PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B01D 35/14, 35/147, 27/10	A1	(11) International Publication Number: WO 96/25995
		(43) International Publication Date: 29 August 1996 (29.08.96)

(21) International Application Number: PCT/FI95/00092

(22) International Filing Date: 22 February 1995 (22.02.95)

(71) Applicant *(for all designated States except US)*: PARKER HANNIFIN OY [FI/FI]; FIN-31700 Urjala As (FI).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: KOIVULA, Tuomo [FI/FI]; Tekijäntie 70, FIN-31720 Urjalankylä (FI).

(74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).

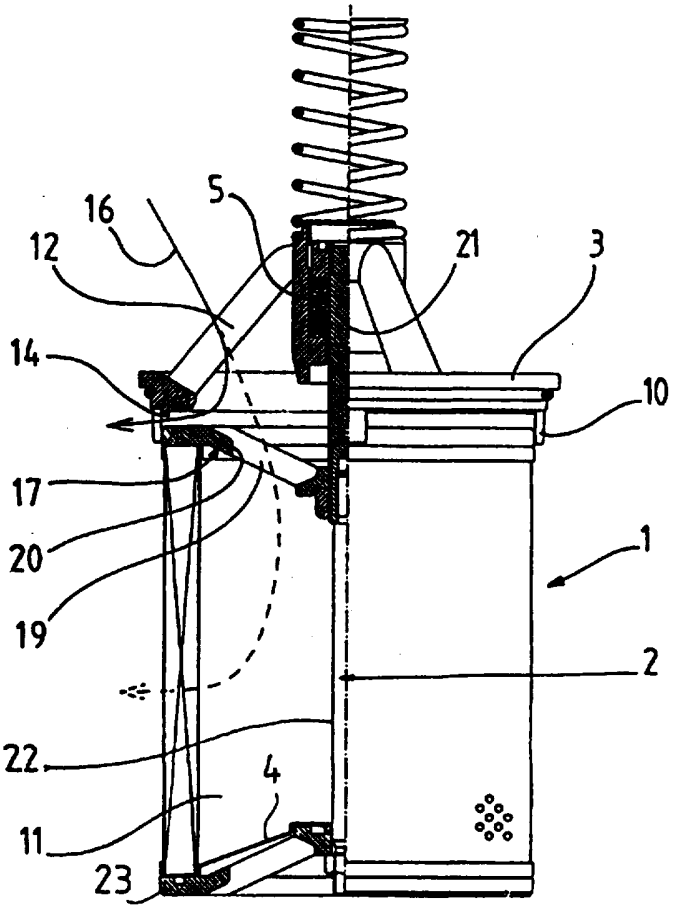
(81) Designated States: US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
In English translation (filed in Finnish).

(54) Title: FILTER PROVIDED WITH A BYPASS OPENING

(57) Abstract

The invention relates to a filter provided with a bypass opening (14) to be used especially as an oil filter in hydraulic systems. The filter includes a casing-like filtering element (1) mounted on a support (3), whereby the stream to be filtered can be conducted into the space (11) defined by the element such that filtering takes place from this space through the filtering element envelope towards the outside of the space. The bypass opening (14) is produced by prestressing the filtering element (1) and the support against each other with a spring (5) such that, as the pressure in the filter exceeds the prestressing force, they will be dislodged relative to each other, leaving the opening concerned between the support and the filtering element (1). Essential features of the filter of the invention are that the filter is equipped with a frame (17) between the casing-like filtering element (1) and the support (3), that the frame and the support are prestressed against each other to leave a bypass opening (14) between them under the effect of pressure, and that the filtering element is removably attached to the prestressed frame. The frame (17) and the support (3) are kept continuously prestressed in the filter, while the cylindrical filtering element (1) attached to the frame, which does not affect prestressing, can be removed and replaced when needed.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

FILTER PROVIDED WITH A BYPASS OPENING.

The invention relates to a filter comprising a support and a removable, casing-like filtering element, whereby the stream to be filtered can be conducted into this element such that filtering takes place through the element envelope towards its outside, the filter element and the support being prestressed against each other by a spring such that, as the pressure within the element exceeds the prestressing force, they are dislodged relative to each other, opening up a by-pass opening for the stream passing by the element.

Filters of the type described above are used for instance in hydraulic systems to cleanse hydraulic an lubricating oils from dirt. The filter may be mounted for instance in the cover of an oil tank or in a piping conveying oil. The filtering envelope may consist of a metal mesh and a paper or glass fibre layer supported against this. The purpose of prestressing the envelope and the holder against each other is to provide a by-pass valve in the event that the envelope is clogged, the by-pass valve allowing the stream of material to be filtered to pass by the envelope as the pressure exceeds the treshold value formed by the prestressing, thus avoiding malfunctions of the system and any damage to the filter.

Figures 1 and 2 in the accompanying drawing illustrate a prior-art filter of the type typically used in hydraulic systems. Figure 1 is a partial vertical section of the filter in normal operating position and figure 2 is a view of the same filter with the by-pass opening opened up.

The filter illustrated in figures 1 and 2 comprises a filter element 1 with its envelope shaped as a circular cylinder, a shaft bar 2 and a stationary support 3 of the filter element. The end of the filter element envelope opposite to the support is sealed with a closed cover 4. The filter element 1 is pressed against the support 3 by a prestressing spring 5 surrounding the shaft bar 2 and attached to the bar with a clamping screw 6. This arrangement allows the filter element 1 to move axially relative to the support 3 against the springback force. The filter element 1 is attached to the shaft bar 2 with a clamping nut 7 pressing the cover 4 such that the bar will move along with the filter element.

The cylindrical envelope of the filter element 1 consists of nested, permeable metal meshes 8 and an intermediate filtering material layer 9, made for instance of paper

or glass fibre. The support 3 is provided with pin-like guides 10 surrounding the upper end of the envelope 1 and retaining the envelope in place as the element is dislodged.

The annular support 3 is equipped with inlet openings 12 for the stream to be filtered opening up into the space 11 defined by the envelope of the filtering element 1. The openings 12 are located on the distances between the radial sides of the circumference of the support 3 and the casing surrounding the shaft bar 2 and the spring 5. A stream of for instance polluted hydraulic oil flows from the openings 12 into the cylindrical space 11, clean oil being filtered through the envelope 8, 9 to the outside of the filter as indicated by arrows 13 in figure 1, so that the dirt is caught on the inner surface of the envelope and in the filtering material layer 9.

In the normal operating position of the filter, the envelope of the filtering element 1 fixed in place with the nut 7 is pressed against the support 3 by means of the shaft bar 2 and the spring 5. As the filtering material 9 is gradually being clogged, the permeability of the envelope 1 drops, while the pressure produced by the entering stream increases in the space 11 within the envelope. As this pressure exceeds the prestress of the filtering element 1 against the support 3 generated by the spring 5, the element will yield, shifting against the spring parallel to the shaft bar 2, and consequently leaving an annular by-pass opening 14 between the support and the upper end of the element envelope, as shown in figure 2. In this situation a major portion of the stream will be conducted through the slot 14 passing by the envelope 8, 9 outside the filter, as indicated with lines 15 in figure 2.

In the prior-art filter configuration described above, the cylindrical filtering element 1 is mounted at assembly by screwing the clamping nut 7 all the way to the bottom, the upper end of the element envelope thus being pressed against the support 3 as the spring 5 is pressed, generating prestress between the members. The filtering element 1 has been dimensioned such that the prestress equals a desired threshold value of the pressure opening up the by-pass opening 14. However, due to large manufacturing tolerances, the filtering elements 1 do not always have exactly the same length, and this entails the problem that, as a clogged or otherwise worn-out element is being replaced, there may be a change in the prestress of the construction, and thus in the pressure opening up the by-pass opening 14. Yet an optimal operation of the system would require this pressure to be exactly maintained.

Another problem entailed by the prior-art filtering design described above is that, as the by-pass opening 14 has opened up, turbulent streams will be generated in the space 11 within the filtering element envelope 1, these turbulences attracting dirt from the inner surface of the envelope and subsequently passing into the by-pass opening 14, as shown in figure 2. In this situation, dirt having already been separated by the filter from the stream to be filtered will pass by the envelope 1.

The purpose of this invention is to provide a design allowing the drawbacks of the conventional filter configuration mentioned above to be eliminated. The filter of the invention is characterised by the filter being equipped with a frame between the casing-like filtering element and the support, of the frame and the support being prestressed against each other in order to leave a by-pass opening between them under the effect of pressure, and of the filtering element being removably attached to the prestressed frame.

In the design of the invention, prestressing is generated between the filtering element frame and the support by using an appropriate clamp, independently of the filtering element envelope and the attachment of the element. In other words, the length of the element envelope will not affect prestressing. This enables the prestress between the frame and the support to be accurately controlled to the desired level by means of the prestressing spring and its attachment, and this prestress will be maintained in the filter, because there will be no need to act on the mounting of these members as the filtering element is being replaced. Moreover, this arrangement enables the clamp of the prestressing spring, such as a clamping screw or nut, to have various prestressing degrees and graded clamping positions corresponding to the pressures opening up the by-pass opening, thus allowing the opening pressure to be varied when desired. The invention has the further advantage that, as the cylindrical filtering element does not have to support and maintain the prestress required, its design and material requirements are no longer critical in this respect. It suffices if the element is stiff enough to remain in place in the filter under the operating pressures prevailing in the cylinder.

The filter of the invention preferably comprises a shaft bar passing axially through the cylindrical filtering element, serving to prestress the frame and the support against each other, to which the element is attached at its end opposite to the frame. The shaft bar may preferably consist of two removably interconnected members such that the first member connects the support with the frame fixed in this member and the second member forms a removable extension of the first member extending

to the stationary cover at the opposite end of the filtering element. When desired, the second member of the bar can thus be replaced with a member of a different length, allowing filtering elements of various lengths to be used in the filter without affecting the prestress between the support and the frame, nor the pressure opening up the by-pass opening.

In terms of the invention, it is also possible to act on the streams occuring after the by-pass inlet has opened up into the filter with the shape and the position of the flow openings defined by he frame, and hence to prevent dirt already caught in the filtering element from rejoining the stream and passing through the filter.

An example of the filter of the invention is illustrated in the accompanying figures 3 and 4, figure 3 being a partly sectional view of a normally operating filter with the lines 13 indicating the flow of the stream to be filtered and figure 4 respectively indicating with flow lines 16 a filter with the by-pass inlet opened.

The filter of the invention shown in figures 3 and 4 basically corresponds to the prior-art filter in figures 1 and 2 described above, and for this reason we shall proceed to explain the members and operations of the inventive filter alone that differ from the previously known filter. In other respects, the facts disclosed in conjunction with figures 1 and 2 also apply to the filter of the invention.

The prestress corresponding to the opening pressure of the by-pass opening 14 is generated in the filter of the invention between the stationary support 3 and the frame 17 placed immediately inside this, pressed by the spring against the support. The frame 17 is attached to the shaft bar 2 with a nut 18. As the pressure in the cylindrical space 11 exceeds the prestress between the support 3 and the frame 17, the frame moves axially towards the spring 5, thus leaving a by-pass opening 14 between the support 3 and the frame 17.

In figures 3 and 4 the flow inlets 19 defined by the frame 17 and opening up into the cylindrical space 11 within the filter are retracted from the outer edge of the frame such that the links 20 between the inlets and the frame edge bar the flows passing from the cylindrical space 11 to the opened by-pass inlet 14. This design serves to prevent or at least to essentially reduce dirt already caught in the filtering element 1 from escaping from the filter.

In the filter illustrated in figures 3 and 4, the shaft bar 2 consists of two members 21, 22 interconnected with a screw joint. The first member 21 of the bar connects the support 3 with the frame 17 mounted in this member 21 with a nut 18. The second member 22 of the bar, which can be unscrewed from the member 21, lodges the support 23 mounted with a nut 7 and bearing against the cover 4 of the element. As a result, the support 23 and the cylindrical filtering element 1 retained by it do not have an impact on the prestress between the frame 17 and the support 3. This means that the length of the filtering element envelope 1 and manufacturing tolerances do not affect the operation of the filter, and in the filter embodiment shown, it is possible to use filtering elements 1 of various lengths by appropriately replacing the second shaft member 22. Accordingly, the filtering element 1 may consist of nested metal meshes 8 and an intermediate filtering material layer 9, however, since the invention does not require the element envelope to maintain the prestress, other envelope designs and materials having lower dimensional stability are also conceivable in terms of the invention.

The filter of the invention is assembled by first attaching the frame 17 to the support 3 with a nut 18 screwed into the shaft bar 2, and by subsequently adjusting the prestress between these exactly to the desired level using the clamping screw 6 and the nut 18. After this, the cylindrical filtering element 1 is fixed with the support 23 and a nut screwed into the lower end of the bar 2. As the clogged filtering element 1 is replaced, there is no need to touch the mounting between the frame 17 and the support 3, unless the pressure opening up the by-pass opening 14 is to be varied for some reason. When desired, this variation can be accomplished by adjusting the spring 5 with the clamping screw 6, which may be provided with pregraded positions corresponding to various pressures. In filters of hydraulic systems, 1.2 bar and 1.6 bar opening pressures are commonly used pressures.

It is obvious to those skilled in the art that the embodiments of the invention are not confined to the example described above, but may vary within the scope of the accompanying claims. Thus, the closed cover 4 of the filtering element 1 and its support 23 may be constructed as a single, integrated piece. Also, the filtering element 1 does not necessarily have the shape of a circular cylinder, but may for instance be conically tapered within the scope of the invention. It is further possible that not the support, but the frame bearing against it is stationary, and in that case the support is movable relative to the frame.

Claims

1. A filter comprising a support (3) and a removable, casing-like filtering element (1), whereby the stream to be filtered can be conducted into this element such that filtering takes place through the element envelope (8,9) to its outside, the filtering element and the support being prestressed against each other with a spring (5) such that, as the pressure within the element exceeds the prestress force, they are dislodged relative to each other, leaving a by-pass opening (14) for the stream passing by the element envelope, **characterised** in that the filter is equipped with a frame (17) between the casing-like filtering element (1) and the support (3), in that the frame and the support are prestressed against each other to leave a by-pass opening (14) between them under the effect of pressure, and in that the filtering element is removably attached to the prestressed frame.

2. A filter as claimed in claim 1, **characterised** in that the frame (17) and the filtering element (1) removably attached to it have been disposed to be dislodged relative to the stationary support (3) under the effect of pressure.

3. A filter as claimed in claim 1 or 2, **characterised** in that the frame (17) and the support (3) are interconnected by a shaft bar (2), and in that prestress has been generated by means of a clamping nut (18) screwed into the shaft bar.

4. A filter as claimed in claim 3, **characterised** in that the shaft bar (2) extends through the filtering element (1) all the way to its end opposite to the frame (17), at which the element is attached to the end of the shaft bar by means of a nut (7) or any similar fixing means.

5. A filter as claimed in claim 4, **characterised** in that the shaft bar (2) consists of two removably interconnected members such that the first member (21) connects the support (3) with the frame (17) and the second member (22) forms a removable extension of the first part extending to the end of the filtering element (1) opposite to the frame.

6. A filter as claimed in any of the preceding claims, **characterised** in that the casing-like filtering element (1) comprises an envelope of a permeable filtering material (9) and a closed cover (4) at its end.

7. A filter as claimed in any of the preceding claims, **characterised** in that the filtering element (1) comprises a permeable envelope (8,9) having the shape of a circular cylinder.

8. A filter as claimed in any of the preceding claims, **characterised** in that the by-pass opening (14) is a substantially annular inlet opening up between the annular support (3) and the frame (17) bearing against it.

9. A filter as claimed in any of the preceding claims, **characterised** in that the support (3) is provided with one or more inlet openings (12) for the stream (13) to be filtered to be conducted inside the filtering element.

10. A filter as claimed in claims 8 and 9, **characterised** in that the frame (17) defines flow openings (19) retracted from its edge such that links (20) between the openings and the frame edge bar the back flow returning from the filtering element (1) towards the by-pass opening (14).

FIG.2

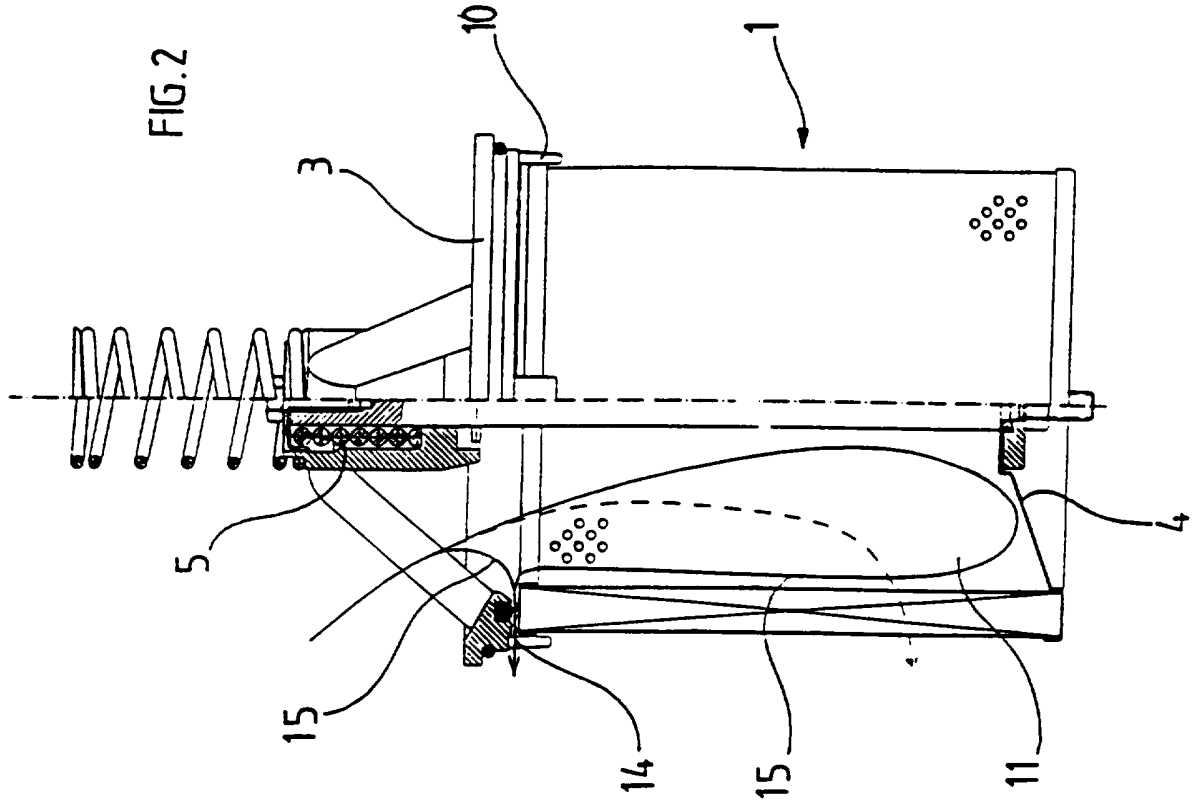


FIG.1

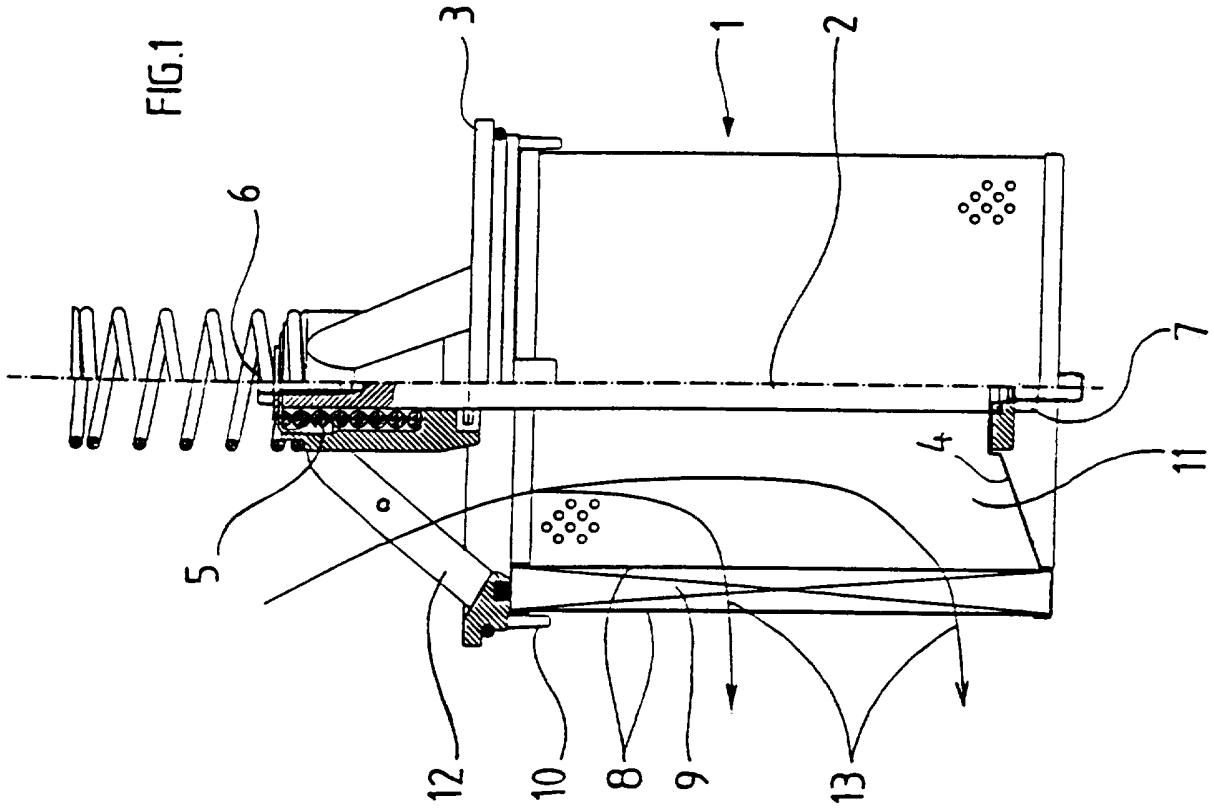


FIG.4

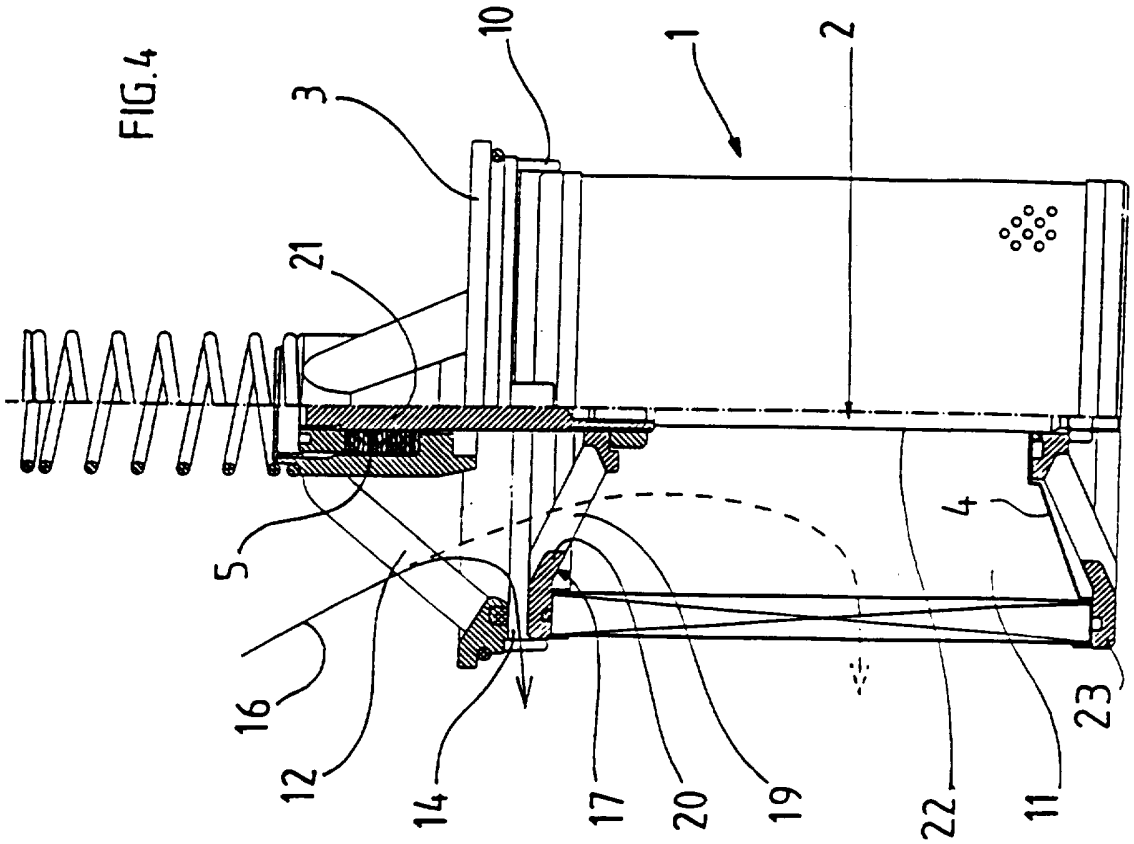
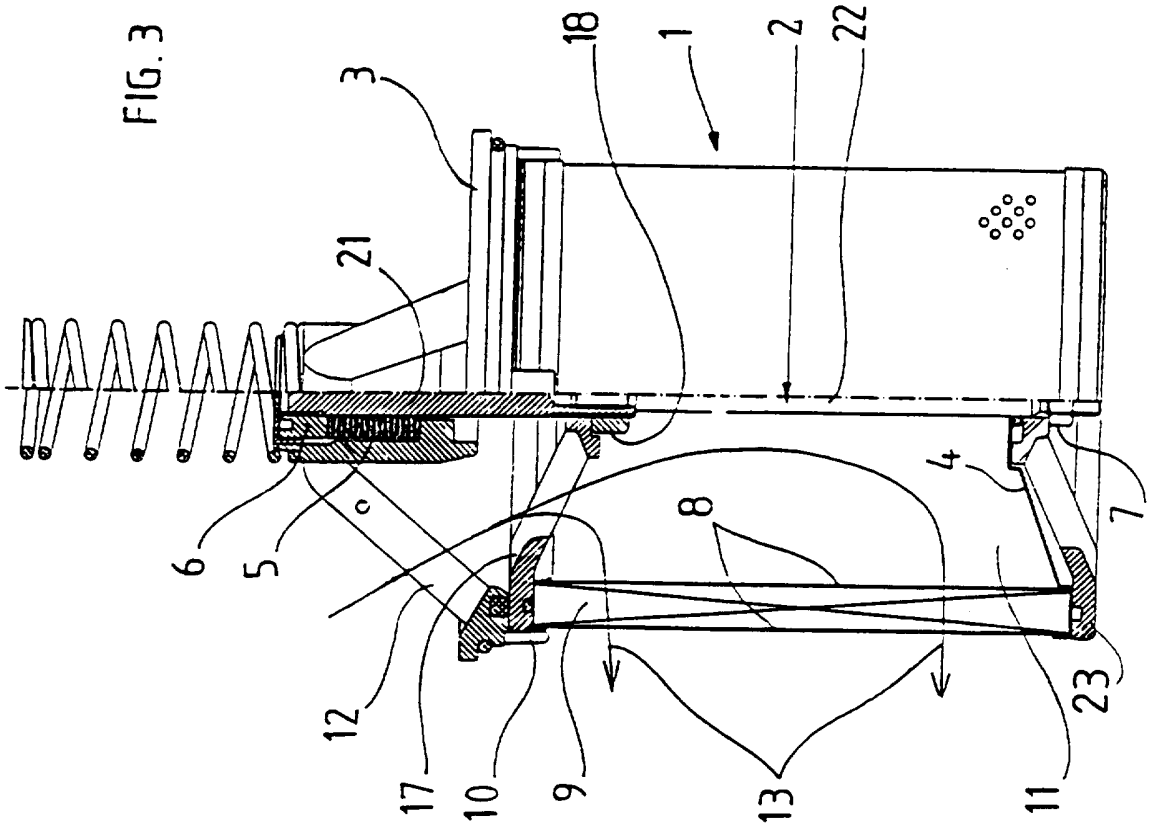

10
1
2
3
21
5
16
12
14
17
20
19
22
11
23
4

FIG. 3


18
1
2
22
3
21
4
7
6
5
8
12
17
10
9
13
11
23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 95/00092

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B01D 35/14, B01D 35/147, B01D 27/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIL, IFIPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 4243217 A1 (KNECHT FILTERWERKE GMBH), 23 June 1994 (23.06.94), column 1, line 42 - line 55, abstract --	1
A	WO 8900881 A1 (POLAK, SONJA), 9 February 1989 (09.02.89), abstract --	1
A	DE 2800486 A1 (CATERPILLAR TRACTOR CO.), 3 August 1978 (03.08.78), page 3 --	1
A	FR 2010841 A (GENERAL MOTORS LIMITED), 20 February 1970 (20.02.70), page 1, line 34 - line 40; page 2, line 41, claims 1-5 --	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier 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 when the document is taken alone
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 October 1995	20. 10. 95
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jan Carlerud Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/FI 95/00092

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A1- 4243217	23/06/94	NONE	
WO-A1- 8900881	09/02/89	AT-B- 389458	11/12/89
		EP-A- 0377602	18/07/90
DE-A1- 2800486	03/08/78	BE-A,A- 862494	30/06/78
		GB-A- 1542373	21/03/79
		JP-A- 53096572	23/08/78
FR-A- 2010841	20/02/70	GB-A- 1237093	30/06/71