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(54) Fire protection device and storage space provided with a fire protection device.

(57) Disclosed is a fire protection device (14) which comprises a combination, arranged in series, of at least one flame-arresting element (16) and at least one fire-resisting element (15). The flame-arresting (16) element is intended to prevent flashback of a flame and is preferably made of a metal gauze, a metal grid or a metal foam. The fire-resisting element (15) is preferably designed to automatically block the gas stream through the grid in case of fire, to that end reacts preferably to an increase in temperature, and is preferably made in the form of a honeycomb, Plates, spirals or the like, of a material that foams or swells up in reaction to an increase in temperature and thereby closes off the passages of that element.

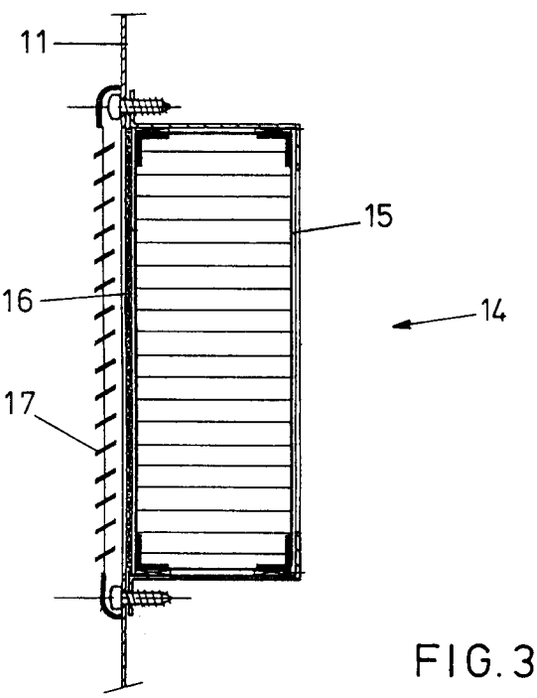

FIG. 3

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The invention relates to a fire protection device which is gas-permeable in a non-activated condition, as well as a storage space for highly inflammable and volatile materials, provided with such a fire protection device.

In the art, there is an increasing need for safe storage of materials that are highly inflammable and/or volatile, and/or materials from which highly inflammable and/or volatile materials can be released. On account of the above-mentioned properties, the handling of these materials must always be done with the necessary care and therefore be left exclusively to experts. In practice, however, it is necessary that a certain stock of the material mentioned be present in certain spaces, even if the materials are not used directly. In that case, to limit the risk of accidents as far as possible, the materials must be stored in a so-called fire-proof chamber or vault. As far as possible, this prevents the materials mentioned from exploding or catching fire when a fire breaks out through whatever cause. Another purpose of such a fire-proof chamber or vault is to prevent the formation of an explosive or inflammable mixture as a result of possible leakage of the materials mentioned from their respective container, for which purpose the chamber or vault mentioned is ventilated to a sufficient degree. This means, however, that the interior of such a chamber or vault is provided with an inflow of outside air, i.e., oxygen. A situation that might occur is the situation where the stored gases release a gas, for instance due to a container being improperly sealed, which gas, mixed with ambient air, is extracted and, through one cause or another, ignited.

Typically, the flame extension rate, or the propagation rate of the flame front, upon ignition of a gas mixture is higher than the flow rate of the relative gas, in particular when that flow rate is only provided by ventilation, with the result that a flame starting outside the chamber or vault can reach the interior of the chamber or vault against the gas flow and ignite or even explode the materials present there.

An important task of the chamber or vault mentioned is therefore to prevent the flame of the gas mixture burning outside the chamber from reaching the materials in the chamber.

In the art, means are already known for preventing such "flashback" of the fire. Such means will hereinafter be referred to as flame-arresting means and are all based on the principle, known with respect to miner's lamps, of a metal wire mesh or grid arranged in the gas stream. A flame front present on the outflow side of such a wire mesh or grid cannot pass the grid; the flame burns on the grid, so to speak.

Although in practice a flame-arresting grid does indeed have the above-mentioned effect, major problems arise in practice when the supply of the inflammable gas mixture is maintained for some time, for instance in the case of a leaking container. In such a case, the flame-arresting grid may lose its flame-arresting activity. The principal reason for this is that the grid is heated as a result of the flame burning continuously against the grid. Owing to the increasing temperature, the grid may melt and thereby lose its function. In some cases it may even happen that, even before the grid melts, the heated grid ignites the gas mixture on the inflow side of the grid. In the case of prolonged fire, therefore, the known fire protection devices do not have any fire-resisting effect.

The object of the invention is to provide a fire protection device that combines good flame-arresting activity with good fire-resisting activity, so that the above-mentioned risk is absent, at least reduced.

To that end, a fire protection device which is gas-permeable in a non-activated condition comprises, according to the invention, the combination, arranged in series, of at least one flame-arresting element, preferably a metal grid, and at least one fire-resisting element, which is preferably designed to automatically block a gas stream therethrough in case of fire.

Although in principle any gas stream shut-off element is suitable for this purpose, a preference is expressed for elements that react to an increase in temperature. One example of such an element is a grid-shaped construction, for instance in the form of a honeycomb, plates, spirals or the like, of a material that foams or swells upon an increase in temperature and thereby closes off the passages of that grid. An example of such a material is known under the name of Palusol, a registered trade mark of BASF. Another example of such a material is known under the name of Fireblock, a registered trade mark of Dufaylite Development. Thus, it is possible to obtain a very compact device with excellent flame-arresting and fire-resisting properties in almost any situation.

Although a combination of a flame-arresting grid and a fire valve that automatically reacts thermally, as described hereinabove, already provides an improvement over known flame-arresting means, in practice problems may still arise here. A first problem may be, for instance, that it is not known beforehand on which side of the flow passage the flame will start. It will be clear that in case a fire starts in the chamber, it is equally desired that the fire be prevented from spreading to the outside.

It may further be desired to increase the quickness of reaction of the fire valve. When the fire valve is located on the side of the flame-arresting grid remote from the flame, the fire valve will not

perform its function until, after a certain amount of time has lapsed, the heat of the flame has also heated the grid on the other side thereof. On the other hand, when the fire valve is located on the flame side of the grid, the reaction of the fire valve can be relatively quick owing to the direct action of the flame, but the chances are that the fire valve will be damaged by the flame itself or even melts.

Preferably, therefore, the device according to the invention consists of at least three layers, with the separate layers alternately having different functions, i.e., a flame-arresting or a fire-resisting function. If a device that is active on two sides is to be provided, for instance because it is not known beforehand on which side a fire may start, it is recommended that the device be provided with at least two flame-arresting layers with at least one fire-resisting layer provided therebetween. The simplest construction that meets this requirement comprises three layers which are, successively, flame-arresting, fire-resisting and flame-arresting.

If the device is to react very quickly to the presence of a flame by shutting off the gas stream at least partly, it is recommended that the device according to the invention be made so as to comprise at least three layers, with, starting from the side where the flame is expected to begin, a first fire-resisting layer, then a flame-arresting layer, and a second fire-resisting layer. In such a construction, the first fire-resisting layer, facing the flame, will react very quickly, but when this layer is affected by the presence of the flame, its task can be taken over by the third layer, i.e., the second fire-resisting layer, which is separated from the flame by the second layer, i.e., the flame-arresting layer.

If so desired, the device according to the invention can contain several alternate layers.

It is also possible to arrange a detector in the device according to the invention, which detector reacts to an increase in temperature to above a predetermined level by shutting off a valve operating mechanically, electrically, electro-mechanically or otherwise, so as to shut off the gas stream completely with 100% certainty.

Hereinafter, the invention will be further clarified through a discussion of preferred embodiments, with reference to the drawings, in which:

Fig. 1 is a section of a workshop including a storage space for chemicals according to the invention;

Fig. 2 is a perspective view of a storage chamber to be arranged as a loose element;

Fig. 3 is a partial section of the door of the chamber shown in Fig. 2, taken on the line III-III;

Fig. 4 is a perspective view of a simple embodiment of a fire protection device according to the invention;

Fig. 5 is a schematic cross-section of a fire protection device according to the invention having flame-arresting activity on two sides; and

Fig. 6 is a schematic cross-section of a fire protection device according to the invention having fire-resisting activity on two sides.

Fig. 1 shows a workshop 1 in which a separate space 2 has been built for storing chemicals (not shown for the sake of clarity). However, the invention also relates to storage spaces which are to be arranged as loose elements, such as a chamber or vault.

The chamber, vault or built-in storage space can be intended for the storage of volatile materials, such as thinner and/or other chemicals. The storage space is ventilated, to which end, in the situation shown in Fig. 1, a fan 4 arranged on the roof 3 of the workshop 1 is connected via a tube 5 with the ceiling 6 of the storage space 2. The storage space 2 is arranged adjacent an outer wall 7 of the workshop 1 and communicates via two tubes 8, 9 with the outside air. When the fan 4 is in operation, fresh air enters the storage space 2 via the tubes 8, 9, as indicated by the arrows P1 and P2, while air to be extracted, which may be mixed with gas originating from the volatile materials mentioned, leaves the storage space 2 via the tube 5.

According to the invention, the storage space 2 is provided with fire protection devices 21, 22 and 23 in the air supply channels 8 and 9 and the air extraction channel 5, respectively.

It is noted that in the situation described the interior of the storage space 2, when the door giving access to it is closed, is not in communication with the interior space of the workshop 1. However, in the case of a storage chamber to be arranged as a separate element, this may well be the case when a separate supply of outside air cannot be realized. Fig. 2 shows a perspective view of such a loose storage chamber 10 with an entrance door 11, with ventilation taking place, not in any forced manner but in a natural manner via two openings 12 and 13 provided in the upper and in the lower part of the door 11, respectively. According to the invention, the storage chamber 10, too, is provided with fire protection devices in the openings 12 and 13, as shown in Fig. 3 in the partial section of the door 11.

The fire protection devices 14 according to the invention utilized in the chamber 10 comprise a fire-resisting element 15 and a flame-arresting element 16, which are arranged in series with regard to the air stream through the relative opening. Further, on the outside of the door 11 an ornamental grid 17 of the Louvre type is arranged, which does not have any fire protection function. For the sake of clarity, the essential parts of the fire protection device 14 according to the invention are shown

in perspective in Fig. 4. The shape of the fire-resisting element 15 and the flame-arresting element 16 can be rectangular or round, adapted to the shape of the openings in the door or the channels. The thickness of the flame-arresting element 16 will generally be a few millimeters; the thickness of the fire-resisting element 15 will generally be a few centimeters.

The flame-arresting element 16 can be made of metal gauze or a metal grid. A material that has been found to be particularly suitable and is to be preferred accordingly, is a metal foam, for instance the metal foam known under the name of Recemat (registered trade mark of SEAC International B.V.).

A preferred embodiment of the fire-resisting element 15, as shown, likewise has a grid-shaped construction, for instance in the form of a honeycomb, plates, sprirals or the like, of a material that foams or swells up in reaction to an increase in temperature, and thereby closes off the passages of the grid. An example of such a material is known under the name of Palusol, a registered trade mark of BASF. A material that has been found to be particularly suitable and is to be preferred accordingly, is known under the name of Fireblock (registered trade mark of Dufaylite Development).

The operation of the fire protection device 14 according to the invention is as follows. When highly inflammable gases that are present or are being released in the chamber 10 leave the chamber through the opening 12 and/or 13, while being mixed or having been mixed with ambient air, in principle a fire hazard arises. When, by whatever cause, the mixture starts to burn outside the chamber 10, the flame front will spread very rapidly in the direction of the openings 12, 13 of the chamber 10. There the flame contacts the flame-arresting element 16 of the fire protection device 14 according to the invention, which, as is known, cannot be passed by the flame. This accordingly prevents the materials and/or gases present in the chamber from being ignited or even exploded.

Under the influence of the increase in temperature caused by the flame, the fire-resisting element 15 is activated so as to close off the gas throughflow opening and thereby deprive the flame of its fuel supply. In the preferred embodiment described, this is achieved in that the material of the fire-resisting element 15 foams or swells up and thereby closes off the passage openings of the grid-shaped structure.

Thus, by using the above-described preferred materials and preferred construction, a very compact fire protection device is provided, having excellent flame-arresting and fire-resisting properties in practically any situation. As appears from Figs 3 and 4, in the application shown there, the fire protection device 14 according to the invention is mounted in the air openings 12 and 13, such that the flame-arresting element 16 faces outwardly and the fire-resisting element 15 is located on the side of the interior of the chamber 10, i.e., on the side of the chemicals. Depending on the use and the desired effect, the fire protection device 14 according to the invention can also be mounted in reversed position, i.e., with the flame-arresting element 16 on the side of the chemicals.

The fire protection devices 21, 22, and 23 for the storage space 2 can have the same construction as the above-described fire protection device 14. An improved operation is obtained, however, with a fire protection device consisting of at least three layers, with the separate layers alternately having different functions, i.e., a flame-arresting or a fire-resisting function. If a device that is active on two sides is to be provided, for instance because it is not known beforehand on which side the fire may start, the outer layers of the thus improved fire protection device are of flame-arresting design, with at least one fire-resisting layer provided therebetween. The simplest construction that meets this requirement is illustrated in Fig. 5. The fire protection device 30 shown schematically there comprises, successively, a first flame-arresting element 31, a first fire-resisting element 32 and a second flame-arresting element 33.

In the case where the element is desired to react very quickly to the presence of a flame by shutting off the gas stream at least partly, the thus improved fire protection device 40 according to the invention comprises at least three layers with, starting from the side where the flame is expected, a first fire-resisting element 41, a flame-arresting element 42, and a second fire-resisting element 43, as schematically shown in Fig. 6. With such a construction, the first fire-resisting element 41 facing the flame will react very quickly to the contact with the flame and very quickly close off the gas passage at least partly. However, when the first fire-resisting element 41 is affected by the presence of the flame, the task thereof is taken over by the third layer, i.e., the second fire-resisting element 43, which is separated from the flame by the second layer, i.e., the flame-arresting element 42, so that the flame cannot reach the second fire-resisting element 43.

If so desired, the fire protection device according to the invention can contain several alternate layers.

It will be clear to those skilled in the art that it is possible to change or modify the embodiment of the device according to the invention shown, without departing from the inventive concept of the invention or the scope of protection. Thus, it is for instance possible to arrange a detector in the device according to the invention, which reacts to an

increase in temperature to above a predetermined level by shutting off a valve operating mechanically, electrically, electro-mechanically or otherwise, so as shut off the gas stream completely with 100% certainty.

Claims

1. A fire protection device which is gas-permeable in a non-activated condition, characterized by the combination, arranged in series, of at least one flame-arresting element and at least one fire-resisting element.

2. A fire protection device according to claim 1, characterized in that the flame-arresting element is made of a metal gauze or metal grid.

3. A fire protection device according to claim 1, characterized in that the flame-arresting element is made of a metal foam.

4. A fire protection device according to at least one of claims 1-3, characterized in that the fire-resisting element is designed to automatically block a gas stream therethrough in case of fire.

5. A fire protection device according to at least one of claims 1-3, characterized in that the fire-resisting element is an element that reacts to an increase in temperature.

6. A fire protection device according to claim 5, characterized in that the fire-resisting element is made in the form of a honeycomb, plates, spirals or the like, of a material that foams or swells up in reaction to an increase in temperature and thereby closes off passages of that element.

7. A fire protection device according to at least one of the preceding claims, characterized in that the fire protection device consists of at least three layers, with the separate layers alternately having different functions, i.e., a flame-arresting or a fire-resisting function.

8. A fire protection device according to claim 7, characterized in that the fire protection device has three layers, which, successively, are flame-arresting, fire-resisting, and flame-arresting.

9. A fire protection device according to claim 7, characterized in that the fire protection device has three layers, which, successively, are fire-resisting, flame-arresting and fire-resisting.

10. A storage space provided with a fire protection device according to any one of claims 1-9.

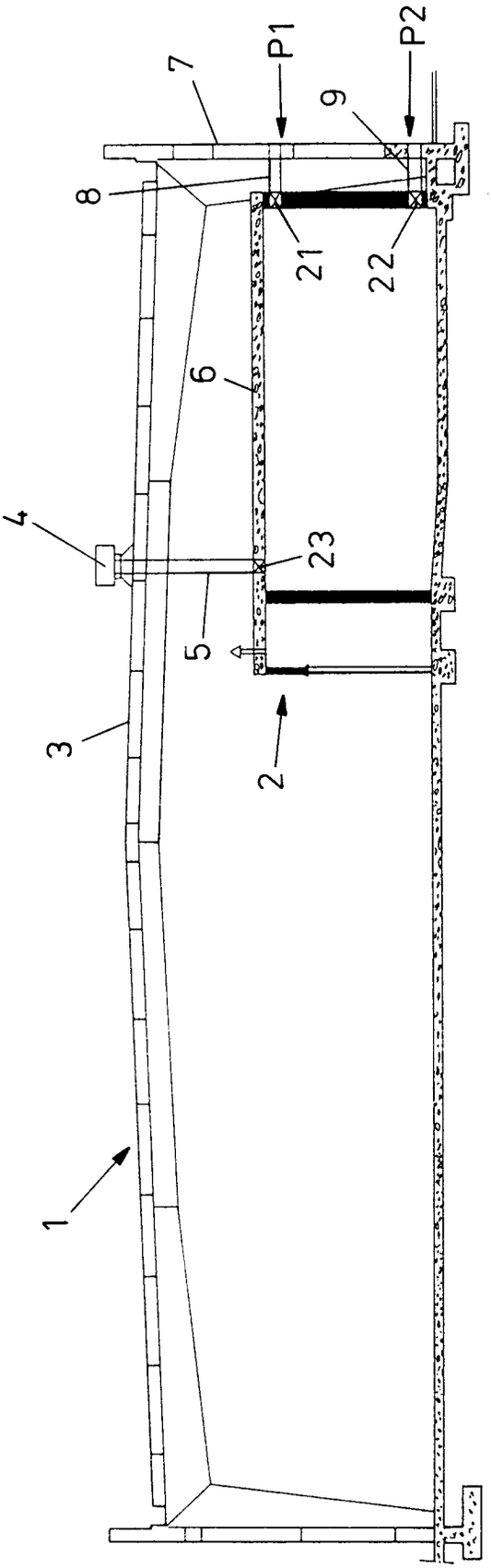

FIG.1

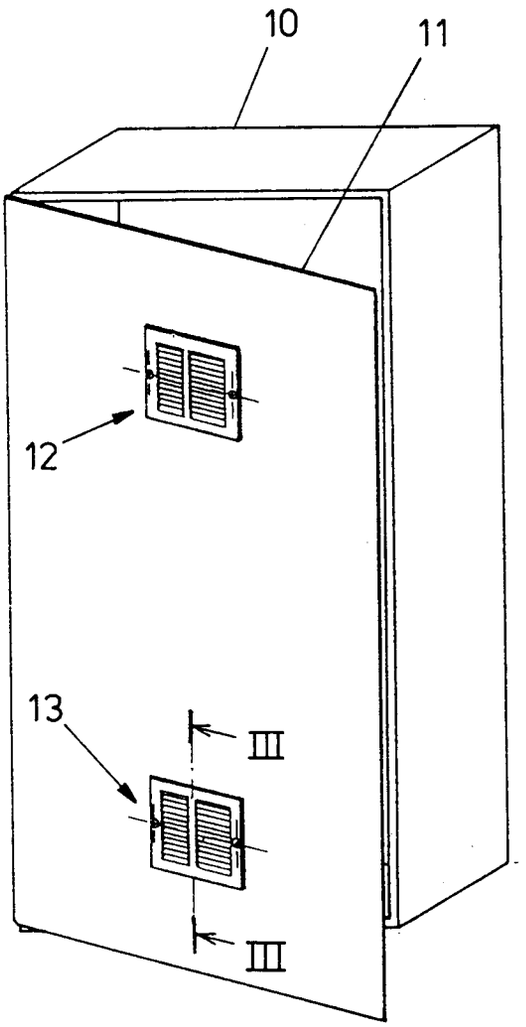

FIG. 2

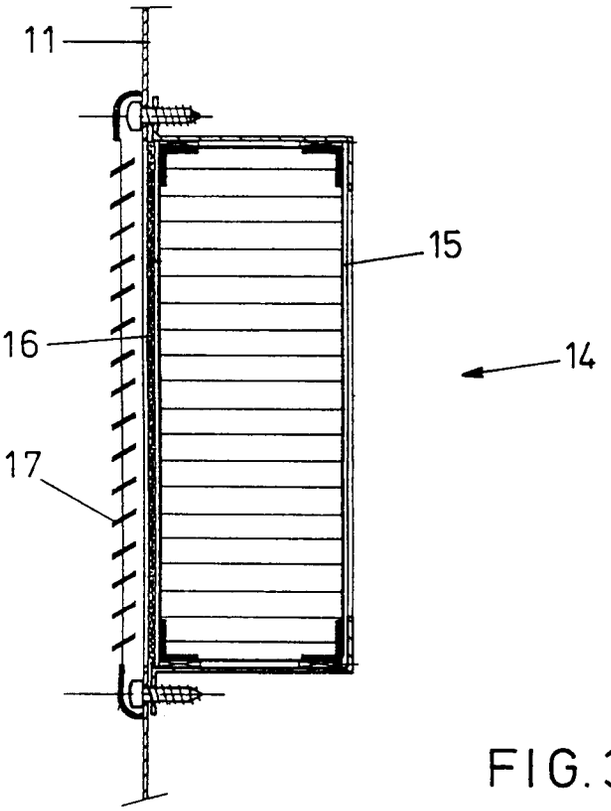

FIG. 3

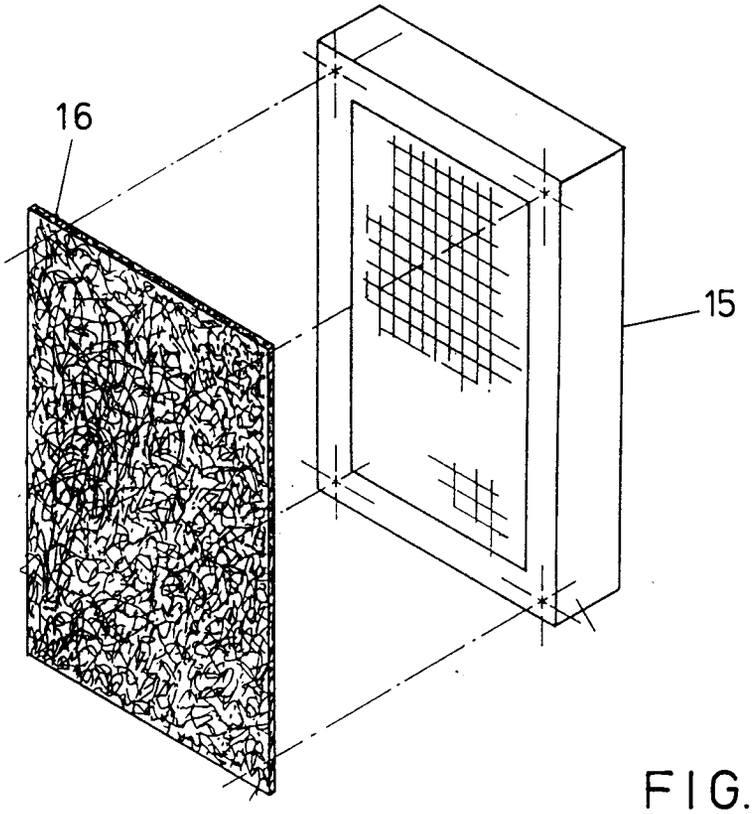

FIG. 4

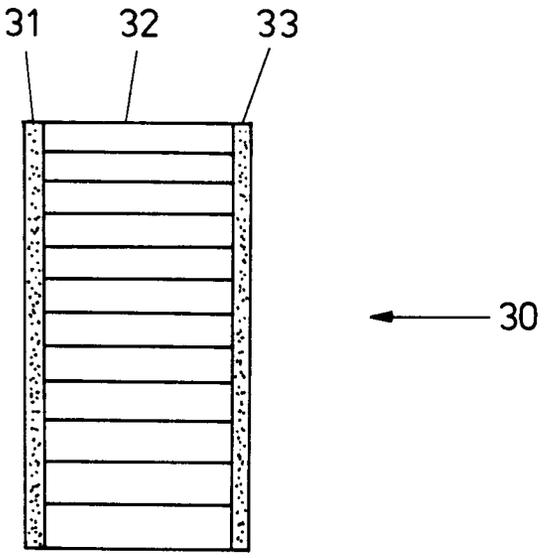

FIG. 5

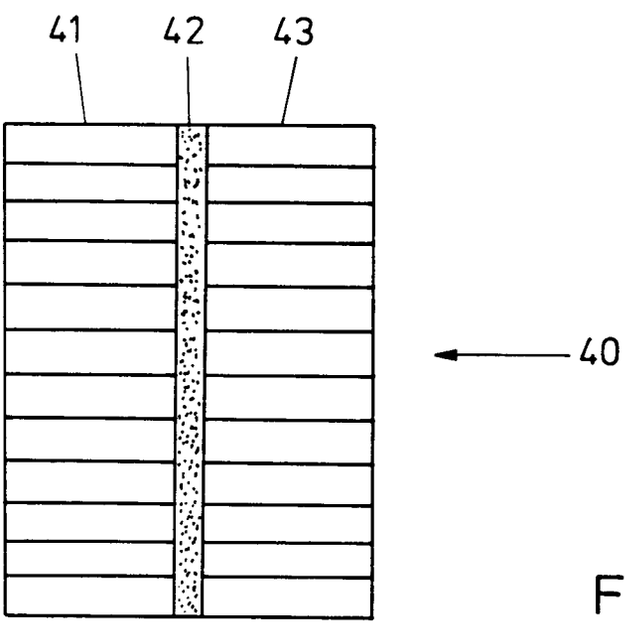

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 20 2921

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.5)
X	EP-A-0 090 635 (DUNLOP LIMITED) * the whole document *	1-3,5,7,8	E04B1/94
Y		6	
A		4	
Y	DE-A-2 605 720 (DUFAYLITE DEVELOPMENTS LTD.) * page 6, line 14 - line 25; figure 1 *	6	
A	CH-A-464 703 (BRITISH AIRCRAFT CORPORATION) * column 2, line 36 - column 3, line 52; figures 1-7 *	1-5	
A	NL-A-7 018 724 (DUNLOP LIMITED) * page 6, line 2 - line 15; figures 1,2 *	1,3	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 OCTOBER 1992	CLASING M.F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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