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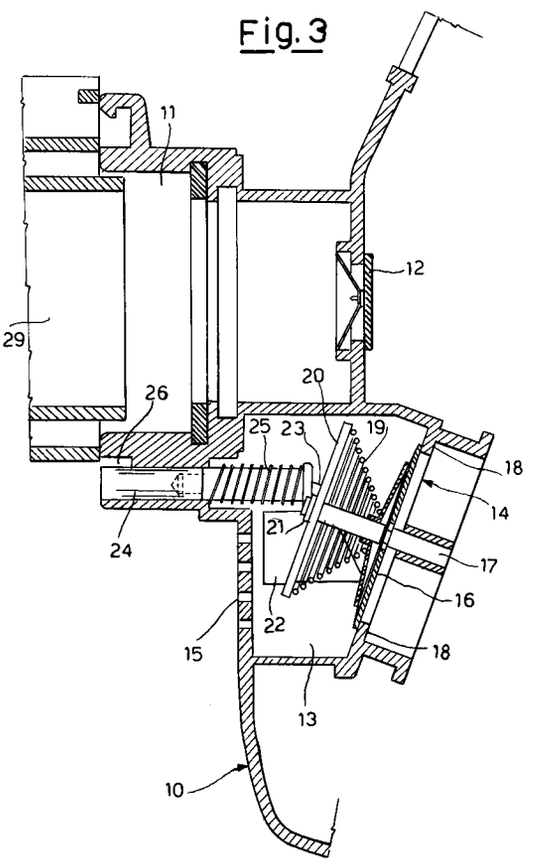
(54) Improved mask for breathing apparatus supplying air under pressure or not.

(57) A mask (10) for breathing apparatus, provided with one-way air inlet (12) and one-way air outlet valves (14) of variable elasticity, in which said outlet or expiration valve (14) has an opening pressure selected between a first and a second predetermined values by means of a prearrangement control member (24). The expiration valve (14) comprises an airtight diaphragm (16) elastically pushed to close an expiration passageway (13) by means of two springs (19, 25) in series with each other, the former (19) having an elastic coefficient greater than the latter (25); the control member (24) is movable between a position of non-interference and a position of interference with the elastic movement of the second spring (25) under the action of a pressure acting on the diaphragm (16).

Fig.3



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The present invention relates to a mask to be used in connection with an apparatus which, through a one-way valve, supplies pure or purified air having the same pressure as, or a different pressure from the atmospheric one.

Mask respirators to be used in environments where air is polluted or at all events noxious, can be divided into two main types: those provided with a filter, which merely filter and purify the air directly inhaled by a wearer, and those utilizing an appropriate source (a bottle, for example) of pure air under pressure or under partial vacuum and completely excluding entering of air from the surrounding atmosphere.

In both types of masks the ejection of the air exhaled by the wearer takes place through an appropriate one-way valve, separate from the inspiration or inlet valve, directly operated by overpressure caused by the expired air; such a valve therefore, is normally closed and only opens during the expiratory steps of the wearer's breathing.

In masks having a filter respirator and in masks provided with a source of air under relative vacuum, the valve must offer a very weak resistance to the passage of the outgoing air, pressure within the mask being lower than or at most the same as the external one.

In masks having a source of air under pressure, on the contrary, the air emitting valve must be such set that it does not open when there is just a difference between the (greater) pressure inside the mask and the (lower) external atmospheric pressure; said valve must offer a higher resistance than in the case seen above, so that it only opens when the difference between the internal and external pressures exceeds a given threshold as a result of the already mentioned overpressure due to the expired air.

As a result, the above described two types of masks can be used only within their own operating field. Application of a breathing apparatus with air under pressure to a mask provided with an outlet valve offering a low resistance would involve a continuous escape of air from the mask which would bring about a drastic reduction in the autonomy of same. On the contrary, application of a filter apparatus or a low pressure apparatus to a mask provided with a valve set for a higher pressure would involve an excessive effort by the wearer for blowing out the expired air.

In order to obviate the incompatibility existing between said two types of masks, the same applicant has envisaged a solution described in a patent for invention IT 1,227,248 according to which a spring counteracting opening of the outlet valve reacts on a pin projecting to the outside of the mask.

The pin is such located that it is pushed to increase compression of the spring when a union for a source of air under pressure is connected to the mask. Thus pressure necessary for opening of the exhaust valve passes from a first value to a second value (greater than the first) depending on whether a vacuum apparatus or an overpressure apparatus is connected to the mask.

While a mask of the above type is greatly innovatory as it enables the user to be equipped with a single mask of universal use, which will be in turn provided with a breathing apparatus appropriate to the contingent situation, however it has a drawback in that it does not enable a simple and independent setting of the opening pressures of the exhaust valve under the two use conditions.

In fact, the two pressure values have to depend on the elastic features of one and the same spring and are greatly affected by the degree of compression of the spring itself. As a result there is also an important critical state in the amount of movement of the pin produced by the connecting member of the source under pressure, since the valve opening pressure depends thereon.

It is a general object of the present invention to eliminate the above drawbacks by providing a mask capable of operation both with a device delivering air under pressure and with a device provided with a filter or under partial vacuum, and equipped with an air outlet valve adapted to be readily and safely set, in order to enable a very sure and efficient use of same without the risk that accidental air escapes or difficulties in opening may occur.

In view of the above object, in accordance with the invention, a mask for breathing apparatus has been devised which is of the type comprising at least one air admitting duct connected to the inside of the mask through a one-way inlet valve and at least one air emitting duct for discharge to the external environment, connected to the inside of the mask through at least one one-way expiration valve, said expiration valve having an opening pressure selected between a first and a second predetermined values by means of a pre-arrangement control member, characterized in that the expiration valve comprises an airtight diaphragm elastically pushed to close an expiration passageway by means of two springs in series with each other, the first spring having an elastic coefficient greater than the second spring, the control member being movable between a position of non-interference and a position of interference with the elastic movement of the second spring under the action of a pressure acting on the diaphragm.

For better explaining the innovatory principles of the present invention and the advantages it offers over the known art, a possible embodiment

of the invention putting into practice said innovatory principles will be given hereinafter by way of non-limiting example with the aid of the accompanying drawings, in which:

- Fig. 1 is a diagrammatic partial view seen in front elevation of a mask according to the invention;
- Fig. 2 is a sectional view according to line II-II in Fig. 1, to which an air feeding device for admitting air at a greater pressure than the atmospheric one is applied;
- Fig. 3 is a view similar to Fig. 2, to which a filter or an air feeding device for admitting air at a lower pressure than the atmospheric one is applied.

Referring to the drawings, a mask denoted by 10 is shown in Fig. 1 and it comprises a union 11 to admit air to the inside of the mask through a one-way inlet valve 12 and a duct 13 for ejecting the expired air through a one-way outlet valve 14 and a perforated surface 15.

As clearly shown in Figs. 2 and 3, the expiration valve 14 consists to advantage of a support (or slide) 22 to which pins 17 slidable in corresponding supports are slidably linked.

Each pin supports a diaphragm 16 pushed against sealing edges 18 by means of a respective spring 19 acting between a resting disc 20 belonging to the support 22 and the diaphragm 16. Pin 17 provides a restraint to the spring 19 expansion by means of a stop 21.

Slide 22, movable within the ejection duct 13 in a direction normal to the diaphragm 16 surface, is formed with a rest 23 for a control sensor means in the form of a pin 24.

The control pin 24 is slidably received within a hole 26 communicating with the mask's surrounding environment, advantageously close to the external flange of the air admitting duct 11.

A compressed spring 25 (of an elastic coefficient much weaker than springs 19 interposed between the valve diaphragms 16 and the support 22) pushes the pin 24 against the movable support 22.

As diagrammatically shown in Figs. 2 and 3, known (and therefore not described or shown in detail) breathing apparatus can be applied to the mask 10, which apparatus are provided either with a source of air under pressure 27 or with a filter or a vacuum air source 29.

Source 27 has a connecting element for airtight connection to union 11, which element is provided with an appropriate projection or surface 28 for engagement with pin 24. Since said pin senses the presence of the connecting element, it is prevented from freely moving against the action of spring 25, being pushed towards the inside.

On the contrary, source 29 is provided with a connecting element which is free of engagement projections, so that the control pin 24 can freely slide within the hole 26 against the action of spring 25.

In this manner, as shown in Fig. 3, when a normal filter or a device with a vacuum air source is applied, the spring 19 can push the slide 22 against the stop 21 and thus the whole valve assembly is elastically supported by spring 25 which has a much weaker elastic coefficient than spring 19, by "much weaker" meaning that the assembly formed of spring 19, slide 22 and diaphragm 16 has a behaviour similar to that of a rigid body as compared to yielding of spring 24.

Spring 25 is selected in such a manner that the small pressure caused by the user's expiration is sufficient to cause opening of valve 14. In other words, since the assembly formed of diaphragm 16, pin 17, spring 19 and disc 20 behaves like a unitary rigid body, due to the relative hardness of spring 19 and the presence of stop 21, opening of valve 14 takes place by axial sliding of pin 17, together with the above assembly, towards the air ejecting duct 13, against the action of spring 25.

As shown in Fig. 2, application of a device 27 with a source of air under pressure, on the contrary, causes the control pin 24 to move backward towards the inside.

The displacement of pin 24 causes the slide 20 to move apart from the stop 21 of pin 17. In this way, spring 19 can work in compression between the slide 20 and the diaphragm 16, the control pin 24 being locked against the projection 28 of the breathing apparatus. Therefore spring 25 is excluded from any action and opening of the expiration valve 14 is only counteracted by spring 19 alone. Thus the elastic coefficient of the spring 19 can be selected such that the valve 14 opens at a pressure level given by the sum of the overpressure within the mask and the pressure of the air expired by the mask wearer.

It is therefore apparent that the intended purpose has been achieved in that a mask has been made which has an expiration valve capable of adaptation to the type of apparatus used for air admission, in which the opening pressure levels are set independently in the two cases.

In addition, the degree of sliding imposed on the pin 24 by the projection 28 is irrelevant to the ends of the opening pressure of valve 14 once the operating projection 28 acts on the pin 24 to an extent sufficient to move the slide 22 away from the limit stop 21.

With the apparatus of the invention, each user can be provided with a single mask to he indifferently used, depending on requirements, either with a device for supplying air under pressure or with a filter or a vacuum air supply device, in both cases adjustments of the working pressures being in-

dependent of each other and being of easy and accurate setting since each of them depends on a respective spring having an independent preload value.

Obviously, the above description of one embodiment applying the innovatory principles of the invention is given for purposes of illustration only and therefore must not be considered as a limitation of the scope of the invention as herein claimed.

For example, the number of the valves and the air admitting and ejecting ducts, as well as the shapes and arrangements of same can be different from those described and shown in the drawings.

The connecting element 27 carrying the projection 28 can also be a mere union adapter between a standard inlet for sources of air under pressure and union 11.

Claims

1. A mask for breathing apparatus, of the type comprising at least one air admitting duct (11) connected to the inside of the mask through a one-way inlet valve (12) and at least one air emitting duct (13) for discharge to the external environment, connected to the inside of the mask through at least one one-way expiration valve (14), said expiration valve (14) having an opening pressure selected between a first and a second predetermined values by means of a prearrangement control member (24), characterized in that the expiration valve (14) comprises an airtight diaphragm (16) elastically pushed to close an expiration passageway (13) by means of two springs (19, 25) in series with each other, the first spring (19) having an elastic coefficient greater than the second spring (25), the control member (24) being movable between a position of non-interference and a position of interference with the elastic movement of the second spring (25) under the action of a pressure acting on the diaphragm (16).

2. A mask according to claim 1, characterized in that the control member (24) comprises an operating end to be engaged by a corresponding surface (28) of an air admitting element (27) connected to the admitting duct (11) to shift the control member (24) between said interference and non-interference positions.

3. A mask according to claim 1, characterized in that the second spring (25) reacts against a movable slide (22) carrying the first spring (19) which exerts a thrust action against the diaphragm (16), means for restraining expansion of the first spring (19) being provided between the slide and the diaphragm.

4. A mask according to claim 3, characterized in that the means for restraining expansion of the first spring (19) consists of a stop (21) located on a pin (17) on which said slide (22) slides.

5. A mask according to claims 2 and 4, characterized in that the slide (22) movement towards said stop (21) is limited by the end of the control member (24) opposite to said operating end.

6. A mask according to claim 1, characterized in that the control member (24) is formed of a pin axially slidable between an interference position and a non-interference position, said second spring (25) being fitted on said pin (24).

7. A mask according to claim 5, characterized in that, on engagement between the end of the control member (24) and the surface (28), the control member is pushed towards the interference position and moves the slide (22) away from the stop (21).

Fig.1

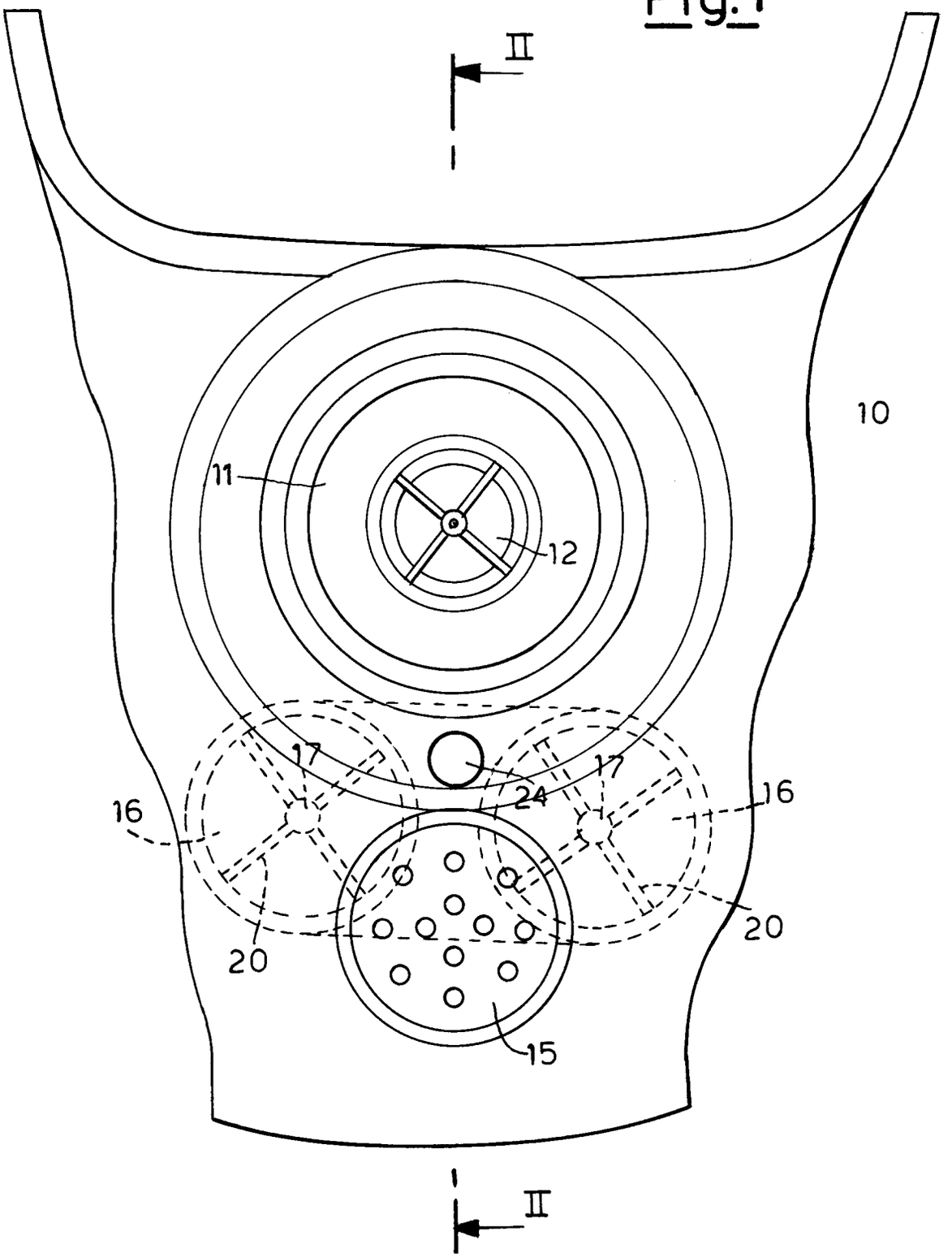


Fig.2

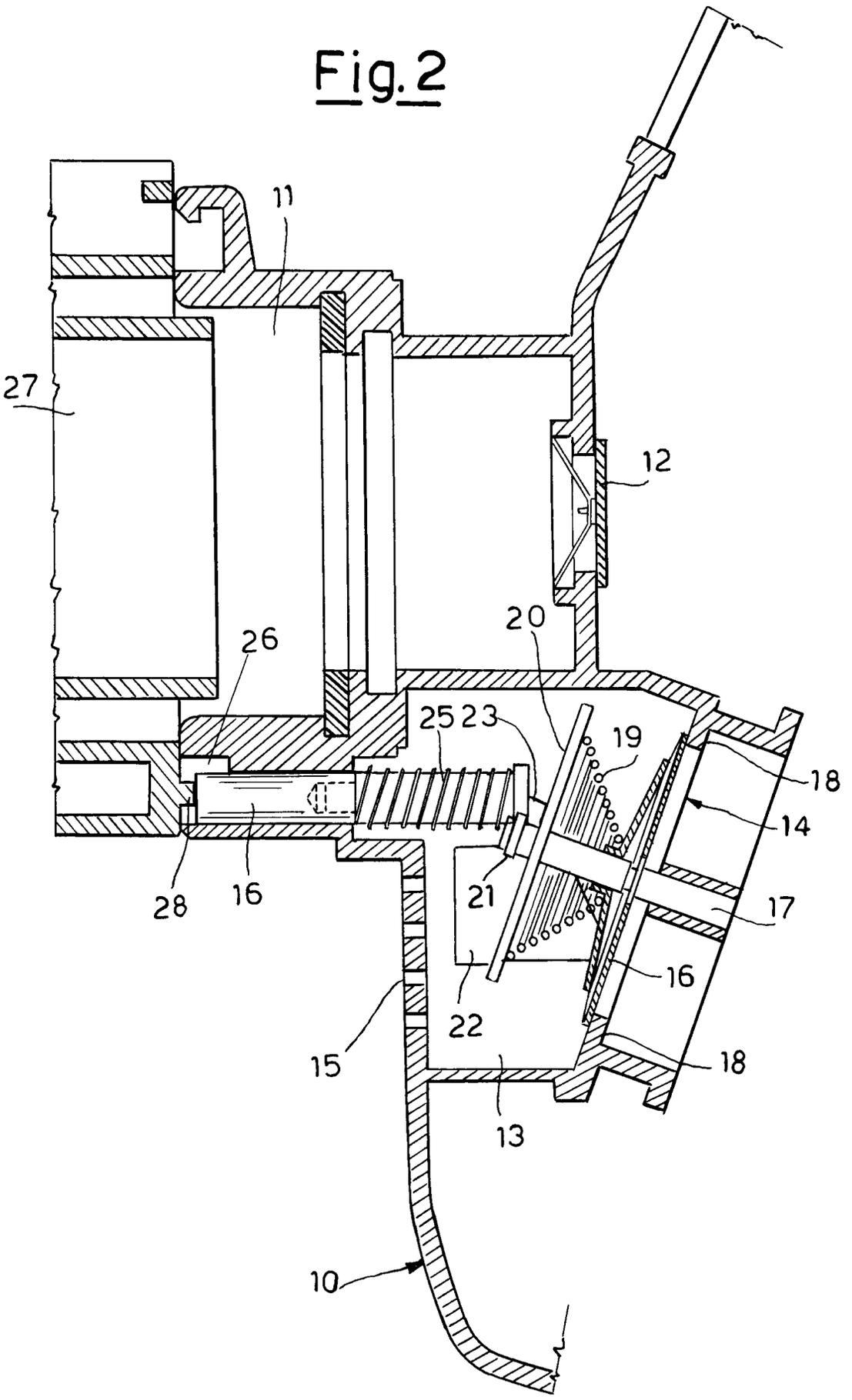
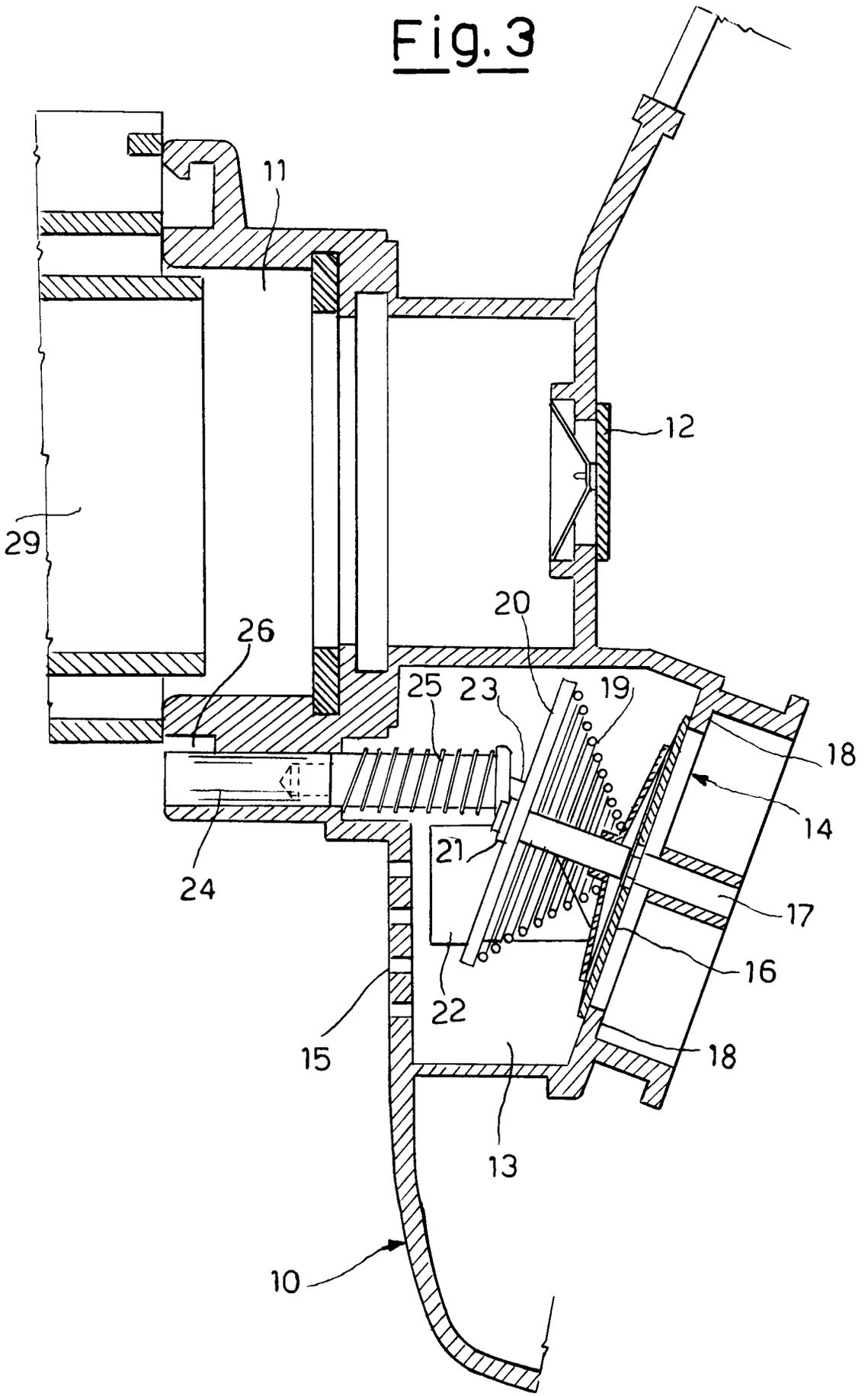


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 0205

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.6)
X	DE-C-736 268 (I.G.FARBENINDUSTRIE AG) 10 June 1943 * page 1, line 1 - page 2, line 60; figures 1-3 *	1-7	A62B18/10
X	GB-A-2 264 646 (SABRE SAFETY LTD) * the whole document *	1,2	
A	GB-A-1 124 703 (COMMISSARIAT A L'ENERGIE ATOMIQUE) 21 August 1968	1	
A	LU-A-59 025 (COMMISSARIAT A L'ENERGIE ATOMIQUE)	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A62B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 May 1995	Triantaphillou, P

CATEGORY OF CITED DOCUMENTS

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