

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 742 370 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

13.11.1996 Bulletin 1996/46(51) Int Cl.⁶: **F04B 37/02**(21) Application number: **96830262.0**(22) Date of filing: **07.05.1996**(84) Designated Contracting States:
DE FR GB NL SE(30) Priority: **11.05.1995 IT MI950954**(71) Applicant: **SAES GETTERS S.P.A.**
I-20151 Milano (IT)

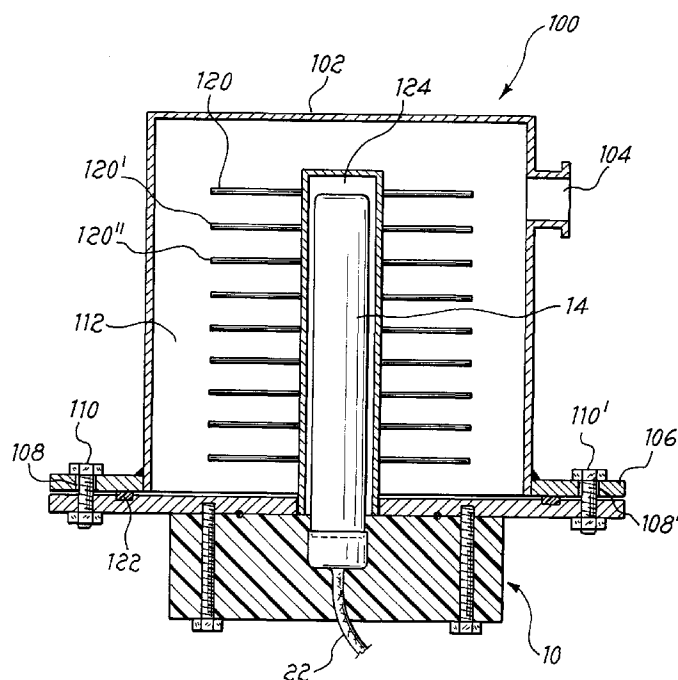
(72) Inventors:

- **Carella, Sergio**
Varese (IT)

• **Belloni, Fortunato****Villastanza di Parabiago, (Milano) (IT)**(74) Representative: **Adorno, Silvano et al**
c/o SOCIETA' ITALIANA BREVETTI S.p.A.
Via Carducci, 8
20123 Milano (IT)**(54) Heating assembly for getter pumps and gas purifiers**

(57) A heating assembly for getter pumps and gas purifiers, wherein a heating element (14) is housed in a sheath (50) formed with a wall portion of the chamber (112) of the pump comprising the heating element (14) mounted on a first flange (10); a second flange (40) on which the wall portion of the pump chamber is mounted which provides the sheath (50) for housing the heating

element (14), with at least one gasket (30) being inserted for the gas-tight sealing between the first and the second flange (10; 40) coupled to each other. The heating element (14) is placed in a chamber (124) defined by the two flanges (10; 40) and gasket (30), in an air-tight condition with respect to the environment. Preferably the first flange (10) is made of a thermosetting plastic material.

Fig. 2

Description

The present invention deals with a heating assembly for devices operating under vacuum or in gases different from air, such as the gas purifiers or the getter pumps which for the sake of simplicity will be referred to in the following description.

The getter pumps are well known in the vacuum technology since about thirty years and are much appreciated due to the fact of not having moving mechanical parts. Thanks to this feature they do not need for their operation the use of lubricants which could contaminate the chamber to be evacuated; furthermore these pumps do not transmit vibrations, often undesired, to the system connected thereto.

Their operation is based on the chemisorption of all gases, except for noble gases, by non-evaporable getter materials (known in the field as NEG materials). The main NEG materials are zirconium or titanium-based alloys in combination with elements such as aluminum, vanadium, iron, nickel or other transition elements or their combinations. Of particular importance in the art are: the alloy of composition Zr 84% - Al 16% by weight, manufactured and sold by the applicant under the name St101^R, and the alloy of composition Zr 70% - V 24.6% - Fe 5.4% by weight, manufactured and sold by the applicant under the name St 707.

The active elements of these pumps (in the following defined as getter elements) can be produced by making the NEG material in powder form to adhere, generally by rolling, onto a suitable metallic support; pumps of this type are described for example in the U.S. patent 4,137,012 assigned to the applicant and in the published patent application JP-A-04/45480, in the name of the company Japan Steel Works. More recently there have been proposed getter pumps in which the getter elements are formed of bodies obtained by sintering powders of NEG materials, as described e.g. in the U.S. patents 5,320,496 and 5,324,172 both assigned to the applicant.

However in both cases, to ensure the best operation of the getter material it is necessary that, during the pump operation, it is kept at temperatures of at least 400°C. Furthermore the NEG material requires an initial "activation" treatment at temperatures of up to 900°C during a time of 10-30 minutes.

As a consequence an essential element of these getter pumps is a heating element integrated in the pump itself. Furthermore, as the heating element can have a life shorter than that of the pump as a whole, this element must be interchangeable, possibly in a simply manner.

Although the heating element may be of various types, particularly advantageous is the use of IR lamps or of metallic resistances embedded in the pump body.

The size and the location of the heating element are critical parameters for the pump operation, especially in pumps of small size. In fact, to allow a pump structure

which is as much as possible sealed and to avoid the pump opening each time the heating element is to be replaced, this can be placed at the outside of the chamber containing the getter elements rather than at the inside thereof. On the other hand it is necessary to bring to the maximum the thermal contact between the heating element and the getter elements. This is generally achieved by forming a wall of the chamber containing the getter elements by means of a portion of wall defining a protruding zone within the chamber itself while forming a recess to the outside. This recess provides the sheath in which the heating element is housed.

The getter elements within the chamber can be placed in the most different ways, such as by simply filling the chamber of sintered pellets obtained from powders. However the getter elements are generally fixed to a support and in a preferred embodiment the support is provided by the inner wall portion itself which is extending into the chamber and houses the heating elements in the recess formed by the wall to the outside; such an arrangement is described e.g. in the mentioned patent application JP-A-04/45480. However the heating element is there integral with the support of the getter elements and its replacement requires much work. Furthermore the sheath in which the heating element is housed is in contact with the environment. In case of a breakage in the support, the getter elements in the chamber are exposed to the air at the operation temperature; the consequence is a turbulent reaction with atmospheric gases, mainly with oxygen, which results in the pump destruction. A breakage of the sheath wall may occur for various reasons, such as by melting or mechanical weakening due to an excessive heating, phenomena connected to an oversizing of the heater; or also the sheath wall may break due to the increasing oxidation caused by the presence of air at high temperature at its inside.

It is an object of the present invention to overcome the drawbacks of the heating assemblies according to the prior art.

In particular, object of the present invention is that of providing a heating assembly to be introduced in the body of a getter pump so that the heating element can be easily replaced and furthermore can be reduced to a minimum both the problem due to the wall oxidation of the sheath that houses the heating element itself, and the possible consequences of a breakage or melting of the wall of such a sheath.

According to the present invention these and additional objects are obtained with the heating assembly for a getter pump in which:

- the heating element is mounted on a first flange;
- the wall portion of the pump chamber which forms the sheath for housing the heating element is mounted on a second flange;
- between the first and second flange, coupled to each other, there are inserted one or more gas-tight

gaskets;

the heating element thereby being placed, in operation, in a chamber defined by the two flanges and the gaskets and hermetically isolated by any contact with the environment.

The first flange is made of a material which must show a good mechanical resistance, resistance to the operation temperature of the heater as well as a good thermal insulation. Although for this purpose it is possible to use a metal, for example steel, showing sufficient qualities of thermal insulation, it is preferred the use of plastic materials, as they are lighter and less expensive. Furthermore the plastic materials allow to use, for coupling the flange to the heating element, a process that is particularly simple and affords advantages of hermetic sealing of the sheath housing the heater, as described in the following. The thermo-resistant plastic materials which is possible to use can be of various types, among which for example phenolic, epoxy, acrylic, polyamidic resins, etc.

This flange is provided with means for its fastening to the second flange. Additionally, this flange may show one or more seats for the correct positioning of the sealing gaskets.

The heating element integrally fixed to the first flange may be of different types: for example it may be a heating quartz lamp. Preferably, however, electrical resistance heaters are used, which are well known in the art, being formed of a metallic resistance embedded in a ceramic material within a metallic housing. Heating elements of this type are manufactured e.g. by the company Watlow of St. Louis, Missouri, USA.

The heating element can be fastened to the flange in general with a thermo-resistant adhesive or by welding when flange and housing of the heating element are made of a metallic material.

In a preferred embodiment, however, the flange is obtained locally, with a thermosetting plastic material, thus providing at the same time the assembly of the flange itself to the heating element. This is obtained with a process in which the heating element is placed coaxially in a mould having essentially the complementary shape of the final flange and by pouring into the mould the thermosetting plastic material in liquid form. The hardened plastic material can be then worked to obtain the finished flange with a seat for the fastening means to the second flange (generally screws), the possible seat of the gaskets or other finishing workings. Among the thermosetting plastic materials it is preferred to use epoxy and acrylic resins.

The second flange is always made of metal as one of its surfaces provides a wall of the pump chamber. The preferred material for making the second flange is AISI 316 steel. This second flange is welded to the sheath wherein the heating element is housed; also the sheath itself can have the function of supporting the getter elements, as previously described. Preferably the size of

the sheath is such to leave a minimum air volume between the inner wall and the heating element.

The sealing gaskets may be made of metal if the two flanges are both metallic; in this case the metal of the gaskets will be of less hardness than that of the two flanges, for example there may be gaskets of copper, aluminum, nickel or other sufficiently soft metals with flanges of steel. In the preferred embodiment, wherein the first flange is made of plastic material, the gaskets will be in turn made of plastic material such as Teflon or Viton; alternatively, should the temperature of the flange not exceed 150°C it is also possible to use gaskets of indium.

With the assembly of the present invention the possibility of air entering pump into the pump chamber in case of sheath breakage is nearly completely prevented. The two main access passages of air to the sheath are the zone of contact between the two flanges, which is hermetically sealed by the gaskets; and the zone of connection between the first flange and the heating element, which is also hermetically sealed, in particular by means of the above described process in which the flange is "formed" about the heating element itself. The last possible way of air entering the sheath is through the wires for feeding electric power to the heater, which generally are not air-tight: the gas conductance through this way is however extremely low and also to have air entering the pump chamber through this way is necessary that both the sheath and the heater housing break at the same time.

A preferred embodiment of the invention is described in the following, making reference, by way of non-limiting example, to a getter pump, while taking into account that the same considerations could apply in other similar applications such as a gas purificator. With reference to the drawings:

Figure 1 shows in a sectional view separately the first and the second flange, the first of which bears the heating element and the second is fixed to the pump chamber, as well as a sealing gasket; and Figure 2 shows a sectional view of a possible getter pump assembled according to the invention.

The first flange 10 has a seat 12 in which the heating element 14 is inserted in an air-tight manner. As previously described, in the preferred embodiment of the invention the seat 12 is obtained locally in the same process of forming the flange 10. This flange has also through holes 16, 16' in case that screws are used as fastening means between flange 10 and the second flange. On the surface 18 of contact between the two flanges a seat 20 is formed for gasket 30. In the drawing also the wires for the electrical supply of the heating element 14 are shown.

The second flange 40 is integral with support 42 of the getter elements; this structure is preferably obtained by welding together the two portions to the support base

in the region 44. The getter elements (not shown) are fixed to the outer surface 46 of the support, while the inner surface 48 defines a sheath 50 for housing the heating element 14. On the surface 52 of flange 40, opposite to the surface 18 of flange 10, there are formed the seats 54, 54' in case that screws are used as fastening means between the two flanges (as shown in figure 2) in association with the seats 16, 16' on the flange 10. On the same surface 52 also the seat 56 for gas-tight gasket 30 is formed. The seats 20 and 56 for the gasket 30 are here shown on both the surfaces 18, 52 but in alternative they can be on one surface only or even on none of said surfaces; in particular the gaskets in Teflon with rectangular cross-section, having the two main faces flat, do not require generally the formation of seats. The surface 62 of flange 40 and the surface 46 of the support 42, together with the inner walls of the housing 102 shown in figure 2, provide the walls of the chamber containing the getter elements. Therefore the flange 40 must be hermetically connected also to said housing 102. As a consequence, on the flange 40 also the seats 60, 60' are formed for the fastening means (generally screws, shown in figure 2) and, on the surface 62 of flange 40 the seat 64 for high-vacuum sealing gasket 122 (shown in Figure 2). As it is well known in the art, these high-vacuum gaskets are made of metal, generally electrolytic copper.

Figure 2 schematically shows in cross-section a possible getter pump with heating element assembled according to the invention.

The pump 100 comprises a housing 102 with an opening 104 for the connection with the chamber to be evacuated. At its open portion, a flange 106 is fixed to the housing 102, generally by welding, with seats 108, 108' corresponding to the seats 60, 60' on the flange 40 for the fastening means 110, 110'. The volume 112 defined by the inner walls of housing 102, the surface 62 of flange 40 and surface 46 of support 42 is the operating chamber of the pump, containing the getter elements 120, 120', 120'',...; this chamber is hermetically sealed by means of the gasket 122. The getter elements are kept at the operation temperature by the heating element 14 protruding into the chamber 124 that corresponds to said sheath 50 at the inside of support 42.

Although figure 2 represents a particular type of pump, in which the getter elements are connected to the support 42, particularly in form of disks perpendicular to the support, it is possible that the getter elements are made as blades fixed to the support parallel thereto and extending radially into the chamber or even simply introduced into the chamber in a non-supported form, e. g. as sintered pellets.

Finally, although the heating assembly has been described in particular for an application to the getter pumps, the same assembly can be advantageously adopted also in other devices showing the same technical problems, in particular the risks of destruction of the device in case that the heater housing breaks. An-

other type of devices in which the heating system of the invention can be applied are for example the gas purifiers based on the use of getter materials, which show a construction and operative principles quite similar to those illustrated herewith for the getter pumps.

Claims

1. Heating assembly for getter pumps and gas purifiers in which a heating element (14) is housed within a sheath (50) formed of a wall portion of the chamber (112) of the pump, characterized in that:
 - the heating element (14) is mounted on a first flange (10);
 - the wall portion of the pump chamber that forms the sheath (50) for housing the heating element (14) is mounted on a second flange (40);
 - between the first (10) and the second flange (40) coupled to each other there are inserted one or more gas-tight gaskets (30); the heating element (14) being therefore placed, in operation, in a chamber (124) defined by the two flanges (10; 40) and the gaskets (30), hermetically isolated by any contact with the environment.
2. Heating assembly according to claim 1, wherein the first flange (10) is made of plastic material.
3. Heating assembly according to claim 2, wherein the plastic material is chosen among the phenolic, epoxy, acrylic and polyamidic resins.
4. Heating assembly according to claim 1, wherein the first flange (10) is obtained by a thermosetting plastic material in a process in which:
 - the heating element (14) is placed co-axially, at the inside of a mould having essentially the complementary shape of the final flange (10);
 - the thermosetting plastic material is poured in liquid form into the mould;
 - the hardened plastic material is extracted from the mould together with the heating element (14);
 - the plastic portion of the assembly between flange and heating element is worked to provide seats (16, 16') for the fastening means to the second flange (40), seats for the gaskets (20) and for finishing.
5. Heating assembly according to claim 4, wherein the thermosetting plastic material is chosen between the epoxy and phenolic resins.
6. Heating assembly according to claim 1, wherein the

heating element (14) is formed as an electric resistance embedded in a ceramic within a metallic housing.

7. Heating assembly according to claim 1, wherein the second flange (40) and sheath (50) for housing the heating element are made of AISI 316 steel. 5
8. Heating assembly according to claim 4, wherein said second flange (40) shows seats (54, 54') corresponding to said seats (16, 16') of said first flange (10) for the fastening means. 10
9. Heating assembly according to claim 1, wherein said second flange (40) shows seats (64) for high-vacuum sealing gaskets (122) between said second flange and an outer flange (106) of the housing (102) of said getter pump, as well as seats (60, 60') corresponding to seats (108, 108') of the flange (106) for fastening means (110, 110') between said flanges (40, 106). 15 20

25

30

35

40

45

50

55

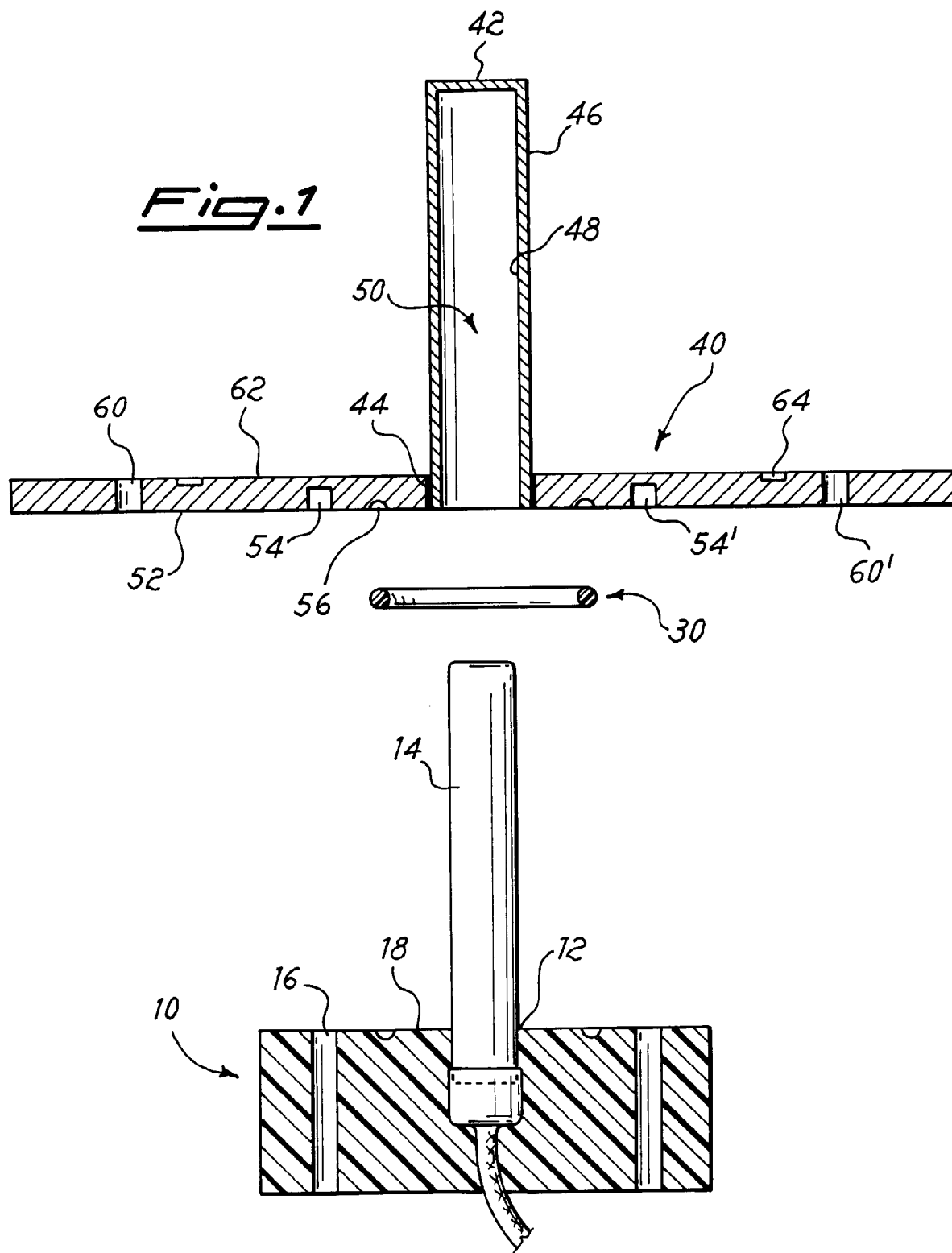
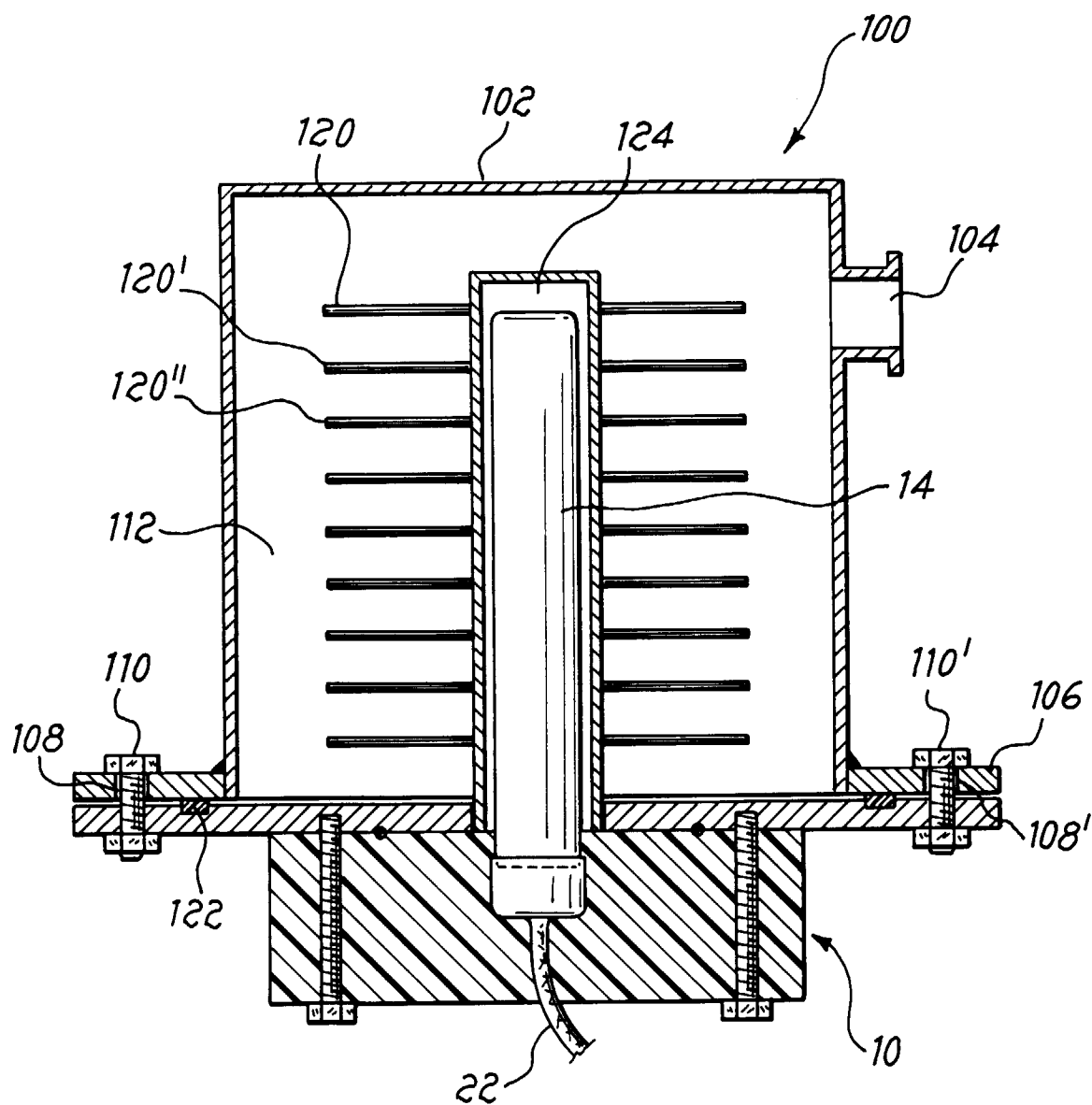


Fig. 2





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0262

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)
A	FR 2 363 714 A (BALZERS PATENT BETEILIG AG) 31 March 1978 * page 4, line 26 - line 40; figure 5 *	1	F04B37/02
A	US 5 154 582 A (DANIELSON PHILIP) 13 October 1992 * column 4, line 13 - column 6, line 49; figures 3,5 *	1	
D,A	US 5 320 496 A (MANINI PAOLO ET AL) 14 June 1994 * the whole document *	1	
D,A	US 4 137 012 A (DELLA PORTA PAOLO ET AL) 30 January 1979 * the whole document *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F04B H01J
Place of search		Date of completion of the search	Examiner
THE HAGUE		2 September 1996	Von Arx, H
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.92 (P4/C01)