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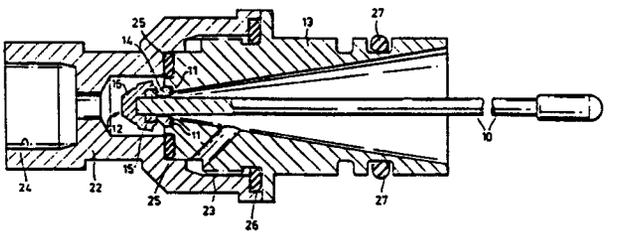
(54) Positive pressure demand valves.

(57) The particular problems of embedding and wear which are encountered in the positive pressure demand valves for controlling the flow of gas in a breathing system are overcome by the provision of a positive pressure demand valve which has apertured jewels (14, 15) constituting the contacting valve surfaces of both the valve seat (13) and the head (12) of the tilt valve member. Both jewels (14, 15) are resiliently mounted as inserts, the jewel (15) of the tilt head member being a snap fit in a cap (16) of a plastics and therefore resilient material, while the seat jewel (14) is cushioned by a layer (11) of resilient material in a recess in a metallic valve seat (13). The seat jewel (14) is of frusto-conical shape thus restricting the area of the contacting valve surfaces.



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POSITIVE PRESSURE DEMAND VALVES

This invention relates to positive pressure demand valves for controlling the flow of gas in a breathing system.

In the known positive pressure demand valve the sealing member is a tilt valve member the stem of which passes through an aperture in a valve seat, the stem being moved by a diaphragm in the demand valve upon inhalation in order that the tilt valve member shall rock on the seat thereby causing the valve to open and emit breathable gas such as air or oxygen from a pressure source of the gas. The positive pressure demand valve therefore experiences wear which does not arise in other demand valves in which there is no contact between the valve member and the valve seat when the valve is open.

Furthermore, during the period when the valve is open as a result of the rocking or pivoting of the tilt valve member on the valve seat the area of contact between the valve member and the valve seat is relatively small. In consequence the force per unit area which is exerted on the limited areas of the tilt valve member and the valve seat which are in pivoting contact when the demand valve is open is substantially greater than the

force exerted between these contacting parts when the valve is closed and the areas of surface contact between the tilt valve member and the valve seat are greater. The forces involved in the rocking or pivoting movement when the demand valve opens are such that there is a special problem of wear in the positive pressure demand valve as a result of which there is a tendency for the materials of the valve member and the valve seat gradually to embed one in the other thereby impairing the breathing performance or causing a leakage through the valve.

In the positive pressure demand valve both the tilt valve member and the valve seat are free to turn about their longitudinal axes and do in fact so rotate as a result of repeated operation of the demand valve. In consequence the wear caused by the rocking or pivoting movement when the demand valve opens is spread over an annular area of both the tilt valve member and the valve seat.

Conventionally, the seat of the positive pressure demand valve has been made using phosphor bronze, and the tilt valve member has been made from Nylon 6. It is with these materials that, as a result of repeated operations of the valve, the relatively soft material of the tilt valve member can embed into the seat with the result that leakage through the valve occurs, or the breathing performance is impaired in some way, for example

the valve does not open as it should in response to inhalation.

The use of a harder material than Nylon 6 for the tilt valve member has proved to be no solution to this problem. When a harder material (such as carbon steel) is used either the seat area on which the tilt valve member pivots is bent and ultimately destroyed or it is found that the surface finish of the harder material used for the tilt valve member is not good enough to make a gas tight seal with the seat.

According to the present invention these problems are overcome by employing jewels to provide the contact surfaces of both a valve seat and the sealing member which engages the seat in the closed condition of the valve. The term "jewel" is used in this specification to denote a crystal or a precious stone.

According to the present invention there is provided a positive pressure demand valve comprising a valve body having an inlet and an outlet, a diaphragm within the valve body, a valve seat mounted within the inlet to the valve body, the valve seat including a jewel having an aperture therethrough constituting a flow passage for gas supplied under pressure, and a tilt valve member having a stem extending through the aperture in the seat jewel, one end of the stem contacting the diaphragm

and arranged to be movable thereby in consequence of a reduction of pressure within the valve body, and a head on the stem on the side of the seat jewel remote from the diaphragm, the head constituting a sealing member engageable with the valve seat, and the head including a jewel which, in the closed condition of the valve, engages the seat jewel to prevent the flow of gas through the seat.

Preferably each jewel is a corundum stone, conveniently a ruby or sapphire.

In the examples which will be described hereinafter each jewel is a corundum ring stone, but the jewels are different. One of the jewels advantageously includes a portion of frusto-conical shape, the flat surface of the frustum constituting the surface engaged by the other jewel in the closed condition of the valve. The use of a jewel having such a portion of frusto-conical shape enables the contact areas of the two jewels to be reduced to an optimum area for obtaining the best sealing contact between the two jewels. Conveniently the seat jewel is the jewel which includes the portion of frusto-conical shape.

It has, however, been found that the direct application of jewels as inserts in the head of the tilt valve member and in the valve seat does not give entirely satisfactory results in that the forces involved

in the repeated opening and closing of the demand valve can result in chipping of the jewel.

In a preferred embodiment of the present invention, therefore, it is proposed to overcome the problem of using jewels in the head of the tilt valve member and the valve seat of a positive pressure demand valve by mounting each of the jewels in a material which has a degree of resilience, for example a plastics material or a rubber material. By mounting both the jewels in a resilient material, the contact between the two jewels during the opening of the demand valve is modified to an extent such that chipping of either of the jewels as a result of their inherent brittleness is entirely avoided.

In accordance with this aspect of the present invention the resilient mounting of the jewels may be obtained by making the bodies of the members in which the jewels are mounted entirely of the resilient material. The head of the tilt valve may be a plastics cap in which the jewel is mounted as an insert and similarly the body of the valve seat may be made of a plastics material. Alternatively either or both of the jewels may have a cushioning layer of resilient material such as rubber or plastics material between the jewel and a hard member.

In a preferred embodiment, the seat jewel is an insert in a valve seat made of brass or similar non-ferrous material or of stainless steel. The jewel is

inset in a recess in the seat, the recess being machined to a size such that the jewel is a tight fit in the recess, so tight a fit it is almost an interference fit. Before inserting the jewel in the recess an annular cushion of a rubber or other resilient material is placed in the base of the recess. The circumferential surface of the jewel may be coated with an engineering adhesive, for example a methacrylate adhesive, which sets once the jewel has been inserted into the recess and in contact with the cushion of resilient material. Alternatively the jewel may be inserted into the recess in the seat without any adhesive and held in position against the cushion of resilient material in the recess either by plating the metallic seat in order to form a lip holding the jewel in position, or else by turning a preformed lip on the metallic seat over into a position to retain the jewel.

The jewel in the sealing member which is for example the tilt valve member may be inserted as a snap fit within a recess in a member of plastics material, for example Nylon 66, or may be mounted in situ as part of the process of forming the tilt valve member.

The present invention will be further understood from the following detailed description of a preferred embodiment thereof which is made by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a side view of a positive pressure demand valve incorporating the invention,

Figure 2 is a cross-sectional view of the seat and the sealing member in the inlet to the valve of Figure 1,

Figure 3 is a side view in cross-section on an enlarged scale of a corundum ring stone used as a jewel in the seat of the valve of Figures 1 and 2, and

Figure 4 is a side view in cross-section on an enlarged scale (different from Figure 3) of a corundum ring stone used as a jewel on the sealing member of the valve of Figures 1 and 2.

Referring to Figure 1, there is shown a positive pressure demand valve which has two plastics body parts 1 and 2 of generally dished shape secured together at their outer peripheries by a clamping ring 3 secured by a clamping screw 4. The body part 2 is integrally moulded with a cylindrical inlet 5 which receives a sub-assembly 6 of the components shown in Figure 2. The body part 2 is also formed with a cylindrical outlet 7 having a threaded ring 8 for attaching the demand valve to the inlet of a face mask not shown.

Between the two body parts 1 and 2 there is clamped at its periphery a diaphragm 9 engaged by one end of a valve stem 10 which extends through the cylindrical inlet 5 and carries at its end remote from the diaphragm a head 12 which constitutes a sealing member. The valve stem 10

and the head 12 are shown, together with the inventive features of the demand valve, in Figure 2 to which reference will now be made.

The valve stem 10 extends through a brass body 13 of a valve seat and through the aperture in a jewel 14 which is advantageously a corundum ring stone. The jewel 14 is mounted as an insert in a machined recess in the seat body 13 upon a layer 11 of rubber material of an annular shape. The body 13 and the jewel 14 together constitute the valve seat, of which the seat surface is provided by the jewel 14. The valve stem 10 carries at its end remote from the diaphragm 9 the head 12 which comprises a plastics cap 16 in which a jewel 15, preferably another corundum ring stone of a different shape, is a snap fit. The jewel 15 is thus mounted in a resilient material while the jewel 14 is resiliently mounted in the body 13 as a result of the layer 11 which is an annular cushion.

The shapes of the two corundum ring stones constituting the jewels 14 and 15 are shown more clearly in Figures 3 and 4 respectively. These figures are side cross-sectional views of the jewels 14 and 15 on an enlarged scale. Referring to Figure 3 the jewel 14 is formed to have a central precisely dimensioned circular aperture 17 and a frusto-conical portion 18 at the end of the jewel 14 which will be engaged by the sealing member. This frusto-conical portion 18 of the jewel 14 is formed

so that a major part 19 of the surface of the jewel 14 facing the sealing member is an inclined conical surface and only a minor part 20 of that surface surrounding the aperture 17 through the jewel 14 is flat.

The jewel 15 as shown in Figure 4 is a simple corundum ring stone having its outermost corners chamferred. Thus the main surface 21 of the jewel 15 facing the seat jewel 14 is a flat surface. However, when the sealing member which is the head 12 engages the valve seat to close the valve, which it does with the flat surface 21 of the jewel 15 contacting the whole of the flat surface 20 of the jewel 14, the area of surface contact is limited by the relatively small area of the annular flat surface 20 of the seat jewel 14, thereby enabling a good gas-tight seal to be obtained.

In addition to the components mentioned above there is shown in Figure 2 a hose connection 22 which is connected to the valve seat by screw threads 23 and which also has a screw thread 24 for receiving the hose from a pressure source of breathable gas. The junction of the hose connection 22 and the valve seat body 13 is sealed by "O" rings 25, 26 and "O" rings 27 are also provided for sealing the valve seat body to the inlet 5 of the demand valve shown in Figure 1.

By use of jewels in the contact parts of demand valves as hereinbefore described an excellent gas-tight

seal may be obtained and little or no embedding or wear is experienced in use. In consequence an improved and constant performance of breathing apparatus to specified standards is achieved.

CLAIMS:

1. A positive pressure demand valve comprising a valve body (1,2) having an inlet (5) and an outlet (7), a diaphragm (9) mounted within the valve body (1,2), a valve seat (13) mounted within the inlet (5) to the valve body, the valve seat (13) having an aperture therethrough constituting a flow passage for gas supplied under pressure, and a tilt valve member having a stem (10) extending through the aperture in the valve seat, one end of the stem (10) contacting the diaphragm (9) and arranged to be movable thereby in consequence of a reduction of pressure within the valve body (1,2), and a head (12) on the stem on the side of the valve seat (13) remote from the diaphragm (9), the head (12) constituting a sealing member engageable with the valve seat (13), characterised in that the valve seat (13) includes a jewel (14) having an aperture therethrough coincident with the aperture in the valve seat (13), and the head includes a jewel (15) which, in the closed condition of the valve, engages the seat jewel (14) to prevent the flow of gas through the valve seat (13).

2. A valve according to Claim 1, characterised in that each jewel (14,15) is a corundum stone.

3. A valve according to Claim 1 or Claim 2, characterised in that each jewel (14,15) is a corundum ring stone.

4. A valve according to Claim 3, characterised in that the seat jewel (14) includes a portion (18) of frusto-conical shape, the flat surface (20) of the frustum constituting the surface engaged by the jewel (15) of the sealing member in the closed condition of the valve.

5. A valve according to any one of Claims 1 to 4, characterised in that each of the jewels (14,15) is in contact with a resilient material (11,16).

6. A valve according to Claim 5, characterised in that the head (12) of the tilt valve member comprises a cap (16) formed of the resilient material, and the sealing member jewel (15) is mounted in the cap (16) of resilient material.

7. A valve according to Claim 5 or Claim 6, characterised in that the resilient material constitutes a cushion (11) between the seat jewel (14) and a hard material of which the valve seat (13) is made.

8. A valve according to any one of Claims 1 to 6, characterised in that the seat jewel (14) is inset as a tight fit in a machined recess in a seat body (13) of metallic material upon an annular cushion (11) of a resilient material selected from the group consisting of plastics materials and rubber materials.

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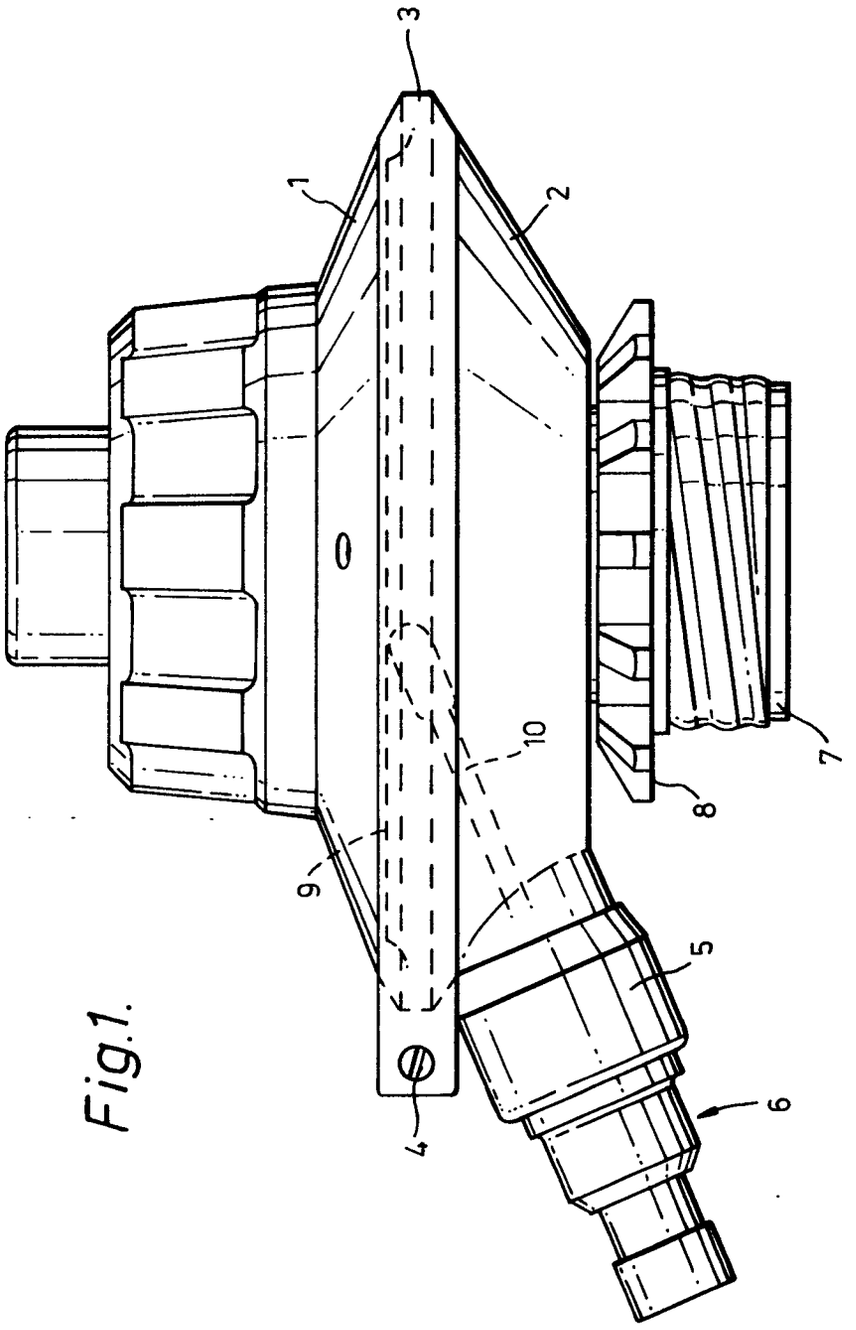

Fig.1.

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Fig.2.

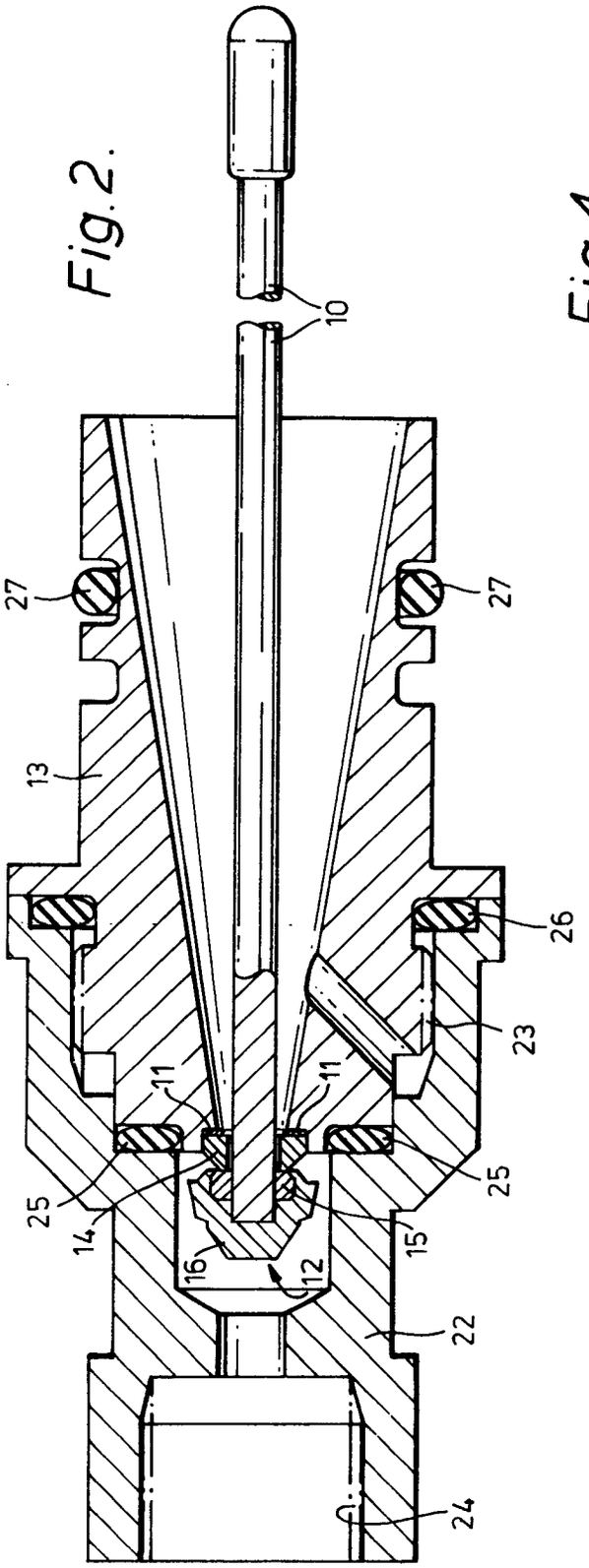
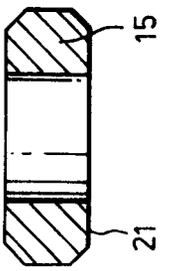


Fig.4.



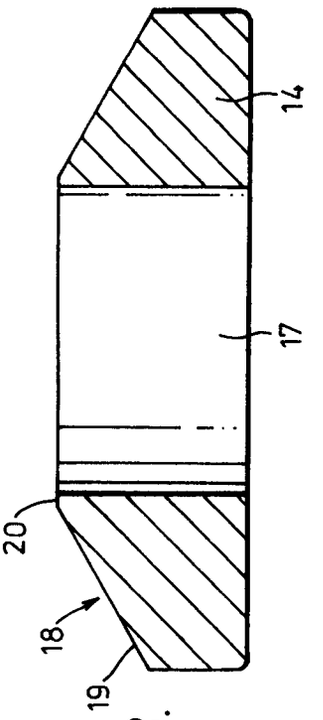


Fig.3.

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EUROPEAN SEARCH REPORT

0212873
Application number

EP 86 30 5808

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	EP-A-0 126 412 (SEKUR SpA)		A 62 B 9/02 F 16 K 1/46 F 16 K 25/00
A	GB-A-2 117 931 (DOWTY HYDRAULIC UNITS)		
P,A	DE-A-3 420 815 (A. KAGE)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A 62 B
F 16 K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18-11-1986	WOHLRAPP R.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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