

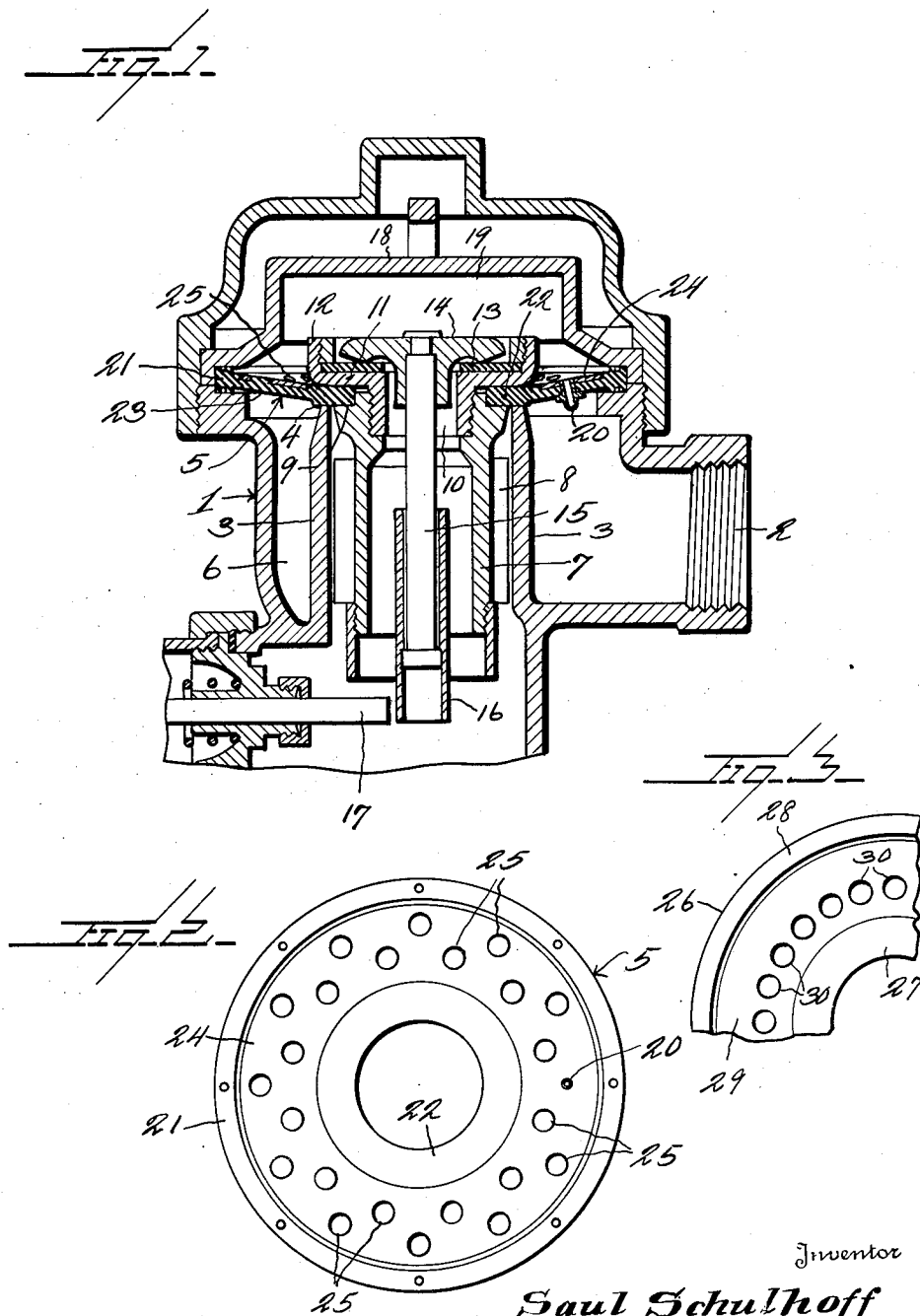
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VALVE DIAPHRAGM

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VALVE DIAPHRAGM

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3 Claims. (Cl. 137—157)

This invention relates broadly to the class of valves and pertains particularly to an improved valve diaphragm.

The present invention has for its primary object to provide an improved valve diaphragm wherein the central portion thereof is adapted to engage a seat while the peripheral portion is securely held, in which the construction is such that the central portion will be permitted to move transversely of the plane of the periphery and maintain a parallel plane with the peripheral plane so that parts attached to the central portion will be shifted in a straight line and thereby prevented from contacting surrounding parts of the structure in which the diaphragm is used.

A further object of the invention is to provide an improved valve diaphragm in which rubber and a more rigid but flexible substance are combined in such a manner as to permit the central portion of the diaphragm when rigidly held to move transversely of the plane of the peripheral portion of the diaphragm while the latter is rigidly held without changing the normal parallel relation of the planes of the said inner and outer rigidly held portions.

A still further object of the invention is to provide a valve diaphragm of the above described character, in which the stiffer one of the two flexible materials of which the diaphragm is made up, is in the form of a thin annulus having two circular series of apertures formed therethrough which are so spaced as to provide an annular flexing area which permits the diaphragm to "break" along a circular line passing between the series of apertures so that the central portion of the diaphragm, when moved transversely of the peripheral portion, will maintain a plane parallel with the plane of the peripheral portion.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawing forming part of this specification, with the understanding, however, that the invention is not confined to any strict conformity with the showing of the drawing but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

In the drawing:

Figure 1 is a vertical section taken thru the longitudinal center of a flush valve showing the invention therein.

Fig. 2 is a view in plan of the diaphragm per se.

Fig. 3 is a plan of a portion of a modified form of the diaphragm.

Referring now more particularly to the drawing wherein like numerals of reference indicate corresponding parts throughout the several views, the valve diaphragm embodying the present invention, while designed for use in various capacities, is here illustrated as being used in a water pressure operated flush valve of a form which is in common use. Since the construction and operation of this well known form of flush valve is familiar to those versed in the art, only a sufficient amount of the construction of the same has been illustrated to make it possible to demonstrate one use of the valve diaphragm embodying the present invention. This valve diaphragm is particularly efficient in the control of valves of the type illustrated as these valves are prone to be noisy when used with other types of valve diaphragm because of the failure of such diaphragms to flex or break in the proper manner, thus causing certain parts, unless fitted together in a manner which is both time consuming and expensive, so that a tight working fit is obtained therebetween, to vibrate and cause noise.

The valve structure illustrated to show the application of the present valve diaphragm will be generally described before giving a description of the diaphragm embodying the present invention. This valve structure comprises a casing 1 into which a water supply pipe leads through the coupling 2. The central part of this casing has the sleeve-like valve supporting part 3 therein, the top surface 4 of which forms a seat for the valve diaphragm which is indicated as a whole by the numeral 5. The outlet of water from the area 6 is by way of the upper end of the valve supporting part 3 and through this part to a lead-off pipe (not shown).

Disposed within the sleeve-like valve diaphragm supporting part 3 is a tubular guide 7 which carries a series of longitudinally extending fins 8 upon its outer surface, the edges of which fins are in relatively close relation with the inner surface of the part 3. This guide is adapted to move longitudinally of the part 3 in the operation of the valve structure and the fins 8 are intended to maintain the guide centered so that it will not have lateral movement.

At the upper end of the guide 7, an external shoulder 9 is formed and the guide is interiorly screw-threaded to receive the centrally apertured stud 10 of a clamp disk 11, the periphery of which is turned upwardly to form the flange 12.

Within the flanged area 12 of the clamp 11, a

gasket 13 is held, upon the top surface of which the underface of a disk valve 14 engages and this disk valve has a stem 15 which passes downwardly through the guide 7 and is provided with the skirt 16 at its lower end which, in the operation of the valve structure, is engaged by a laterally moved pin 17 so as to lift one side of the disk 14 from its seat, for the purpose hereinafter explained.

Overlying the valve diaphragm 5 and the valve 14, is the unit 18 which forms what is known as an inside cover for these parts, providing the water chamber 19 above the two valve elements. As shown, this inside cover clamps the periphery of the valve diaphragm 5 against a supporting shoulder which forms a part of the casing 1, so that the valve diaphragm forms a wall between the water chamber 6 and the chamber 19. As is well known, the valve unit described is normally maintained closed by the pressure of the water which has passed through the bleed passage 20 from the chamber 6 into the chamber 19, thus equalizing the pressures and causing the valve diaphragm 5 to engage the seat of the part 3 and holding the valve 14 upon the gasket 13. When the valve is to be opened, the rod 17 is shifted by a suitable handle (not shown) so as to tip the valve 14 and allow the water to flow from the chamber 19 through the guide 7. This release of the water pressure above the diaphragm and the valve 14 permits the water which is under relatively high pressure, to press upwardly against the underside of and flex the diaphragm 5 so as to lift the central portion from the seat 4 and thus permit water to flow directly into the upper end of the part 3. As this operation takes place and as the water gradually passes back through the bleed passage 20 into the chamber 19 so as to equalize the pressures upon the two sides of the diaphragm so as to cause the diaphragm to be reversely flexed and re-seated on the seat 4, there is a tendency for the guide 7 to move slightly laterally and thus create a noise unless the fins 8 are very accurately made so as to slide smoothly along the inner surface of the part 3. Even after being accurately fitted, these fins become worn and permit this rattling to occur.

The present diaphragm is designed to overcome this rattling of the guide by flexing in such a manner that the central part of the diaphragm will move transversely of the plane of the periphery thereof while maintaining a plane parallel with the plane of the periphery.

As illustrated, this improved diaphragm consists of an outer annular peripheral portion or rim 21 and an inner relatively wide valve seat engaging annulus 22 connected together by the thinner intermediate web portion 23. As illustrated, the guide 7 has a portion extending into the annulus 22 and a part of the annulus is clamped between the shoulder 9 and the clamp 11 leaving an outer portion for contact with the seat 4 of the tubular part 3. The rim 21 is clamped between the inside cover 18 and an adjacent part of the casing 1, thus leaving the web portion 23 to form the division wall between the chambers 6 and 19.

The top surface of the web portion of the valve diaphragm has secured thereto or embedded therein the relatively thin annulus 24 which is formed of a flexible material which, however, is of slightly less flexibility than the rubber of which the remainder of the diaphragm is formed. This material is preferably a condensation product such, for example, as Bakelite or one of the other

well known substances of this general character. This annulus 24 extends substantially the full width of the web 23 and as is shown in plan in Fig. 2 it is provided with the two circular series of apertures 25, one of which series is adjacent the inner edge of the annulus while the other series is adjacent the outer edge. These two series of apertures are so disposed that the inner sides of the ones of the outer series and the outer sides of the ones of the inner series are in relatively close proximity to a medial line passing therebetween and it is upon this imaginary line that the web and the annulus 24 flex or break when the diaphragm is actuated either in the opening or the closing of the valve. These apertures 25 also serve the additional function of providing means for securing the annulus to the web 23 by the engagement of the rubber material of the web therein.

As illustrated in Fig. 1 the inner edge of the annulus 24 is free from contact with the clamp 11 at all times so that when the valve is opened and the guide 7 rises with the other parts attached thereto so as to lift the inner portion or annulus 22 of the diaphragm from the seat 4, the stiffer annulus 24 will be free to bend or flex without contacting any of the fixed parts of the valve structure. When the valve structure is opened and as it is automatically closed, the diaphragm will flex or bend along a circular path or line passing between the inner and outer circular series of apertures 25. Due to this flexing of the diaphragm along this circular path intermediate between the portions 21 and 22, the center annulus will rise from a plane below the outer rim 21 to a plane above the same without changing its parallel relation with the plane of the outer rim. Thus the valve will rise directly upwardly from the seat 4 and will return in the same line so that even though the fins 8 may be badly worn so that a substantial amount of space exists between them and the wall of the body 3, the guide 7 will not wobble and, therefore, there will be no noise developed in the valve structure.

Experiment has shown that the particular positions of the two series of apertures in the annulus 24 is of importance. If the relation of one series is changed with respect to the other so that the outer edges of the inner series will project beyond the inner edges of the outer series, the same smooth opening of the valve and noiseless operation of the guide will not be obtained.

While the foregoing description has been confined entirely to the use of the diaphragm valve in a flush valve structure, it will be readily apparent to those versed in the art that a diaphragm constructed in accordance with this invention may be used in other capacities where it is essential that the central part of the diaphragm move across the plane of the rim without altering the parallel relation between the central portion and the said plane of the rim.

In Fig. 3 is shown a portion of a modified form of the valve diaphragm which has been found to give very satisfactory operation. In this form the portion of the rubber disc 26 lying between the inner and outer rims 27 and 28 respectively has secured thereto the flat annulus 29, which is of the same character as the annulus 24, which has formed therethru inwardly of the center line between the inner and outer edges thereof, the annular series of apertures 30 which may be set slightly closer together than the apertures 25 of each of those series. In this form as well as in

the one previously described, the apertured annulus is so assembled with the rubber one that when the diaphragm is in service the clamping ring 12 will not touch the apertured annulus when the valve closes.

What is claimed is:

1. In a valve comprising a casing having a passageway therethrough, a hollow cylindrical portion in said casing having an end edge forming a valve seat, a flexible diaphragm extending across the casing and dividing it into two chambers, and a guide connected with said diaphragm and loosely fitting in said cylindrical portion and including an annular clamping means; the herein described improved diaphragm made up of two portions, one of said portions consisting of an annular disk of rubber having a thickened portion at the inner and outer peripheries and a relatively thin web connecting said peripheral portions, said thickened portion at the inner periphery being secured concentric with said hollow cylindrical portion by said clamping means and adapted to engage on said valve seat, the thickened outer peripheral portion being adapted to be secured against movement in the casing, and a second portion consisting of a thin flat annulus secured to said web and being of less width than the same whereby it is free from contact at its inner and outer edges with said thickened peripheral portions and having an inner edge circumference sufficient to avoid contact with said clamping means during flexing of the diaphragm, and said second portion having an annular series of apertures therethrough and concentric therewith which is so constructed and arranged as to cause the diaphragm to flex along a circular line concentric therewith.

2. A valve diaphragm, comprising an annulus

of rubber having a peripheral rim portion, an inner relatively broad annular portion and an intermediate connected web of less thickness than the rim and inner portions, and a relatively thin flat annulus of material of slightly less flexibility than the rubber annulus and secured to said web portion concentric with the rubber annulus, said second annulus being of slightly less width than the web portion and having two concentric annular series of apertures formed therethrough, the apertures of one series being disposed on radial lines passing between the apertures of the other series and the major diameter defined by one annular series of apertures being less than the minor diameter defined by the other series of apertures, the said apertures functioning to cause the annuli to flex along a circular line passing between the two series.

3. A valve diaphragm, comprising an annulus of rubber and consisting of a peripheral rim portion, an inner relatively broad annular portion and an intermediate connecting web of less thickness than the rim and inner portions, and a relatively thin flat annulus of fibre material secured to said web portion concentric with the first annulus, said fibre annulus being of less width than the web portion and having two concentric series of apertures, one series of apertures defining a circle of materially less diameter than the other series, the said apertures of the two series being arranged whereby the apertures of the one series will lie on radial lines passing between the apertures of the other series, the said annular series of apertures functioning to cause the rubber and fibre annuli to flex along a circular line passing between the two series of apertures.

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