March 20, 1945. D. A. STARK 2,371,657

VALVE ASSEMBLY

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Fig.1.

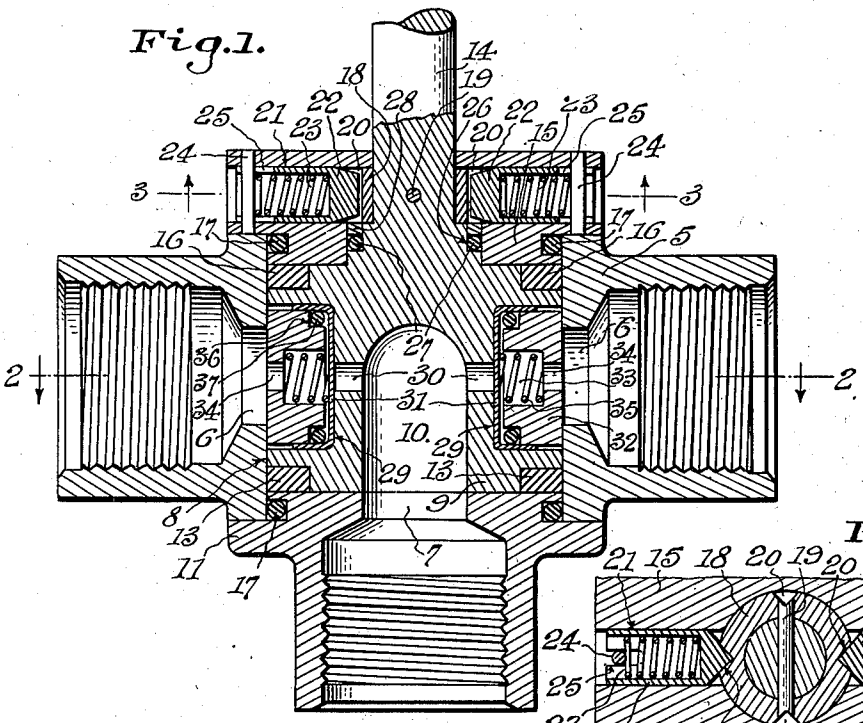


Fig.3.

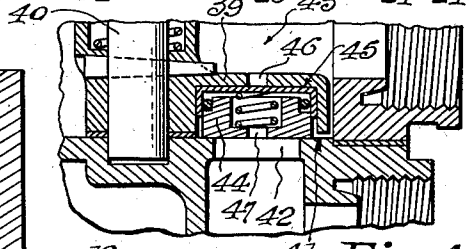
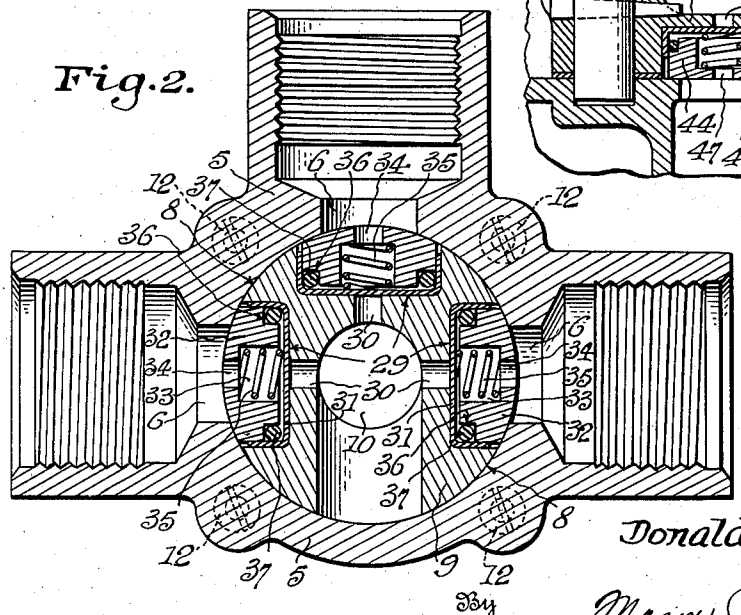


Fig.4.

Fig.2.



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VALVE ASSEMBLY

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7 Claims. (Cl. 251—84)

The invention relates generally to valve structures and primarily seeks to provide a novel valve structure embodying a casing having a plurality of inlet ports and a single exhaust port through which liquid is to be discharged from a selected inlet port, or a plurality of exhaust ports and a single inlet port from which liquid is to be distributed to a selected exhaust port, a rotor for controlling the flow of liquid through said ports, and novel port sealing elements movable with the rotor and engageable over ports intended to be closed and effective to seal said ports against passage of liquid whether the pressure thereon be directed from the inlet side or the exhaust or delivery side.

An object of the invention is to provide a valve structure of the character stated which may employ either a cylindrical or disk type rotor.

Another object of the invention is to provide in a valve structure of the character stated a rotor having a portion placeable over a port or passage for closing the same, said portion having a sealing unit receiving surface recess and a pressure aperture communicating with the bottom of the recess, and a sealing unit removably and replaceably mounted in said recess and comprising a cup-like imperforate thin metal shell shallower than the depth of the recess, and a sealing disk slidably mounted in the shell and of a thickness slightly less than the distance of the bottom of the shell from the outer extremity of the recess and having a pressure chamber forming recess in its inner face and an aperture extending through its outer face from said chamber, whereby dominant fluid pressure acting through the disk aperture will be effective against the inner face of the disk to tend to press the disk out of the shell, or dominant fluid pressure acting through the rotor aperture will be effective against the shell to first press the shell against the disk and then tend to displace the whole sealing unit from the rotor recess.

Another object of the invention is to provide in a sealing unit of the character stated a compression spring mounted in the pressure chamber between the disk and shell and constantly tending to seat the shell in the bottom of the rotor recess and to force the disk out of the shell, and sealing means between the shell and the disk for sealing the unit against fluid leakage past the disk regardless of the position thereof in the shell.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more fully understood by following the detailed description, the appended claims and the several views illustrated in the accompanying drawing.

In the drawing:

Figure 1 is a central vertical cross section of a valve structure involving the invention.

Figure 2 is a horizontal section taken on the line 2—2 on Figure 1.

Figure 3 is a horizontal section taken on the line 3—3 on Figure 1.

Figure 4 is a fragmentary vertical cross sectional view illustrating the improved sealing unit applied in a valve structure of the rotary disk type.

In the example of embodiment of the invention illustrated in Figures 1 to 3 the valve structure includes a casing 5 which has a plurality of inlet ports 6 arranged in the same horizontal plane, and a single exhaust or delivery port 7 arranged in right angular relation to and centrally between the ports 6. The casing also is equipped with a cylindrical rotor receiving bore 8 in which is rotatably mounted a cylindrical rotor 9 having an elbow passage 10 one leg of which constantly registers with the port 7, and the other leg of which is selectively presentable in registry with the ports 6, or turned to the position illustrated in Figure 2 to completely close off the valve.

With the ports arranged in the manner stated, it is possible, by proper manipulation of the valve rotor, to receive fluid from a selected one of the inlet ports 6 and deliver it through the port 7, or to close off the valve entirely. It is to be understood however that the port 7 may be employed as an inlet port, in which case the rotor may be properly manipulated to deliver fluid from the port 7 through a selected one of the ports 6, or the valve may be entirely closed off.

The exhaust or delivery port 7 is formed in a casing bore end closure plate 11 which is secured by screws 12 to the casing over one end of the rotor bore 8. The rotor is equipped with a non-metallic bearing ring 13 which engages the end closure plate in the manner clearly illustrated in Figure 1. At its other end the rotor is equipped with an actuator stem 14 which projects through a bore in an end closure ring 15 which also may be screw secured to the casing. The rotor also has a non-metallic bearing ring 16 positioned for engagement with the closure ring 15. The plate 11 and the ring 15 are grooved to receive a packing ring 17 which serves to seal the valve rotor chamber against leakage of fluid.

An indexing collar 18 is pin secured as at 19 on the actuator stem 14 and is provided with four equi-distantly spaced peripheral notches 20, three of which register with the inlet ports 6, and the fourth one of which constitutes a shut off station. The ring 15 is provided with two diametrically oppositely disposed bores 21 in each of which a hollow plunger 22 is mounted. Each plunger includes a V-shaped nose for engaging in the indexing collar notches 20, and a compression spring 23 is interposed between each plunger and an abutment pin 24 extending across the respective bore and yieldably presses the respective plunger against the periphery of the indexing collar. Each plunger is provided with a U-shaped notch 25 which straddles the abutment pin 24 and prevents turning of the plunger in the bore 21 in which it is mounted.

The actuator stem extension is reduced in diameter adjacent the main body of the rotor as at 26 to provide a chamber within the ring 15 wherein is mounted a packing ring 27 backed up by a retaining ring 28.

The rotor has its external cylindrical surface provided with three sealing unit receiving recesses 29 simultaneously placeable in registry with the three inlet ports 6 in the manner clearly illustrated in Figure 2 of the drawing. A pressure port 30 communicates between the rotor elbow passage 10 and the bottom of each recess 29 in the manner clearly illustrated in Figures 1 and 2.

The sealing units removably and replaceably mounted in the several rotor recesses 29 each comprises an imperforate, cup-like shell 31, which is shallower than the depth of the recess 29 in which it is mounted, and a non-metallic sealing disk 32 slidably mounted in said shell. It will be obvious by reference to Figures 1 and 2 that each disk 32 is of a thickness slightly less than the distance of the bottom of the respective shell 31 from the outer extremity of the recess so that when the external surface of the disk which is curved to conform to the shape of the rotor bore 8 is in engagement with said bore, the inner face of the disk will be spaced slightly from the bottom of the respective shell in the manner clearly illustrated in Figures 1 and 2. Each sealing disk is provided at its inner face with a pressure chamber forming recess 33, and an aperture 34 opens through the external face of the disk into said chamber recess. A compression spring 35 is mounted in each pressure chamber recess 33, and constantly presses the external surface of the sealing disk against the rotor bore 8, thereby constantly tending to maintain the slight space between the inner face of the respective disk and the bottom of the respective shell 31. Each disk also is equipped with an annular peripheral recess 36, and a gasket ring 37 is mounted in each recess 36 and engages the inner wall of the respective shell 31 in a manner for sealing the shell and disk against fluid leakage regardless of the position of the disk.

It will be obvious by references to Figures 1 and 2 of the drawing that by turning the rotor the valve may be completely shut off in the manner illustrated in Figure 2, or the elbow passage 10 in the rotor can be presented for connecting a selected one of the inlet ports 6 with the outer port 7 for delivery of fluid therethrough. It will be obvious that the indexing equipment 18, 20, 22 will facilitate placement of the valve rotor in proper registry with the selected ports, and also retain the rotor in positions of port registering adjustment.

Whenever pressure through one of the ports 6 is dominant and is directed against one of the sealing disks 32, pressure will enter the respective sealing unit chamber 33 through the aperture 34 and will act against the whole internal diameter or surface area of the disk 32 to place the same in sealing contact with the rotor bore 8. The effective sealing pressure will be the whole area of the inwardly presented diameter of the disk 32 minus the diameter of the port 6 over which the disk engages. Should pressure within the rotor elbow passage 10 be dominant, said pressure would act through the ports 30 against the whole inner surfaces of the respective sealing units, namely over the whole diameters of the shells 31, assuming there is no leakage of fluid about the rotor 9 and into the sealing unit mounting recesses 29, first moving the shells outwardly to take up the space between the shells and the respective disks 32 and then forcing said disks in tight sealing contact with the rotor bore 8 engaged thereby. It will be obvious that should fluid under pressure leak about the rotor and into the sealing unit mounting recesses it would act against the cup edge of each shell 31 and reduce the effective area of each shell bottom against which pressure would act through the rotor apertures 30 to the extent of the thickness of the metal of the shell.

While the invention is shown in Figures 1 to 3 as applied to a valve of the type employing a cylindriform rotor, the invention is applicable as well to valve structures of the well known disk rotor type such as are shown in U. S. Letters Patent to A. L. Parker, 2,209,136, issued July 23, 1940. In Figure 4 of the drawing there is illustrated a fragment of a valve structure of the disk rotor type equipped with a sealing unit embodying the invention.

In the form of the invention illustrated in Figure 4 the disk type rotor is indicated at 39, the same being pin secured as at 40 to the actuator stem. The rotor is movable over the flat surface 41 of the valve casing so as to cover or uncover the port 42 formed therein. The port 42 communicates with the pressure chamber 43 within the valve casing. The sealing unit is constructed and operates in the same manner hereinabove described and is generally designated 44 in Figure 4. The sealing unit is removably and replaceably mounted in a recess 45 provided in the rotor 39, an aperture 46 being provided in the rotor for admitting fluid pressure from the pressure chamber 43 into the recess in which the sealing unit is mounted, and the sealing unit disk being provided with an aperture 47 for admitting fluid under pressure from the port 42 into the pressure chamber within the sealing unit. Since the sealing unit operates in the same manner described in connection with Figures 1 to 3, further detailed description of the operation of this sealing unit is deemed unnecessary.

It is to be understood that the details of construction of the cooperating parts can be variously changed without departing from the spirit and scope of the invention, as defined in the appended claims.

What is claimed is:

1. In a valve structure, a casing structure having a flow passage therethrough including a port, a rotor having a portion placeable over said port for closing the same, said portion having a sealing unit receiving recess and a pressure aperture

communicating with the bottom of the recess, and a sealing unit removably and replaceably mounted in said recess and comprising a cup-like imperforate thin metal shell shallower than the depth of the recess, and a sealing disk slidably mounted in the shell and of a thickness slightly less than the distance of the bottom of the shell from the outer extremity of the recess and having a pressure chamber forming recess in its inner face and an aperture extending through its outer face from said recess, whereby when fluid pressure acting through the disk aperture is dominant it will be effective against the whole diameter of the disk to tend to force the disk out of the shell and into sealing contact over the port, and when fluid pressure acting through the rotor aperture is dominant it will be effective against the bottom of the shell to first press the shell against the disk and then tend to displace the whole sealing unit from the rotor recess and thereby press said disk into sealing contact over said port.

2. In a valve structure, a casing structure having a flow passage therethrough including a port, a rotor having a portion placeable over said port for closing the same, said portion having a sealing unit receiving recess and a pressure aperture communicating with the bottom of the recess, and a sealing unit removably and replaceably mounted in said recess and comprising a cup-like imperforate thin metal shell shallower than the depth of the recess, a sealing disk slidably mounted in the shell and of a thickness slightly less than the distance of the bottom of the shell from the outer extremity of the recess and having a pressure chamber forming recess in its inner face and an aperture extending through its outer face from said recess, whereby when fluid pressure acting through the disk aperture is dominant it will be effective against the whole diameter of the disk to tend to force the disk out of the shell and into sealing contact over the port, and when fluid pressure acting through the rotor aperture is dominant it will be effective against the bottom of the shell to first press the shell against the disk and then tend to displace the whole sealing unit from the rotor recess and thereby press said disk into sealing contact over said port, said sealing disk having an annular peripheral recess opposed to the inner wall of the shell, and a packing ring in said annular recess and forming a fluid seal between the disk and the opposed shell wall.

3. In a valve structure, a casing structure having a flow passage therethrough including a port, a rotor having a portion placeable over said port for closing the same, said portion having a sealing unit receiving recess and a pressure aperture communicating with the bottom of the recess, and a sealing unit removably and replaceably mounted in said recess and comprising a cup-like imperforate thin metal shell shallower than the depth of the recess, a sealing disk slidably mounted in the shell and of a thickness slightly less than the distance of the bottom of the shell from the outer extremity of the recess and having a pressure chamber forming recess in its inner face and an aperture extending through its outer face from said recess, whereby when fluid pressure acting through the disk aperture is dominant it will be effective against the whole diameter of the disk to tend to force the disk out of the shell and into sealing contact over the port, and when fluid pressure acting through the rotor aperture is dominant it will be effective against the bottom of the shell to first press the shell against the disk and then tend to displace the whole sealing unit from the rotor recess and thereby press said disk into sealing contact over said port, and a compression spring interposed between the shell and disk and constantly tending to seat the shell in the bottom of the rotor recess and to force the disk out of the shell.

4. In a valve structure, a casing structure having a flow passage therethrough including a port, a rotor having a portion placeable over said port for closing the same, said portion having a sealing unit receiving recess and a pressure aperture communicating with the bottom of the recess, and a sealing unit removably and replaceably mounted in said recess and comprising a cup-like imperforate thin metal shell shallower than the depth of the recess, a sealing disk slidably mounted in the shell and of a thickness slightly less than the distance of the bottom of the shell from the outer extremity of the recess and having a pressure chamber forming recess in its inner face and an aperture extending through its outer face from said recess, whereby when fluid pressure acting through the disk aperture is dominant it will be effective against the whole diameter of the disk to tend to force the disk out of the shell and into sealing contact over the port, and when fluid pressure acting through the rotor aperture is dominant it will be effective against the bottom of the shell to first press the shell against the disk and then tend to displace the whole sealing unit from the rotor recess and thereby press said disk into sealing contact over said port, a compression spring interposed between the shell and disk and constantly tending to seat the shell in the bottom of the rotor recess and to force the disk out of the shell, said sealing disk having an annular peripheral recess opposed to the inner wall of the shell, and a packing ring in said annular recess and forming a fluid seal between the disk and the opposed shell wall.

5. A valve port sealing unit comprising a cup-like imperforate thin metal shell, a sealing disk slidably mounted in the shell and projecting from the open end thereof and having a pressure chamber forming recess in its inner face and an aperture extending through its outer face from said recess, a compression spring interposed between the shell and disk and constantly tending to force them apart, said disk having an annular peripheral recess opposed to the inner wall of the shell, and a packing ring in said annular recess and forming a fluid seal between the disk and the opposed shell wall.

6. A valve port sealing unit comprising two relatively movable members telescoped one within the other and forming a pressure chamber therebetween, one of said members being a sealing disc having an aperture extending through its outer face from said pressure chamber, a compression spring interposed between the members and constantly tending to force them apart, said members also being cooperatively shaped to define between them an annular packing recess, and a packing ring in said annular recess and forming a fluid seal between the members.

7. In a valve structure, a casing structure having a flow passage therethrough including a port, a rotor having a portion placeable over said port for closing the same, said portion having a sealing unit receiving recess and means affording communication of fluid pressure with the bottom of the recess, and a sealing unit mounted in said recess and comprising two relatively movable telescoped members the combined thicknesses of

which are less than the distance from the bottom of the recess to the valve port so that said members can be spaced apart in said recess to admit fluid between them, one of said members having an aperture extending therethrough communicating with the port whereby when fluid pressure acting through the aperture in said apertured member is dominant it will be effective between said members and against said apertured member to tend to force said apertured member out of the recess and into sealing contact over said port and when fluid pressure is dominant at the bottom of the recess it will be effective against the other of said members to press it against said apertured member and then tend to displace the whole sealing unit from the recess and thereby press said apertured member into sealing contact over said port.

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