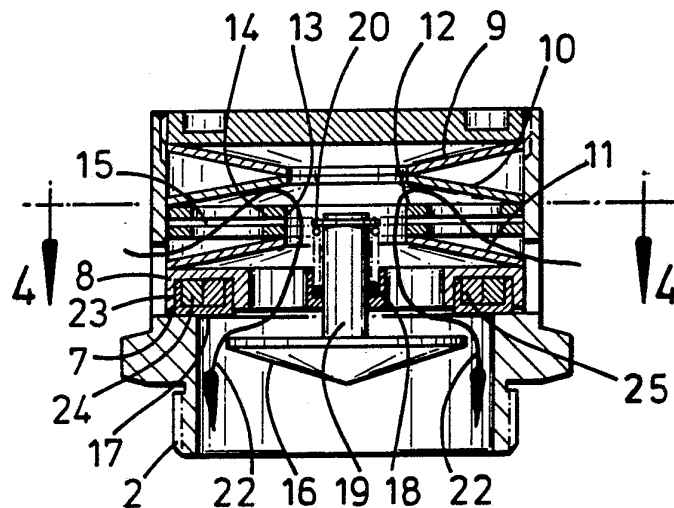




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<p>(21) International Application Number: PCT/GB90/01974 (22) International Filing Date: 18 December 1990 (18.12.90) (30) Priority data: 8928766.8 20 December 1989 (20.12.89) GB (71) Applicant (for all designated States except US): PROGRESSIVE ENGINEERING LIMITED [GB/GB]; Clarke Street, Ashton-under-Lyne, Lancashire OL7 0LJ (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : WILLIAMS, Clive, Graham [GB/GB]; Progressive Engineering Limited, Clarke Street, Ashton-under-Lyne, Lancashire OL7 0LJ (GB).</p>		<p>(74) Agent: ALLMAN, Peter, John; Marks & Clerk, Suite 301, Sunlight House, Quay Street, Manchester M3 3JY (GB). (81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GR, GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US. Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>

(54) Title: PRESSURE RELEASE VALVES



(57) Abstract

A bidirectional pressure release valve comprising a valve body, a first valve member mounted in the body and biased against a first valve seat, and a second valve member movably mounted on the first valve member and biased against a second valve seat defined by the first valve member. A flame arrester is mounted in the body. The valve members and seats are arranged such that excess pressure across the valve in one direction lifts the first valve member off the first valve seat to open a first flow passageway through the valve assembly, and an excess pressure in the other direction lifts the second valve member off the second valve seat to open a second flow passageway through the valve assembly. The flame arrester is positioned in the second flow passageway such that fluid passing along the second flow passageway passes through the flame arrester, whereas the first passageway by-passes the flame arrester.

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PRESSURE RELEASE VALVES

The present invention relates to pressure release valves.

Pressure release valves are used in a wide variety of applications. For example, containers used for transporting fluids such as petroleum products are currently fitted with bidirectional pressure release valves. These valves comprise a housing in which is mounted a compression spring which normally holds a first valve member against a valve seat. If the internal pressure of the container exceeds a predetermined limit the valve member is lifted from its seat and gas can escape from the container. A second valve member is provided mounted in the first, the second valve member being arranged to open if a predetermined excess external pressure is reached. If that pressure is reached, air flows into the container. As air can flow into the container it is necessary to reduce the risk of explosion by providing a flame arrester in the form of a gauze mesh around the valve. This can be a fairly simple arrangement, for example a sheet of mesh wrapped around the valve body so as to cover apertures in the valve through which gas flow is to be permitted.

The known bidirectional valve arrangements incorporate undesirable features. Firstly, the spring force required to maintain the valve member in position against internal pressure is such that a large diameter and relatively large compression spring is required. This in effect determines the minimum height of the valve assembly. Where such valves are to be used on containers which must meet tight dimensional limits, the size of the valve can significantly affect the total container capacity. Furthermore, the use of a large compression spring makes it likely that when the internal pressure exceeds the pre-set limit the valve member will lift off its seat at one side only. It would be far preferable to have a spring biasing arrangement which was not prone to this characteristic.

Another problem with the known bidirectional valve assemblies is that the flame arrester represents a significant restriction on the maximum rate of flow of gas through the valve. The surface area of the flame arrester must be relatively large if specified minimum flow rates for gas being released through the valve are to be attained.

Finally, the known bidirectional valve assemblies are often used

in circumstances where they remain exposed to adverse weather conditions for long periods. Water can penetrate into the valve mechanism and freeze, thereby preventing correct operation of the valve. This problem is sufficiently well-known for the users of such valves to pour anti-freeze into the valve assemblies when ice is thought to be a problem. This is clearly not a satisfactory procedure to be used.

It is an object of the present invention to obviate or mitigate the problems outlined above.

According to the present invention there is provided a pressure release valve comprising a body for mounting in a wall of a fluid container, a valve member movably mounted in the body, a valve seat, and means for biasing the valve member against the valve seat, the biasing means comprising at least one resilient dish-shaped spring member.

The dish-shaped spring member may be a washer of the type generally referred to as a "Belleville" washer. Such washers are of substantially uniform thickness, but are concave on one side and convex on the other. Applying a compressive force so as to flatten out the washer results in the washer being distorted. This applies a resilient force to the peripheral edge of the washer on one side and the radially inner edge of the washer on the other side. Relatively large resilient spring forces can be generated using a single washer or a stack of such washers the overall height of which is relatively small. Thus, in contrast to a conventional large diameter helical spring, a relatively small spring assembly can be achieved. When used in a pressure release valve in accordance with the invention the overall height of that valve can be substantially reduced. Furthermore, the resilient force delivered by such a washer tends to be distributed more evenly than in the case of large diameter helical springs, thereby reducing the risk of one portion of the valve member lifting off the seat prematurely.

The use of one or more dish-shaped spring members makes it possible to construct a valve assembly which is protected against the penetration of water. For example, the body may define a casing for retaining the valve member and the spring member, the valve member being sandwiched between the valve seat and the dish-shaped spring

first valve member and a further dish-shaped washer is mounted on top of the flame arrester disc, the concave side of the further washing facing the flame arrester disc. Thus the second passageway extends through the washer adjacent the first valve member, through the central aperture in the flame arrester disc, beneath the second washer to the peripheral apertures in the flame arrester disc, through those apertures and thence to the exterior of the valve assembly. In contrast the first passageway is simply defined between the first valve member and the first valve seat.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Fig. 1 is a side elevation of a bidirectional valve assembly in accordance with the present invention;

Fig. 2 is a section through the valve member of Fig. 1 on line II-II, the valve assembly being shown in the configuration in which fluid is flowing in one direction through the valve;

Fig. 3 is a part sectional view similar to that of Fig. 2 but showing the valve assembly in which fluid is flowing in the opposite direction through the valve; and

Fig. 4 is a view on the lines IV-IV of Fig. 2.

Referring to Figs. 1 and 2, the illustrated valve assembly comprises a body supporting a hexagonal nut 1 and a threaded portion 2, the threaded portion 2 being screwed in use into the wall of a fluid container. The body further comprises a cylindrical casing 3 defining apertures 4 and receiving an end cap 5 which engages threads 6 in the casing 3. The body defines a first valve seat 7 against which a first valve member 8 engages. The valve member 8 is normally pressed against the seat 7 by three Belleville washers 9, 10 and 11. A flame arrester disc 12 is sandwiched between the washers 10 and 11, the flame arrester having a central open aperture 13 and an array of peripheral apertures 14 across which an annular sheet of metal gauze 15 extends.

A second valve member 16 normally bears against a second valve seat 17 defined by the first valve member. The first valve member is provided with a ring of apertures 18 and a central aperture through which a pin 19 supported by the second valve member 16 extends. A

member. If the dish-shaped spring member has its concave side facing the valve member it automatically defines a surface arranged such that water drains off it away from the valve member. Thus the likelihood of water penetration is greatly reduced as compared with valve assemblies incorporating a helical compression spring.

According to another aspect of the present invention, there is provided a bidirectional pressure release valve comprising a valve body, a first valve member movably mounted in the body, means for biasing the first valve member against a first valve seat, a second valve member movably mounted on the first valve member, a second valve seat defined by the first valve member, means for biasing the second valve member against the second valve seat, and a flame arrester mounted in the said body, the valve members and seats being arranged such that excess pressure across the valve in one direction lifts the first valve member off the first valve seat to open a first flow passageway through the valve assembly, and, an excess pressure in the other direction lifts the second valve member off the second valve seat to open a second flow passageway through the valve assembly, the flame arrester being positioned in the second flow passageway such that fluid passing along the second flow passageway passes through the flame arrester, and the first passageway by-passing the flame arrester.

With the above arrangement in accordance with the invention the valve member can be arranged to rapidly vent gas from a container in which an excess pressure has built up through the first passageway which is not partially obstructed by the flame arrester. On the other hand air can flow at an acceptable rate back into the container through the second passageway if the pressure within a container is less than atmospheric pressure by a predetermined amount.

Preferably the means for biasing the first valve member against the first valve seat comprises one or a stack of dish-shaped spring washers. A washer adjacent the first valve member has its peripheral edge in contact with that valve member, the second passageway being defined through the aperture in the centre of the washer. The flame arrester is in the form of a disc which is apertured centrally and has a series of peripheral apertures across which a metal gauze extends. The flame arrester disc rests on top of the washer which contacts the

helical compression spring 20 biases the valve member 16 against the valve seat 17.

When there is no excess pressure across the valve assembly the first valve member rests against the first valve seat 7 and the second valve member rests against the second valve seat 17.

Referring now to Fig. 3, if the pressure on the side of the valve assembly corresponding to the threaded portion 2 exceeds a predetermined limit determined by the strengths of the washers 9 to 11, the first valve member moves away from the valve seat 7. Fig. 3 shows the configuration which is assumed if the valve is in total discharge mode, that is if the internal pressure is so large as to completely flatten the washers 9, 10 and 11. In this configuration a first flow passageway 15 defined as indicated by arrows 21, that is fluid can flow out of the valve assembly through the apertures 4. Very high flow rates can be achieved given that there is no obstruction to the apertures 4. If on the other hand there is an internal vacuum, the valve 16 assumed the position shown in Fig. 2 and a second passageway is defined through the valve assembly following the path indicated by arrows 22. This second passageway is more restricted than the first passageway, but this is not a problem when the valve is operating in vacuum flow mode. Furthermore, the gauze 15 of the flame arrester disc extends across the second passageway as required to achieve the appropriate flame arresting characteristics.

It will be noted that the coil spring 20 is arranged such that if it was surrounded with water and that water became frozen it would be difficult or impossible for the valve member 16 to move away from the valve seat 17. This is a common problem with prior art assemblies. In the case of the illustrated arrangement however, assuming that the valve assembly axis is vertical as shown in Fig. 2 water can only penetrate the area around the spring 20 if it can follow the first part of the passageway 22, that is by following a route up the slope of the convex side of the washer 11, vertically through the gauze 15 and then radially inwards to the vicinity of the spring 20. In practice it is very unlikely indeed that any water will penetrate the valve assembly in this way and thus it is not necessary to take precautions against ice formation, for example by pouring antifreeze into the assembly.

Fig. 4 shows the configuration of the flame arrester in more detail. It will be seen that there are eight peripheral apertures in the disc each covered by the gauze 15.

The valve members and valve seats can be fabricated from any convenient materials. It is advantageous however if as shown in Fig. 2 a PTFE member 23 is used to define one side of each of the mating valve member/seat arrangements. This makes sticking of the valve much less likely. A solid ring of PTFE could be used, but this material can become permanently deformed under the loads that might be expected in such a valve assembly. To avoid this happening it is advantageous to support the PTFE on a rubber reinforcement. In the illustrated case a first hard rubber ring 24 supports the PTFE against the large force applied by the washers 9, 10 and 11 and a relatively soft rubber ring 25 supports the PTFE where it is contacted by the second valve member 16. This arrangement ensures that the relatively thin PTFE 23 is displaced by displacement of the supporting rubber rather than by permanent deformation. Seal integrity is thus enhanced.

The low height of the described valve makes it possible to position the valve at the vertically highest point of the container to which it is fitted without substantially increasing the overall height of the container and valve assembly. The relatively large valves of the prior art were often offset for the highest point of a container to save overall height, but at the risk of the valve no longer being located in the ullage area of the container, particularly if the container was tilted. Thus the valve of the present invention reduces the risk of liquid rather than gas being discharged from a container of for example petroleum products.

CLAIMS:

1. A bidirectional pressure release valve comprising a valve body, a first valve member movably mounted in the body, means for biasing the first valve member against a first valve seat, a second valve member movably mounted on the first valve member, a second valve seat defined by the first valve member, means for biasing the second valve member against the second valve seat, and a flame arrester mounted in the said body, the valve members and seats being arranged such that excess pressure across the valve in one direction lifts the first valve member off the first valve seat to open a first flow passageway through the valve assembly, and an excess pressure in the other direction lifts the second valve member off the second valve seat to open a second flow passageway through the valve assembly, the flame arrester being positioned in the second flow passageway such that fluid passing along the second flow passageway passes through the flame arrester, and the first passageway by-passing the flame arrester.
2. A pressure release valve according to claim 1, wherein the means for biasing the first valve member against the first valve seat comprises one or a stack of dish-shaped spring washers.
3. A pressure release valve according to claim 2, wherein a washer adjacent the first valve member has its peripheral edge in contact with that valve member, the second passageway being defined through an aperture in the centre of the washer.
4. A pressure release valve according to claim 3, wherein the flame arrester is in the form of a disc which is apertured centrally and has a series of peripheral apertures across which a metal gauze extends, the flame arrester disc resting on top of the washer which contacts the first valve member, and a further dish-shaped washer being mounted on top of the flame arrester disc, and the concave side of the further washer facing the flame arrester disc, whereby the second passageway extends through the washer adjacent the first valve member, through the central aperture in the flame arrester disc, beneath the second washer to the peripheral apertures in the flame arrester disc, through those apertures and thence to the exterior of the valve assembly, and the first passageway is simply defined between

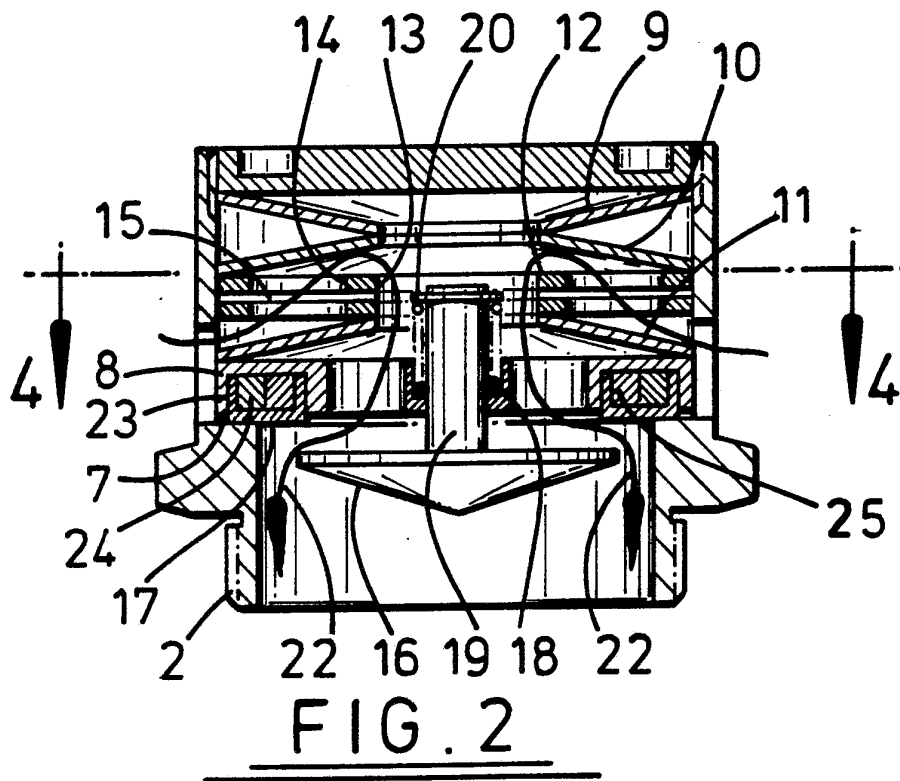
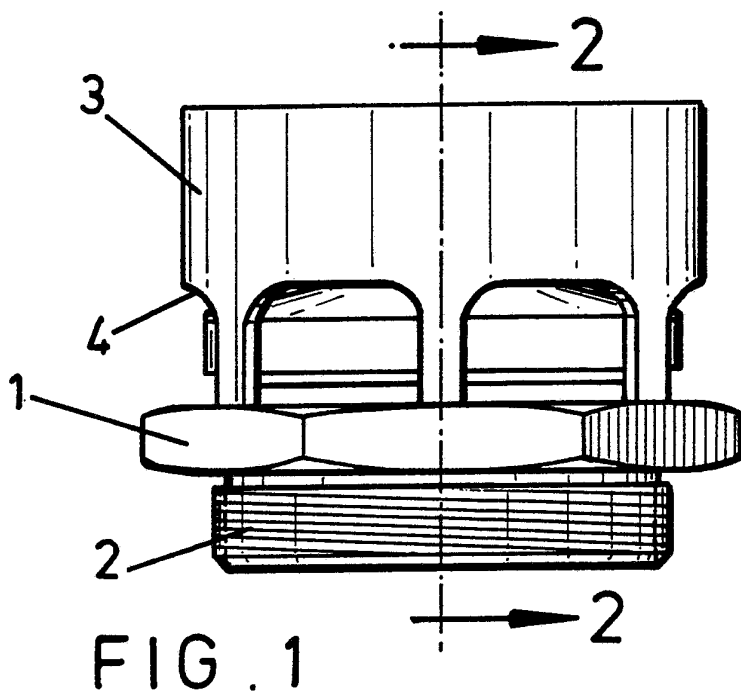
the first valve member and the first valve seat.

5. A pressure release valve comprising a body for mounting in a wall of a fluid container, a valve member movably mounted in the body, a valve seat, and means for biasing the valve member against the valve seat, the biasing means comprising at least one resilient dish-shaped spring member.

6. A pressure release valve according to claim 5, wherein the dish-shaped spring member is a Belleville washer.

7. A pressure release valve according to claims 5 or 6, wherein the body defines a casing for retaining the valve member and the spring member, the valve member being sandwiched between the valve seat and the dish-shaped spring member.

8. A pressure release valve according to claim 7, wherein the first valve member, a further dish-shaped washer being mounted on top of the flame arrester disc, and the concave side of the further washer facing the flame arrester disc, whereby the second passageway extends through the washer adjacent the first valve member, through the central aperture in the flame arrester disc, beneath the second washer to the peripheral apertures in the flame arrester disc, through those apertures and thence to the exterior of the valve assembly, and contrast the first passageway is defined between the first valve member and the first valve seat.



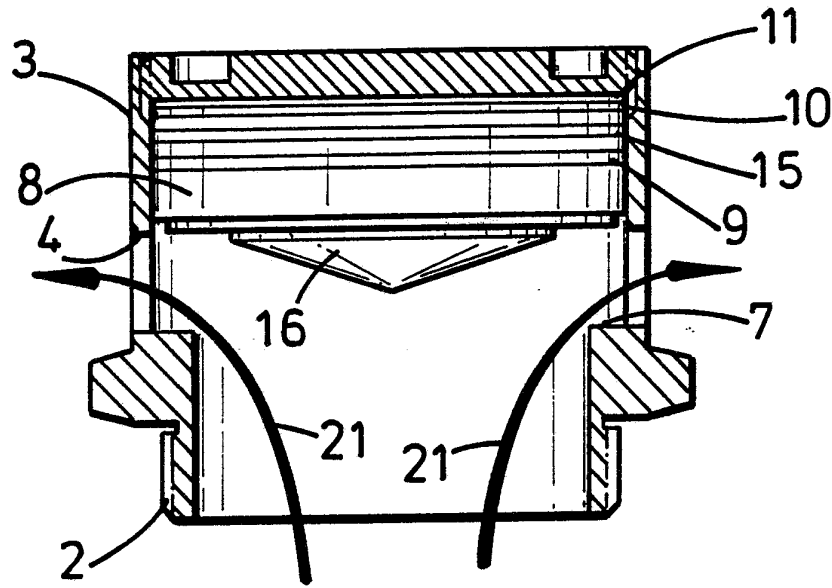


FIG. 3

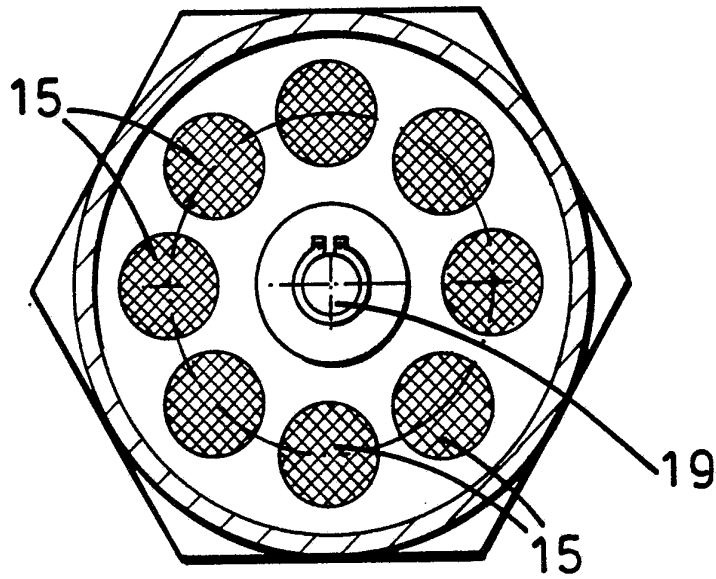


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01974

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶				
According to International Patent Classification (IPC) or to both National Classification and IPC				
IPC ⁵ : F 16 K 17/196, B 65 D 90/34, F 16 K 24/00				
II. FIELDS SEARCHED				
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Classification System	Classification Symbols			
IPC ⁵	F 16 K 17/00, F 16 K 24/00, B 65 D 90/00, 51/00			
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹				
Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³		
A	US, A, 1342985 (A.W. CASH) 8 June 1920 see page 2, lines 9-14; figure 1 --	1		
A	GB, A, 2004625 (ETS. A. DUBOIS) 4 April 1979 see page 2, lines 18-27 --	1		
A	US, A, 3937357 (TOM McGUANE IND. INC.) 10 February 1976 --			
A	US, A, 3304952 (W.A. KNAPP CO.) 21 February 1967 --			
A	US, A, 4016904 (CENTRAL SAFETY EQUIPMENT CO) 12 April 1977 --			
./.				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> [*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; vertical-align: top;"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family </td> </tr> </table>			[*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family
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IV. CERTIFICATION				
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report			
27th March 1991	23. 04. 91			
International Searching Authority	Signature of Authorized Officer			
EUROPEAN PATENT OFFICE	miss T. MORTENSEN			

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	GB, A, 935945 (W. SLINGSBY CO.) 4 September 1963 --	
A	GB, A, 2199373 (SHELL INTERNATIONALE RESEARCH MY) 6 July 1988 --	
A	DE, A, 3741639 (HOEBBIGER VENTILWERKE) 14 July 1988 -----	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9001974

SA 42790

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 19/04/91. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 1342985		None	
GB-A- 2004625	04-04-79	FR-A- 2404159	20-04-79
US-A- 3937357	10-02-76	None	
US-A- 3304952		None	
US-A- 4016904	12-04-77	CA-A- 1073318	11-03-80
		GB-A- 1521809	16-08-78
		JP-A- 52081722	08-07-77
GB-A- 935945		None	
GB-A- 2199373	06-07-88	None	
DE-A- 3741639	14-07-88	None	