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2,562,631

DIAPHRAGM VALVE

Filed Dec. 15, 1945

2 Sheets-Sheet 1

Fig-1

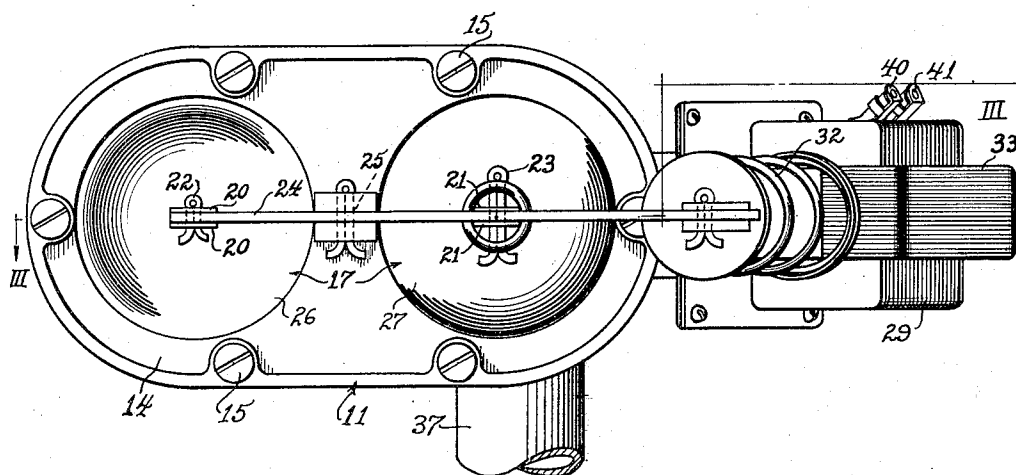
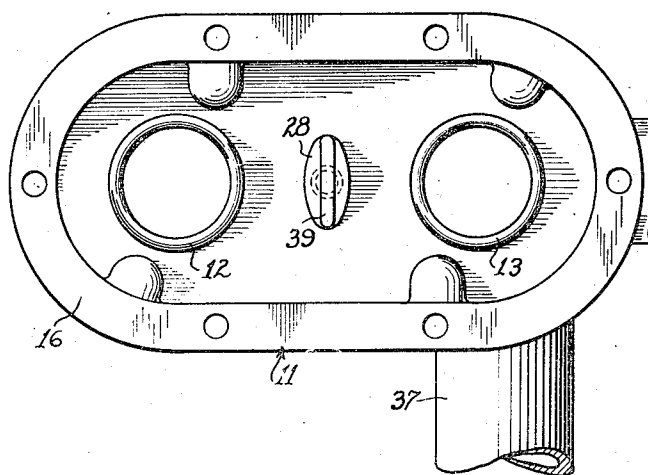


Fig-2



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Fig. 3

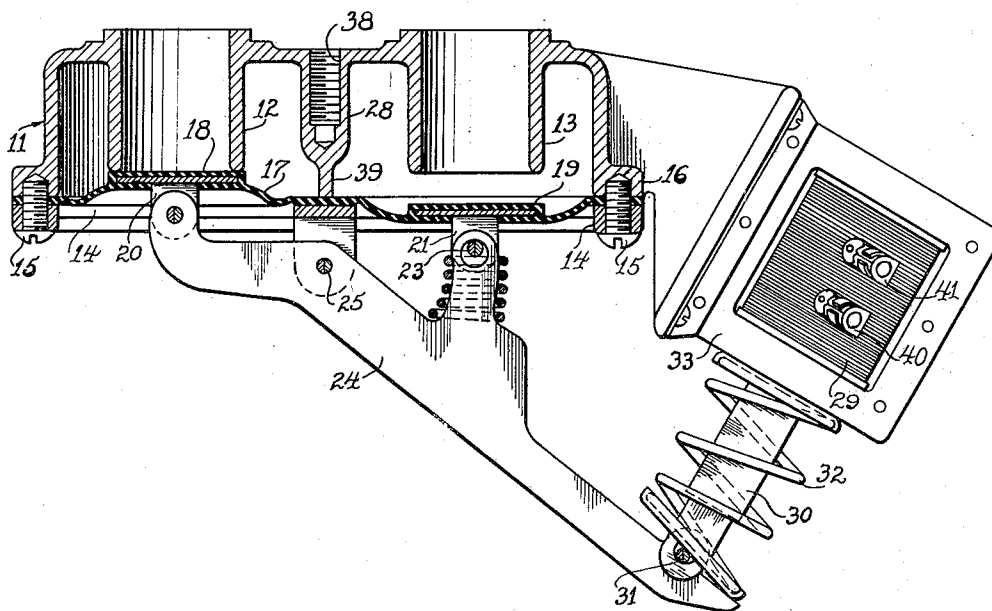
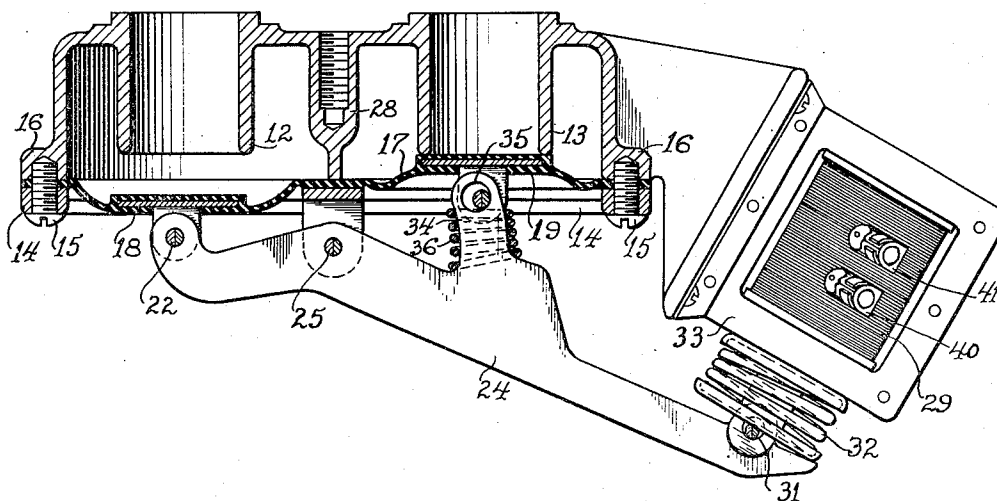


Fig. 4



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UNITED STATES PATENT OFFICE

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DIAPHRAGM VALVE

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5 Claims. (Cl. 137-144)

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This invention relates to a three-way valve and more particularly to a three-way single diaphragm valve.

One of the principal features and objects of the present invention is to provide a novel three-way valve which is particularly suited for handling liquids such, for example, as the cleaning fluids used in household laundry machines.

Another object of the present invention is to provide a three-way valve having a single diaphragm valve member which alternately opens one port and then another of the three-way valve.

Still another object of the present invention is to provide a novel solenoid actuated valve.

A still further object of the present invention is to provide a novel valve housing and valve actuation mechanism.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its manner of construction and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a plan view of a three-way valve embodying the novel teachings of the present invention;

Figure 2 is a plan view of the valve housing with the valve actuating mechanism and the cover plate removed;

Figure 3 is an elevational view partly in section, as indicated along the line III-III of Figure 1, of the three-way valve shown in Figure 1; and

Figure 4 is a view similar to Figure 3, but showing the valve actuating mechanism in its position when the actuating solenoid is energized.

The particular embodiment of the invention illustrated in the drawings comprises a housing 11 having two hollow center posts or sleeves 12 and 13 extending through the bottom wall thereof. These hollow center posts or sleeves 12 and 13 terminate within the housing 11 in a region or plane lying in proximity to and spaced away from a cover plate or web member 14 which is bolted or otherwise secured as at 15 to a flange 16 formed on the main housing portion 11. This cover member 14 is arranged to clamp a flexible diaphragm 17 into position against the flange 16 to form the top wall of the housing 11. The flexible diaphragm 17 may be of any suitable material such as rubber, Neoprene, or the like, and has two reinforced disc-like portions 18 and

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19 which lie opposite the inner ends of the sleeves or center posts 12 and 13. The reinforced disc-like portions 18 and 19 have ears 20 and 21 formed on the reinforced portions of the diaphragm 17 and are arranged to be pinned as at 22 and 23 to a rocker arm 24 which is pivotally mounted as at 25 on a central portion of the cover plate or web member 14.

The cover member 14 is provided with two relatively large openings 26 and 27 opposite the reinforced disc-like portions 18 and 19, thereby providing free access to the reinforced disc-like portions 18 and 19 through the cover plate 14 for the necessary hinge connection to the rocker arm 24.

The hollow center posts or sleeves 12 and 13 at their inner ends provide valve seats, and the reinforced disc-like portions 18 and 19 provide valve members for opening and closing the ends of the sleeves 12 and 13. Thus the sleeves 12 and 13 provide two of the ports of the three-way valve construction.

In order to reinforce the region of the cover member 14 where the rocker arm is pivotally mounted thereon, a substantially solid center post 28 extends up from the base of the housing 11 to a position where the central portion of the diaphragm 17 is seated tightly thereagainst and thus in turn forces the central portion of the cover plate or web member 14. It will be observed that the center post 28 is a relatively small post and that fluid flows freely therearound within the housing 11.

Mounted on one side of the housing 11 is a solenoid 29 into which a laminated armature 30 extends. The armature 30 is pivotally mounted as at 31 by a loose pin and hole connection on the rocker arm 24. A coil spring 32 extends between the rocker arm 24 and the yoke 33 of the solenoid 29 and thus biases the rocker arm 24 in a clockwise direction about its pivot point 25, as viewed in Figures 3 and 4 of the drawings.

Stated in a somewhat different manner, the compression spring 32 normally forces the disc-like central portion 18 of the diaphragm 17 tightly against the sleeve 12, while the disc-like portion 19 has been moved away from the sleeve 13. Upon energization of the solenoid 17 the armature 30 is drawn into the solenoid 29 and the rocker arm 24 is thus moved to force the disc-like center portion 19 against the sleeve 13 while withdrawing the disc-like center portion 18 away from the sleeve 12.

It will be noted, from an inspection of Figures 3 and 4 of the drawings, that the connection be-

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tween the cotter pin 23 and the rocker arm 24 is a relatively loose connection. More particularly, the rocker arm 24 is provided with a finger portion 34 having a relatively large hole 35 near its end through which the cotter pin 23 extends. This hole 35, as is shown in the drawing, is substantially larger than the cross-sectional area of the cotter pin and thus takes into consideration the relative transitional movement of the center of the opening 35 with respect to the axis of the sleeve 13. A small helical compression spring 36 is fitted around the finger 34 to assure a tight seal between the reinforced central portion 19 of the diaphragm 17 which forms the valve member for the sleeve or port 13.

Two of the ports of the three-way valve are provided by the sleeves 12 and 13. The third port or duct is provided by the outwardly extending tubular portion 37 which opens into the interior of the casing 11 and which, as shown, extends at right angles to the axes of the sleeves 12 and 13.

The post 28, which extends up into the center of the casing 11, is provided with a threaded recess 38 which enables the casing to be conveniently secured to any structure upon which the valve is to be mounted. The center post 28 is also provided with a lip 39 which extends transversely of the major axis of the casing 11, as is clearly shown in Figure 2 of the drawings.

From the above description it will be apparent that fluid may be passed through the tubular casing portion 37 and then selectively out through either the port 12 or the port 13, depending upon whether the solenoid 29 is energized or deenergized. The particular manner in which the solenoid 29 is energized forms no part of the present invention, it being sufficient for purposes herein to point out that this solenoid may be electrically energized through the terminals 40 and 41 from any electrical control circuit. As previously pointed out, this valve is arranged for the flow of fluid in either direction. The tubular portion 37 may form the outlet port of the valve and fluid may be selectively received either through port 12 or port 13, depending upon whether the solenoid 29 is energized or deenergized.

One of the particularly advantageous features of the present valve lies in the fact that when the tubular portion 37 is to be used as the outlet port and is connected to a suction pump, an air-tight seal is provided between the valve member and its associated port, which is not being used. Thus when the port 13 is closed by the valve member portion 19 of the diaphragm 17, fluid may be sucked through the tubular portion or port 12 and withdrawn through the tubular portion 37 by a suction pump connected to the tubular portion 37.

While I have shown a particular embodiment of my invention it will, of course, be understood that I do not wish to be limited thereto, since many modifications may be made, and I, therefore, contemplate by the appended claims, to cover all such modifications as fall within the true spirit and scope of my invention.

I claim as my invention:

1. A valve unit comprising a housing forming a chamber, said housing having a pair of sleeve-like portions extending through the base wall thereof and terminating in proximity to but short of the opposite side of said housing, thereby providing a pair of ports, said housing having a third port extending through a wall thereof, a flexible diaphragm extending across said housing on the opposite side thereof from said base wall and above the ends of said tubular portions form-

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ing said two ports, an open web cover plate extending over said flexible diaphragm and clamping the entire peripheral edge thereof to said housing with a fluid-tight seal, a centrally disposed ear on said web, a rocker arm pivotally mounted on said ear, said diaphragm having reinforced valve member portions on opposite sides of said ear and disposed opposite the ends of said tubular portions, means connecting said rocker arm on opposite sides of said ear to said valve member portions respectively, and mechanism for rocking said rocker arm to one position to move one of said valve member portions into port-closing engagement with one of said tubular portions while positively lifting the other of said valve member portions away from the other of said tubular portions and vice versa.

2. A valve unit comprising a housing forming a chamber, said housing having a pair of sleeve-like portions extending through the base wall thereof and terminating in proximity to but short of the opposite side of said housing, thereby providing a pair of ports, said housing having a third port extending through a wall thereof, a flexible diaphragm extending across said housing on the opposite side thereof from said base wall and above the ends of said tubular portions forming said two ports, an open web cover plate extending over said flexible diaphragm and clamping the entire peripheral edge thereof to said housing with a fluid-tight seal, a centrally disposed ear on said web, a rocker arm pivotally mounted on said ear, said diaphragm having reinforced valve member portions on opposite sides of said ear and disposed opposite the ends of said tubular portions, means for biasing said rocker arm so that one of said valve member portions is in port closing engagement with the end of one of said tubular portions, the other of said valve member portions being mechanically held away from port-closing engagement with its associated tubular portion and means for actuating said rocker arm against the action of said biasing means for moving the second one of said valve member portions into port closing engagement with the end of the second one of said tubular portions, and for lifting said first valve member portion away from its associated tubular portion.

3. A three-way valve comprising a housing forming a chamber, said housing having a pair of sleeve-like portions extending through the base wall thereof and terminating in proximity to but short of the opposite side of said housing, thereby providing a pair of ports, said housing having a third port extending through a wall thereof, a flexible diaphragm extending across said housing and forming a closed wall therefor on the opposite side of the housing from said base wall and above the ends of said tubular portions forming said two ports, a rocker arm, means for pivotally mounting said rocker arm exteriorly of said diaphragm, means on opposite sides of the pivot point of said rocker arm and carried thereby for engaging spaced portions of said diaphragm to force said portions alternately into engagement with the ends of said tubular portions respectively, said rocker arm having a tail portion extending outwardly at an acute angle with respect to the plane of the diaphragm, means for biasing said rocker arm in a direction to increase the size of said acute angle, and means acting in a direction substantially at right angles to said tail portion and against said biasing means for rocking said rocker arm.

4. A three-way valve comprising a housing forming a chamber, said housing having a

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pair of sleeve-like portions extending through the base wall thereof and terminating in proximity to but short of the opposite side of said housing, thereby providing a pair of ports, said housing having a third port extending through a wall thereof, a flexible diaphragm extending across said housing and forming a closed wall therefor on the opposite side of the housing from said base wall and above the ends of said tubular portions forming said two ports, a rocker arm, means for pivotally mounting said rocker arm exteriorly of said diaphragm, means on opposite sides of the pivot point of said rocker arm and carried thereby for engaging spaced portions of said diaphragm to force said portions alternately into engagement with the ends of said tubular portions respectively, said rocker arm having a tail portion extending outwardly at an acute angle with respect to the plane of the diaphragm, means for biasing said rocker arm in a direction to increase the size of said acute angle, an electric solenoid mounted on said housing with its magnetic axis extending substantially at right angles to said tail portion of said rocker arm, an armature slidably fitting within said solenoid and pivotally connected to said tail portion, whereby upon energization of said solenoid said rocker arm is rocked to close the normally open tubular portion and to open the normally closed tubular portion.

5. In a valve structure, a housing having a base wall and lateral walls extending therefrom to define a chamber open on the side opposite said base wall, a pair of sleeves extending through said base wall and terminating in proximity to but short of the plane of said open side, thereby providing a pair of ports, said sleeves being spaced from said lateral walls to provide a free path of fluid flow within said chamber, said housing shaped to provide a third port extending through a wall thereof, a flexible diaphragm extending across said open side and having reinforced portions opposite said pair of ports, an open web

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cover plate extending over said flexible diaphragm and clamping the entire peripheral edge thereof in a fluid-tight seal, a centrally disposed ear on said web, a unitary rocker arm pivotally mounted on said ear and means carried on opposite sides of the pivot point of said rocker arm for engaging said reinforced portions and for positively displacing same to close tightly and open wide said pair of ports, said rocker arm having a tail portion extending outwardly at an acute angle with respect to the plane of said diaphragm, means for biasing said rocker arm in a direction to increase the size of said acute angle, an electric solenoid mounted on said housing with its magnetic axis substantially at right angles to said tail portion, a laminated armature slidably fitting within said solenoid and pivotally connected to said tail portion, said solenoid positioned so that upon energization of the same said rocker arm is rocked counter to the direction of bias to close the normally open port while opening the normally closed port, and a lost motion device operating from said rocker arm assuring a tight closure of the normally open port.

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