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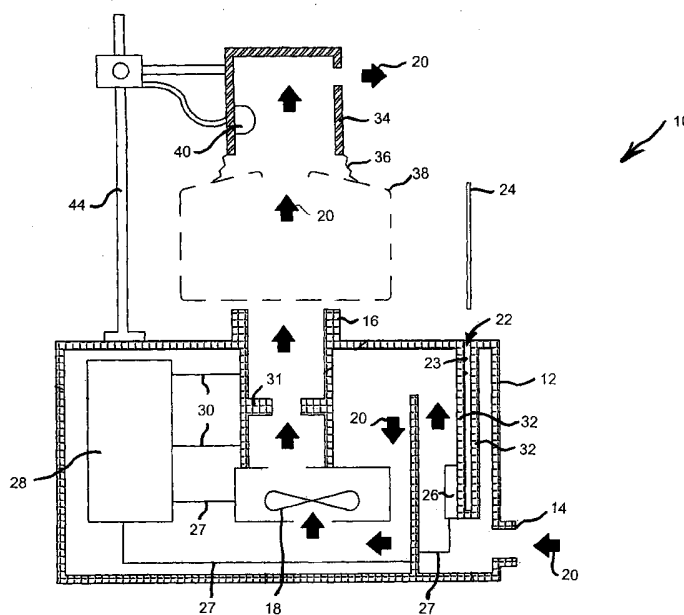
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(54) Title: PORTABLE TEST EQUIPMENT FOR AIR FILTERS



(57) Abstract: Portable test equipment for testing air filters is disclosed. The equipment includes filter receiving means and source receiving means for receiving a source, such as a frangible container containing a challenge substance, preferably isopropyl alcohol. Means for passing a gas flow containing the substance is provided for passing the gas through the filter. Also, challenge substance detection means is provided in the flow down stream of the filter. The challenge substance is preferably contained in one or more microcapsules mounted on a substrate of the container.

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PORTABLE TEST EQUIPMENT FOR AIR FILTERS

The present invention relates to methods for the testing of air filters and to portable equipment for testing air filters, in particular (but not exclusively) for testing filters for
5 personal breathing masks or respirators.

It is a characteristic of the manner of use of such masks and respirators that they are used a number of times before the filter is replaced, generally on a basis of its hours of use. Depending on the degree of contamination of the atmosphere in
10 which the mask or respirator is used this can result in a filter being discarded and replaced whilst still having a significant useful life remaining. More importantly, it can result in a filter which has been subjected to heavy contamination becoming ineffective before it is replaced.

15 It is an object of at least the preferred embodiments of the invention to overcome or ameliorate this problem.

According to a first aspect of the invention there is provided portable test equipment for air filters comprising:

- 20 means for receiving a filter to be tested;
means for receiving a source of a challenge substance;
means for passing a gas flow containing the challenge substance through the filter; and
means for detecting the challenge substance in the flow downstream of the
25 filter.

Preferably, the source is a frangible container.

According to a second aspect of the invention there is provided portable test
30 equipment for air filters comprising:

- means for receiving a filter to be tested;
means for receiving a frangible container containing a challenge substance;

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means for passing a fluid flow containing the challenge substance through the filter; and

means for detecting the challenge substance in the flow downstream of the filter.

5

Advantageously, due to the configuration of the equipment of the present invention, it can be more readily transported for testing of filters in places remote from the manufacturing facility or service centre.

10 Preferably, the frangible container comprises a substrate and the challenge substance is contained in one or more microcapsules mounted on the substrate. Thus the frangible container and substrate may be in the form of a "scratch and sniff", or "scratch and smell" type card. In this embodiment, the "scratch and sniff" card is produced by known printing methods, encapsulating the challenge
15 substance in frangible microcapsules carried by a surface of a card-type substrate.

Preferably, the equipment comprises means for detecting when the container is seated in a predetermined position on the receiving means; a controller for actuating the fluid flow passing means when the container is seated in the predetermined
20 position; and/or means for monitoring flow rate of the fluid.

Preferably, the equipment comprises a housing for housing the source receiving means and the fluid flow passing means. Preferably, the source receiving means comprises a receptacle in a wall of the housing.
25

25

Preferably, the housing comprises an inlet and an outlet configured to allow fluid to flow therethrough such that the fluid mixes with the challenge substance prior to exiting the outlet. Preferably, the inlet comprises a porous wall of the housing, and the source receiving means comprises at least one porous wall.

30

Preferably, the equipment comprises a detector housing for housing the detecting means and the filter receiving means. Preferably, the detector housing comprises

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an inlet and an outlet, and wherein the filter receiving means forms the inlet. Preferably, the filter receiving means comprises a releasable attachment means for releasably attaching the filter to be tested thereto.

5 In a third aspect the invention provides a method of testing an air filter comprising disposing it in portable test equipment and passing through it a gas flow containing a challenge substance and sensing for the presence of the substance downstream of the filter, the challenge substance being presented to the filter from a frangible container inserted in or otherwise connected to the test equipment.

10

The container may be opened upon or immediately before inserting it in the test equipment.

Preferably the challenge substance is entrained in the gas flow from the container.

15

The challenge substance may be stored in the container in non-gaseous form. In this case, the challenge substance as stored is adapted to react with the atmosphere upon contact therewith to form a gaseous form of the challenge substance.

20

According to another aspect of the invention there is provided a card configured and presented for use with portable test equipment for air filters, the card comprising:

a substrate; and

one or more frangible microcapsules carried by the substrate, the one or

25 more microcapsules containing a challenge substance,

wherein the card is adapted to be presented into the portable test equipment to release the challenge substance therein.

30 Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a sectioned side elevation of portable test equipment according to an

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embodiment of the present invention, with a filter to be tested illustrated by a broken line;

Figure 2 is a sectioned side elevation of some components of portable test
5 equipment according to another embodiment of the present invention; and

Figure 3 is a sectioned side elevation of some components of portable test
equipment according to yet another embodiment of the present invention.

10 Referring to Figure 1, portable test equipment 10 according to one embodiment of
the invention is configured for testing air filters for use with protective masks or
personal respirators. Such protective masks typically are designed to fit securely
over a user's mouth or face to filter the ambient air breathed by the user. The
respirators may either be in the form of a hood which covers the wearer's head and
15 is sealed around the neck, or it may be part of an overall protective suit.

The preferred embodiment has been configured for testing "scrubber"-type filters,
such as activated carbon filters, to test either for leak paths or for whether the
carbon is no longer effective at removing undesired pollutants from the air. As will
20 be appreciated, alternative embodiments of the invention may be configured to test
other filter types, such as porous physical-barrier-type filters, or combination filters.

The equipment 10 includes a main housing 12 which comprises an inlet 14 and an
outlet 16 for flow of air through the housing 12. Movement of air through the
25 housing 12 is achieved by means for passing a fluid in the form of a fan 18 which
draws air through the housing 12 in the direction of arrows 20. The housing 12
further comprises source receiving means in the form of a slot 22. The source
received by the slot in the preferred embodiment is a frangible container in the form
of a so-called "scratch and sniff" card 24 printed with microcapsules containing a
30 challenge substance, preferably isopropyl alcohol. The microcapsules on the
surface of the card have are frangible such that isopropyl alcohol vapour is released
when the coating is scratched by a user. Optionally one or more spikes 23 may be

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provided within the slot 22 so as reliably and consistently to scratch the card 24 when it is inserted in the slot.

As will be apparent to the skilled addressee, the challenge substance may be contained in other shaped frangible containers and the challenge substance source receiving means shaped accordingly. For example, the container may be an ampule which is opened prior to being inserted into a source receiving means of complementary shape, or is pierced by being impaled on or scratched by a suitable spike. Alternatively, a measured quantity of the challenge substance may be introduced into the source receiving means, by a suitable dropper or syringe. Also, the challenge substance itself can be any appropriate substance which could test a filter's integrity without damaging the filter itself. Typically, it will be a liquid which vaporises at room temperature, or (if a heating element is provided) at an elevated temperature. Examples of other challenge substances include any other suitable alcohol or acetone.

The main housing 12 also comprises container detecting means in the form of an optical sensor 26 for detecting when the card 24 is seated in a predetermined operating position in the slot 22. The sensor 26 is electrically connected by leads 27 to a controller 28 which actuates the fan 18 when the card 24 is detected by the sensor 26. An airflow sensor 30 is disposed to bridge an orifice plate 31 and connected to the controller 28. The airflow sensor 30 determines the pressure difference across the orifice plate 31 using known methods.

Walls 32 defining the slot 22 are porous such that when air is drawn through the housing 12 by the fan 18, vaporised isopropyl alcohol from the card 24 passes through the walls 32 into the interior of the housing 12 and mixes with the air flowing therethrough in the direction of arrows 20.

Air filter receiving means in the form of a detector housing 34 comprises a releasable attachment means in the form a flexible rubber seal 36 configured for either threaded or snap-locking engagement with an air filter 38. The detector

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housing 34 also comprises a sensor 40, such as a pellistor sensor, for sensing the presence of isopropyl alcohol in the interior of the detector housing 34. A detector housing outlet 42 is provided on the detector housing 14 to allow air drawn into the housing 34 to exit therefrom. A stand 44 mounted on the main housing 12 positions
5 the detector housing 34 and filter 38 over the outlet 16 of the main housing 12.

In use, a user attaches the air filter 38 to be tested to the flexible rubber seal 36 and positions the detector housing 34 such that the air filter 38 is positioned over the outlet 16 of the main housing. The user then takes a disposable card 24, scratches
10 the surface of the card (if no spikes 23 are provided) to release the isopropyl alcohol vapour, and inserts the card 24 into slot 22. Once the card 24 has been positioned in a predetermined configuration in the slot 22, the sensor 40 is activated and the controller 28 notified. The controller 28 then actuates the fan 18. Air is drawn through the housing 12 by the fan, mixing with the isopropyl alcohol from the card
15 24 on the way therethrough such that the isopropyl alcohol exits the housing via outlet 16 and passes through filter 38. If the filter has any deficiencies in filtering isopropyl alcohol from the air, isopropyl alcohol in the filtrate is detectable by sensor 40.

20 Once the airflow reaches a predetermined rate as measured by the airflow sensor 30, the controller 28 actuates the sensor 40 which feeds back detection data to the controller 28. The controller monitors the sensor 40 data over a predetermined time period and determines whether the amount of detected isopropyl alcohol, if any, is above or below a predetermined threshold. The predetermined time period is long
25 enough to give a meaningful result, yet short enough to ensure the filter's effective life is not significantly reduced. If the detected amount is the same as or above a predetermined threshold, an LED (not shown) emits a red colour, whereas if the amount of isopropyl alcohol is below the threshold, an LED emits a green colour. Once the predetermined time period has passed, the controller 28 de-activates the
30 fan 18.

Figures 2 and 3 illustrate alternative embodiments of the invention, where like

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reference numerals denote like parts as described above in relation to the embodiment illustrated in Figure 1. Figures 2 and 3 illustrate embodiments of the main housing 12 of the portable test equipment. In either of the embodiments illustrated in Figures 2 and 3, the detector housing and filter as described above may be positioned above the outlet 16 by a retort stand or held thereabove by the user. Also, in each of these embodiments, rather than using a sensor to sense the presence of card 24 and slot 22, a switch 26' is employed.

With reference to Figure 2, the controller 28 is located outside of main housing 12 in electrical communication with the switch 26', fan 18 and airflow sensor 30. In the embodiment illustrated in Figure 3, the controller 28 is positioned on an exterior wall 48 of the main housing 12 and includes an LED display (not shown) to illustrate to a user the output readings of the sensor 40. In this embodiment, airflow sensor 40 is positioned upstream of the fan 18.

In an alternative arrangement, a heating element is provided in or adjacent the slot to heat the card when inserted therein. In this arrangement, challenge substances which vaporise at a temperature higher than room temperature may be used. Bromobutane is one example of such a challenge substance.

In further alternative embodiments, the airflow sensor is not required but rather the controller detects the rotational speed of the fan 18 to estimate the flow rate of air through the main housing 12. In this alternative embodiment, the controller actuates the sensor 40 once the fan reaches a desired constant rotational speed.

As would be clear to the skilled addressee, the configuration of the invention allows for a more compact and user friendly design for equipment for testing air filters. This design also allows for portability of the test equipment such that it may be transported to various locations where testing of air filters is required. The use of a challenge source carrying card, such as the scratch card described, allows for a uncomplicated reproducible test which need not be performed a skilled technician.

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More sophisticated alternative embodiments may include an LCD display which shows a graph or a numerical reading relating to the amount of detected isopropyl alcohol. In another alternative embodiment, the equipment 10 may be connected to a computer and the output from the sensor 40 communicated directly thereto. In
5 yet another alternative embodiment, the equipment includes an LED status display to display the test status to the user. For example, the status display would display when the card is seated, when the fan has reached operating speed and when the sensor 40 has read vapour levels for the predetermined amount of time.

10 Also, as will be understood by the skilled addressee, embodiments of the invention may be simplified to further increase its simple operation. For example, the sensor 26 or switch 26' need not be included, such that the user would actuate the fan by a manual switch either prior to or after inserting the card 24 into the slot 22.

15 In another alternative arrangement of the invention in use, the equipment is inverted and reconfigured such that the detector housing 34 is below the main housing 12, and the fan 18 blows air downwards through the filter 38.

Although the described embodiment uses fan-driven ambient air to entrain and
20 convey the challenge substrate to the filter, alternatively it is possible to use a dedicated source of pressurised air or some other gas such as nitrogen or an inert aerosol propellant to force such gas across the frangible container and through the filter.

25 While the invention has been described in reference to its preferred embodiments, it is to be understood that the words which have been used are words of description rather than limitation and that changes may be made to the invention without departing from its scope as defined by the appended claims. For example, while the preferred embodiment has been described in relation to filters for protective masks
30 and respirators, those skilled in the art will appreciate that the testing equipment may be adapted for use in testing air filters for other applications.

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The text of the abstract filed herewith is repeated here as part of the specification.

Portable test equipment for testing air filters is disclosed. The equipment includes filter receiving means and source receiving means for receiving a source, such as
5 a frangible container containing a challenge substance, preferably isopropyl alcohol. Means for passing a gas flow containing the substance is provided for passing the gas through the filter. Also, challenge substance detection means is provided in the flow down stream of the filter. The challenge substance is preferably contained in one or more microcapsules mounted on a substrate of the container.

CLAIMS:

1. Portable test equipment for air filters comprising:
means for receiving a filter to be tested;
5 means for receiving a source of a challenge substance;
means for passing a gas flow containing the challenge substance through the
filter; and
means for detecting the challenge substance in the flow downstream of the
filter.
10
2. The equipment of claim 1 wherein the source receiving means is configured
to receive the challenge substance in a frangible container.
3. Portable test equipment for air filters comprising:
15 means for receiving a filter to be tested;
means for receiving a frangible container containing a challenge substance;
means for passing a gas flow containing the challenge substance through the
filter; and
means for detecting the challenge substance in the flow downstream of the
20 filter.
4. The equipment of claim 2 or 3 wherein the frangible container comprises a
substrate and the challenge substance is contained in one or more
microcapsules carried by the substrate.
25
5. The equipment of any of claims 2 to 4 comprising means for detecting when
the container is seated in a predetermined position on the receiving means.
6. The equipment of claim 5 comprising a controller for actuating the fluid flow
30 passing means when the container is seated in the predetermined position.
7. The equipment of any preceding claim comprising means for monitoring flow

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rate of the fluid.

8. The equipment of any preceding claim comprising a housing for housing the source receiving means and the fluid flow passing means.
- 5
9. The equipment of claim 8 wherein the source receiving means comprises a receptacle in a wall of the housing.
10. The equipment of claim 8 or 9 wherein the housing comprises an inlet and an outlet configured to allow fluid to flow therethrough such that the fluid mixes with the challenge substance prior to exiting the outlet.
- 10
11. The equipment of claim 10 wherein the inlet comprises a porous wall of the housing.
- 15
12. The equipment of any of claims 8 to 11 wherein the source receiving means comprises at least one porous wall.
13. The equipment of any preceding claim comprising a detector housing for housing the detecting means and the filter receiving means.
- 20
14. The equipment of claim 13 wherein the detector housing comprises an inlet and an outlet, and wherein the filter receiving means forms the inlet.
- 25
15. The equipment of claim 14 wherein the filter receiving means comprises a releasable attachment means for releasably attaching the filter to be tested thereto.
16. The equipment of any preceding claim wherein the filter is configured for use in a face mask or respirator.
- 30
17. A method of testing an air filter comprising disposing it in portable test

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equipment and passing through it a gas flow containing a challenge substance and sensing for the presence of the substance downstream of the filter, the challenge substance being presented to the filter from a pre-packaged source inserted in or otherwise connected to the test equipment.

5

18. The method of claim 17 wherein the pre-packaged source is a frangible container.

19. The method of claim 17 or 18 comprising opening the source upon or immediately before inserting it in the test equipment.

10

20. The method of any of claims 17 to 19 wherein the challenge substance is entrained in the gas flow from the container.

15 21. The method of any of claims 17 to 20 wherein the challenge substance is stored in the source in non-gaseous form.

22. A card configured and presented for use with portable test equipment for air filters, the card comprising:

20

a substrate; and

one or more frangible microcapsules carried by the substrate, the one or more microcapsules containing a challenge substance,

wherein the card is adapted to be presented into the portable test equipment to release the challenge substance therein.

25

23. The card of claim 22, being a "scratch and sniff"-type card.

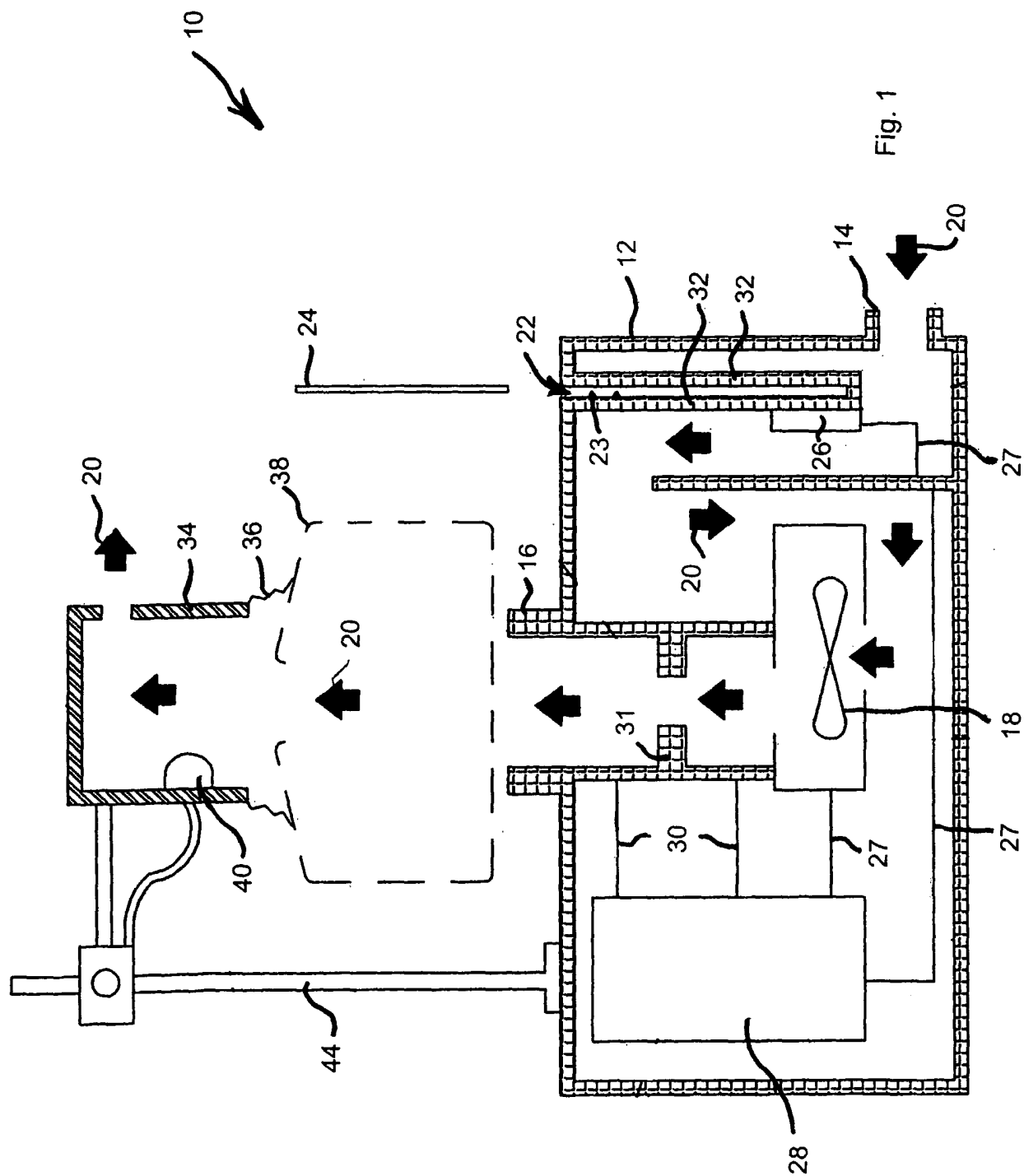


Fig. 1

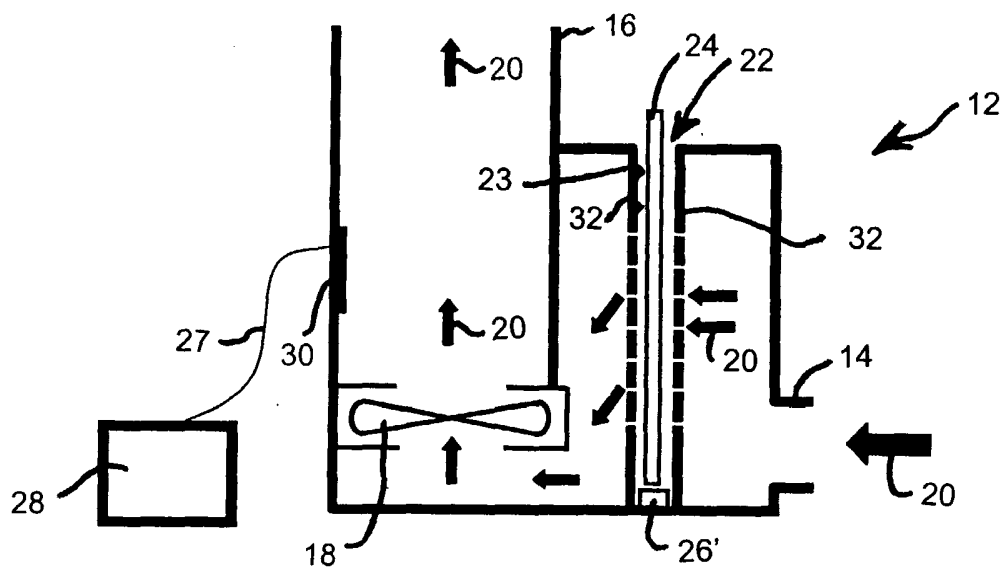


Fig. 2

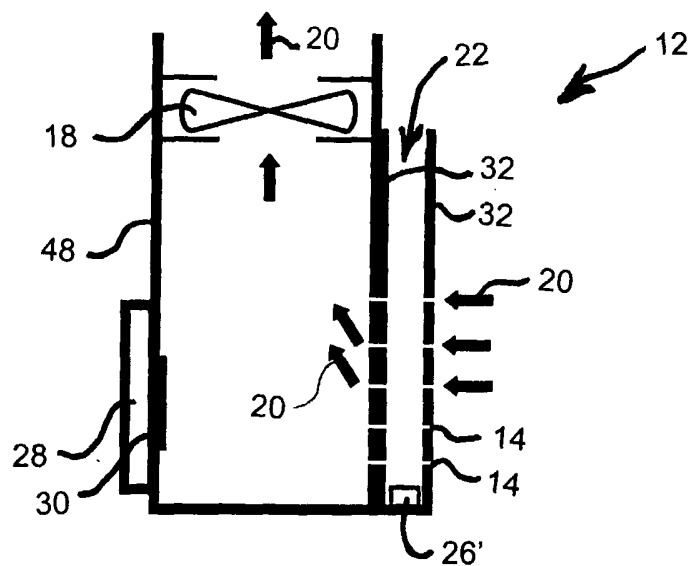


Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB2005/000628

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 G01N15/08 B01D46/00		
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) IPC 7 G01N B01D A61L		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in 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* 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 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	
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Hocquet, A	

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