

DIAPHRAGM VALVE

The present invention relates to a diaphragm valve, and has particular reference to a diaphragm valve of the type hereinafter referred to as "the kind described" comprising a fluid inlet means, a fluid outlet means, fluid path means defining a path for fluid flow between the inlet and the outlet, a flexible diaphragm means juxtaposed said path, a valve seat means, and means for flexing the diaphragm means into contact with the valve seat to reduce or stop the flow of fluid in the path in service.

In prior art diaphragm valves of the kind described, the seat means is typically formed integrally with a wall of a valve body circumjacent the inlet means. When the valve seat means becomes damaged or worn in service it is therefore difficult to repair or replace the seat, and replacement of the whole valve is usually necessary.

According to one aspect of the present invention there is provided a diaphragm valve of the kind described, characterised in that the valve seat means is removable for ease of maintenance or replacement.

The diaphragm valve of the present invention may therefore be easy to maintain or repair, and may accordingly have an extended life in service.

Typically, the seat means may be carried by a removable seat carrier.

In another aspect of the invention the fluid path may extend through said seat means; where the seat means is carried by a removable seat carrier, the fluid path may extend through the seat means and seat carrier.

In some embodiments the seat carrier may define an inlet passage in fluid communication with said inlet means and outlet passage in fluid communication with the outlet means; the seat means may be disposed in juxtaposition with at least one of said inlet and outlet passages, the arrangement being such that in service fluid passing through the valve flows at least twice through the seat carrier i.e. once through the inlet passage, and once through the outlet passage.

Typically, the seat carrier may comprise a carrier ring having at least one additional hole formed therein spaced from the central hole defined by the carrier ring; one of the central and additional holes may define the inlet passage, and the other hole may define the outlet passage. In some embodiments the carrier ring may comprise a plurality of such additional holes circumferentially spaced one from another around the central hole formed through the ring.

Said seat means may be disposed juxtaposed the central hole of the carrier ring. In some embodiments the seat means may comprise a seat ring disposed in a recess formed in the carrier ring circumjacent said central hole; typically the seat ring may be formed from a synthetic resin material.

Alternatively, however, the seat means may be formed integrally with the seat carrier.

In another aspect of the invention, said diaphragm means may be retained in abutment with the carrier ring juxtaposed the periphery of the latter by a diaphragm retaining means; said diaphragm may be shaped such that in a relaxed position it is spaced from said central and additional holes thereby to allow fluid to flow between the inlet and outlet passages formed in the carrier in the space between the carrier ring and the diaphragm means. On operating said means for flexing the diaphragm, the diaphragm may be brought into contact with the seat means circumjacent said central hole thereby to obturate the fluid path between the central and additional holes formed in said carrier ring.

In a different aspect of the present invention said seat carrier may be disposed within a valve cavity formed in a valve body. Said carrier ring may be disposed in

juxtaposition with a wall of said valve body having said inlet and outlet means formed therein. Substantially fluid-tight spacing means may be disposed between the wall and the carrier ring intermediate the inlet and outlet means thereby to allow fluid to flow between the carrier ring and said wall.

In some embodiments said spacing means may comprise a first spacing ring circumjacent the central hole in the carrier ring; a second spacing ring may be disposed juxtaposition with the periphery of said carrier ring.

The present invention comprehends in another aspect that the wall and said first and second spacing means may be configured such that when the first spacing ring abuts on the wall, the second spacing ring may be spaced slightly from said wall; means may be provided for urging the carrier ring against the wall thereby to deform said first spacing ring and bring the second spacing ring into contact with the wall, thereby to form a substantially fluid-tight seal between the first spacing ring and the wall. In some embodiments the carrier ring may be urged against the wall from said diaphragm retaining means.

Typically, said first and second spacing rings may be formed integrally with said carrier ring. Alternatively, however, at least one of said first and second spacing

rings may be formed from a synthetic resin material and may be disposed in a recess formed in the carrier ring.

In some embodiments said diaphragm means may comprise a diaphragm formed from a thin metal plate which can be flexed by said means for flexing the diaphragm means.

In accordance with the present invention as hereinbefore described there is therefore provided a diaphragm valve in which the valve seat means is removable from the valve. Typically, the valve seat may be carried by a seat carrier removably disposed within a valve cavity of a valve body. The valve of the present invention has the advantage therefore that when the valve seat means becomes damaged or worn in service, it can be easily removed from the valve or cavity for repair or replacement.

Following is a description by way of description only and with reference to the accompanying drawings of methods of carrying the present invention into effect.

In the drawings:-

Fig. 1 is a sectional view showing an open valve state of the diaphragm valve according to the invention.

Fig. 2 is a sectional view showing a closed valve state.

Fig. 3 is a sectional view of III-III line in Fig. 1.

Fig. 4 is a magnified detailed drawing of essential part (seat ring) in Fig. 1.

Fig. 5 is a sectional view showing a modified example of seat ring.

Fig. 6 is a sectional view showing other modified example of seat ring.

Fig. 1 shows an open valve state of the diaphragm valve, and Fig. 2 shows a closed valve state.

In the diaphragm valve shown in Fig. 1 and Fig. 2, numeral 1 is a metallic valve body, 2 is a valve compartment with a circular cross section formed in the valve body 1, 3 is a valve operating compartment formed in the valve body 1, 4 is a metallic stem acting as diaphragm manipulating means disposed retractably in the valve operating compartment 3, 5 is a diaphragm holder disposed in the valve operating compartment, 6 is a diaphragm made of circular thin metal plate such as stainless steel for shutting off between the valve compartment 2 and valve operating compartment 3, and 7 is a seat ring which is a valve seat forming member and is inserted in the valve compartment 2.

In the valve body 1, as shown in Fig. 1, fluid passages 8 and 9 communicating with each other through the valve compartment 2 are formed. That is, the flow-in passage 8 and flow-out passage 9 have mouths 8a, 9a in the bottom wall 2a. In particular the flow-in passage mouth 8a is opened in the center of the bottom wall 2a.

The diaphragm holder 5 is for pressing the peripheral edge of the diaphragm 6 to the seat ring 7 as shown in Fig. 1, and its pressing force is applied by tightening a nut member (not shown) threadedly mounted on the valve body 1.

The seat ring 7 is formed in a metallic annular form and is made from stainless steel or the like, with its outside diameter roughly equal to the inside diameter of the valve compartment 2. Making relatively thin the thickness in the axial direction allows it to possess a certain elasticity or flexibility. The valve hole 10 which is the central hole of the seat ring 7 is overlaid on the flow-in passage mouth 8a. In the seat ring 7, four communication holes 11 ... communicating with the flow-out passage mouth 9a are provided. The communication holes 11 ... are disposed at equal intervals around the valve hole 10.

On the surface 7a of the seat ring 7, an annular valve seat 12 is projecting along the peripheral edge of the valve hole 10, and an annular diaphragm holding part 13 is projecting along the peripheral edge of the seat ring 7. The diaphragm holding part 13 holds the peripheral edge of the diaphragm 6, in cooperation with the diaphragm holder 5, by the pressing force of the diaphragm holder 5.

In the embodiment, meanwhile, the valve seat 12 is made from a synthetic resin material, and is buried and held in an annular groove 14 formed in the ring surface 7a, so that the surface area of the valve seat 12 may be as small as possible. This valve seat 12 is designed to contact with or depart from the central part of the diaphragm 6 by the extending and withdrawing operation of the stem 4, and the fluid passages 8, 9 are closed and opened by the contacting and departing action. That is, when the valve hole 10 is closed as the diaphragm 6 contacts with the valve seat 12, flow of fluid from the flow-in passage 8 into the flow-out passage 9 is inhibited (see Fig. 2). When the diaphragm 6 is departed from the valve seat 12, the flow-in passage 8 and flow-out passage 9 communicate with each other through the valve hole 10 and communication holes 11 ... with the result that flow of fluid from the flow-in passage 8 into the flow-out passage 9 is permitted (see Fig. 1).

On the back side face 7b of the seat ring 7, an annular seal part 15 is projecting along the peripheral edge of the valve hole 10, and an annular ring

contact part 16 is projecting along the peripheral edge of the seat ring 7. The projection of the seal part 15 from the ring back side face 7b is, as shown in Fig. 4, set larger than the projection of the ring contact part 16 by a slight amount h (usually about 0.05 mm). Therefore, when the ring contact part 16 is pressed against the bottom wall 2a of the valve compartment 2 by the pressing force of the diaphragm holder 5, the seat ring 7 is bent with the seal part 15 acting as a flucrum. As a result, the seal part 15 is pressed against by the peripheral edge of the flow-in passage mouth 8a with an increased force.

That is, the contact surface pressure of the seal part 15 to the bottom wall 2a is heightened, and in the closed valve state shown in Fig. 2, there is no fear of the so-called back leakage, i. e. escape of fluid through between the seal part 15 and bottom wall 2a due to back pressure from the flow-out passage 9.

As understood from the description above, in the diaphragm valve of the invention, since the valve seat 12 is formed on the independent replaceable seat ring 7, as compared with the conventional diaphragm mentioned at the beginning, the maintainability is notably improved, and the life of the valve itself can be extended outstandingly. Moreover, although the seat ring 7 is formed as an independent member, fluid leak through between the seat ring 7 bottom wall 2a, i. e. so-called back leakage does not occur. The required valve function is exhibited sufficiently, and its practical value is extremely great.

The invention is not limited to the foregoing embodiments alone, but it may be changed and modified in a range not departing from the true spirit of the invention.

For example, in the above embodiment, the ring contact part 16 is formed integrally with the seat ring 7. But, as shown in Fig. 5, the ring contact part 16 may be separately made of synthetic resin material, and may be buried and held in an annular groove 17 formed in the ring back side 7b. In this case, too, the valve seat 12 may be made of synthetic resin material, and may be also buried and held in the ring surface 7a.

Moreover, as shown in Fig. 6, all of the valve seat 12, diaphragm holder

13, seal part 15, and ring contact part 16 may be formed integrally with the seat ring 7.



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CLAIMS

1. A diaphragm valve for the control of fluid flow comprising:-

a fluid inlet means (8);

a fluid outlet means (9);

a fluid path means defining a fluid flow path through said valve between the inlet and outlets;

a flexible diaphragm means (6) juxtaposed said fluid flow path;

valve seat means (12); and

means (4) for flexing said diaphragm means into contact with said seat means thereby to reduce or stop the flow of fluid in said path;

characterised in that said seat means (12) are removable for ease of maintenance or replacement.

2. A valve as claimed in claim 1 characterised in that said fluid path extends through said seat means (12).

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3. A valve as claimed in claim 1 or claim 2 characterised in that the seat means (12) is carried by a removable seat carrier (7).

4. A valve as claimed in claim 3 characterised in that the seat carrier (7) defines an inlet passage (10) in fluid communication with the inlet means (8) and an outlet passage (11) in fluid communicated with the outlet means (9), and the seat means (12) is disposed juxtaposed at least one of said inlet and outlet passages (10,11); the arrangement being such that, in service, fluid passing through the valve flows twice through the seat carrier (7).

5. A valve as claimed in claim 4 characterised in that the seat carrier (7) comprises a carrier ring having at least one additional hole (11) formed therein spaced from the central hole (10) defined by the carrier ring; wherein one of the central and additional holes defines the inlet passage (10), and the other defines the outlet passage (11).

6. A valve as claimed in claim 4 wherein the seat means (12) is disposed juxtaposed the central hole (10) of the carrier ring (7).

7. A valve as claimed in claim 6 wherein the seat means



(12) comprises a seat ring disposed in a recess (14) formed in said carrier ring circumjacent the central hole.

8. A valve as claimed in claim 7 wherein said seat ring (12) is formed from a synthetic resin material.

9. A valve as claimed in claim 6 wherein the seat means (12) is formed integrally with said carrier (7).

10. A valve as claimed in claims 6, 7, 8 or 9 wherein said diaphragm means (6) is retained in abutment with the carrier ring (7) juxtaposed the periphery of the latter by diaphragm retaining means (5); and said diaphragm (6) is shaped such that it is spaced from said central and additional holes.

11. A valve as claimed in any of claims 6 - 10 wherein the carrier ring is disposed within a valve cavity (2) formed in a valve body (1), is disposed in juxtaposition with a wall (2a) of said body having said inlet and outlet means (8a,9a) formed therein, and a substantially fluid-tight spacing means (15,16) is disposed between the wall (2a) and the ring intermediate the inlet and outlet means to allow fluid to flow between the carrier ring and said wall.



13

12. A valve as claimed in claim 11 wherein the spacing means (15,16) comprises a first spacing ring (15) circumjacent the central hole (10) in the ring, and a second spacing ring (16) is disposed juxtaposed the periphery of the ring.

13. A valve as claimed in claim 12 wherein the wall (2a) and first and second spacing rings (15,16) are configured such that when the first spacing ring (15) abuts said wall (2a), the second spacing ring (16) is spaced slightly from the wall, and means are provided for urging the carrier ring against the wall to deform the first spacing ring and bring the second spacing ring in to contact with the wall, thereby to form a substantially fluid-tight seal between the first spacing ring and the wall.

14. A valve as claimed in claim 13 when dependant on claim 10 wherein said carrier ring (7) can be urged against the wall (2a) by said diaphragm retaining means (5).

15. A valve as claimed in any of claims 12 - 14 wherein said first and second spacing rings (15,16) are formed integrally with said carrier ring (7).

16. A valve as claimed in any of claims 12 - 14 wherein

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14

at least one of said first and second spacing rings (15,16) is formed from a synthetic resin material and is disposed in a recess (17) formed in the carrier ring.

17. A valve as claimed in any preceding claim characterised in that the diaphragm means comprises a diaphragm (6) formed of a thin metal plate.

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