain the valve element 81 in its proper position for regulating flow through the seat 80.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claim.

I claim:

In a stroke changing device for connecting axially aligned reciprocable driving and driven elements, the combination of: a stationary body having a pair of axially extending stationary parallel gear racks fixed relative thereto, a movable carrier member within the body including a pair of laterally spaced plates, means joining the plates for operation as a unit, two axially spaced pairs of gears rotatably mounted on the carrier member between said plates and meshing with said racks, one of said elements having an end portion extending between said plates, pivot means connecting said end portion to said plates, an axially movable member extending between the plates and provided with parallel gear racks meshing with each of said pairs of gears, releasable means connecting the latter said member to the other of said elements, said carrier member being maintained in axial alignment solely by said axially spaced pairs of gears meshing with said racks, whereby movement of one of the members by the driving element acts to cause the gears and racks to move the other element in the same direction but with a different stroke length.

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