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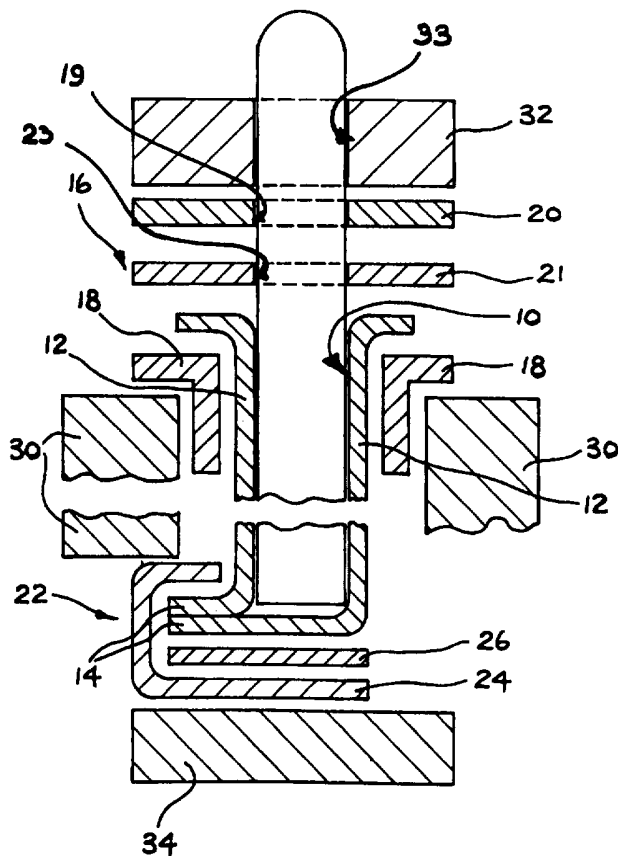
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(54) Title: FILTER UNIT AND PROCESS FOR MANUFACTURING A FILTER UNIT

(57) Abstract

A self-supporting filter unit having at least one passage (10) defined by wall portions (12) made from air-permeable fibre fabric, through which wall portions air can pass and be drawn off along the passage but which prevent the passage therethrough of dust and/or other debris carried by such air, in which the passage is closed off at one end portion and at the other end portion there is formed integral with said wall portions a rigid mounting portion (16) into which the passage (10) opens whereby the filter unit can be supported as part of a filter assembly, wherein the mounting portion (16) comprises a first reinforcing portion (18) of material around and secured with said fabric of the wall portion parts of the first reinforcing portion and fabric integral therewith remote from said one end being outwardly flanged, and wherein the mounting portion (16) further comprises a second reinforcing portion (20, 21) of material positioned over the outwardly flanged portions and secured thereto, said second reinforcing portion having an aperture (19, 23) formed therein corresponding to the open end of the passage (10).



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1 **FILTER UNIT AND PROCESS FOR MANUFACTURING A FILTER UNIT**

 This invention is concerned with a filter unit having
at least one passage but preferably a plurality of passages
5 defined by fluid permeable wall portions through which fluid,
for example air, to be filtered can pass and be drawn off
along the passage or passages but which prevent the passage
therethrough of particulate material and/or other debris
carried by the fluid. Co-pending European Patent
10 Applications numbers EP0515045A1 and EP0549105A1 are both
concerned with such filter units and their manufacture and
in particular self-supporting filters units which are
particularly suitable for filtering of air in dust filters
but may be used for filtering other fluid materials.

15
 In the filter units described in EP0515045A1, the
passage or passages of the filter units are opened at one
end and closed at the other. Mounting means is conveniently
provided adjacent the open end of the passages by an outward
20 flange which is formed integral with the wall portions of
the passages into which flange the open ends of the
passages open. In a preferred filter unit an additional
portion of material may be secured to the flange for
reinforcing it, this reinforcing material being of the same
25 material as the flange and secured to the flange prior to
treatment for rendering the flange rigid. In the
aforementioned two European patent specifications, processes
are described for forming filter units of various fibre
materials and similar processes as described in detail in
30 these two co-pending applications can be used to form filter
units in accordance with the present invention.

 One of the various objects of the present invention is
to provide a filter unit having an improved mounting
35 portion.

1 Another of the various objects of the present invention is to provide an improved process for manufacturing a filter unit with a mounting portion.

5 In one aspect, the invention may be considered to provide a filter unit having at least one passage defined by wall portions of air-permeable fibre fabric, said passage being configured to prevent passage of dust and/or debris in a fluid flow drawn therethrough, said passage being closed
10 at one end and at the other end there being an integral filter mounting portion to enable the filter unit to be incorporated in a filter assembly characterised in that said mounting portion includes a first reinforcing portion arranged and secured about said wall portions of said
15 passage, at least some of said first reinforcing portion and said wall portions secured therewith being arranged to be outwardly flanged to form an outward flange and said mounting portion further includes a second reinforcing portion positioned adjacent said outward flange and secured
20 thereto, said second reinforcing portion having an aperture formed therein to correspond to the open end of the passage.

 In another aspect the invention may be considered to provide a process for manufacture of a filter comprising:-

25

(1) forming at least one passage from fluid permeable fibre fabric;

30

(2) closing off an end part of that passage; and,

35

(3) at an open end of the passage forming a mounting portion by inserting a former member in the passage, positioning a first reinforcing fibre fabric layer around said open portion such that at least part of the

1 first reinforcing fibre layer and the passage
extend beyond the former member, pressing the
first reinforcing fibre layer against said
5 passage extending beyond the former member to
bend said first reinforcing layer and said
passage extending beyond the former member
outwardly, positioning a second reinforcing
layer in alignment and adjacent with the bent
10 outwardly projecting parts of said passage
and said first reinforcing member, pressing
said second reinforcing layer against said
part of said first reinforcing layer and said
passage to form an outwardly flanged portion
and treating said passage and said first and
15 second reinforcing layers to secure them
together and rigidise them to provide a
mounting portion for the filter.

A preferred filter unit in accordance with the
20 invention has a plurality of passages defined by wall
portions made from a rigid corrugated air permeable fibre
fabric, secured along the peaks of the corrugations, the
secured reinforcing portion having an aperture or apertures
therein corresponding with the open ends of the passages.

25 In preferred filter units the first and second
reinforcing portions each comprise non-woven fibre fabrics
but these are not necessarily the same fabrics although they
may be in some instances, and nor are they necessarily the
30 same as the fibre fabric of the wall portions. Indeed, in
most filters, the properties required for the first and
second reinforcing portions are such that the composition of
these fibre fabrics should preferably be different from that
of the wall portions.

35

1 Conveniently the second reinforcing portion comprises a
first reinforcing layer and a second layer by which the
first layer is bonded to the outwardly flanged portion;
where the mounting portions are consolidated and rigidified
5 by heating, in carrying out a process in accordance with the
invention, this second layer conveniently comprises heat
softenable fibres with a softening point lower than the bulk
of the fibres of the first reinforcing layer or of the wall
portions, although this second layer may include some fibres
10 of a higher melting point to provide additional strength
and/or to facilitate manufacture.

Conveniently a process in accordance with the invention
is used in forming a filter unit in accordance with the
15 invention.

The second reinforcing portion may conveniently
comprise at least one further reinforcing layer bonded to
the first reinforcing layer.

20

Preferably a filter unit in accordance with the
invention also comprises a strengthening portion adjacent
said one closed end portion of the passage, the
strengthening portion being provided by forming parts of the
25 wall portions. The strengthening portion may, for example,
have the shape of an inverted V with the apex pointing
toward the open end portion of the passage, or an inverted
T, or be generally L-shaped. Preferably the strengthening
portion additionally comprises a third reinforcing portion
30 secured to the formed parts of the wall portions.

There now follows a detailed description, to be read
with reference to the accompanying drawings, of two filter
units and a process of manufacturing the filter units,
35 embodying the invention.

1 In the accompanying drawings:-

Fig. 1 is a diagrammatic exploded view in section showing a first illustrative filter unit and apparatus used in its
5 manufacture;

Fig. 2 is a diagrammatic view of a second illustrative filter unit; and

10 Fig. 3 is a diagrammatic view showing the manufacture of the first illustrative filter unit partially complete.

In the accompanying drawings like reference characters indicate like parts.

15

A self-supporting filter unit is shown in Fig. 1 having a plurality of passages (10) defined by wall portions (12) made from air permeable non-woven fibre fabric through which wall portions (12) air can pass and be drawn off along
20 passages (10) but which prevent the passage therethrough of particulate material e.g. dust, and/or other debris carried by such air. The passages (10) are closed off at one end portion by securing together extremities (14) of the fabric. At the other, open end portion there is formed integral with
25 the wall portions (12) a rigid mounting portion (generally designated 16) into which the passages (10) open whereby the illustrative filter unit can be supported as part of a filter assembly.

30 The mounting portion (16) comprises a first reinforcing portion (18) of non-woven fibre fabric material which extends around and is secured to the fabric of the wall portions (12), parts of the first reinforcing portion (18) and of the fabric of the wall portion being outwardly
35 flanged. The mounting portion further comprises a second

1 reinforcing portion (20,21) of non-woven fibre fabric
material positioned over the outwardly flanged portions, in
alignment therewith, and secured thereto, the second
reinforcing portion (20,21) having one or more apertures
5 (19,23) therein corresponding to the open end of the passage
(10).

Adjacent said closed one end of the passages (10) a
strengthening portion, (generally designated 22) is provided
10 by forming parts of the wall portions, including the
extremities (14). This strengthening portion (22) is
generally L-shaped and comprises fabric of the wall portions
(12) including the extremities (14) and a third reinforcing
portion (24) which is secured by means of a bonding material
15 (26) to the fabric of the wall portions (12). The third
reinforcing portion (24) is wrapped around the extremities
(14) of the wall portions (12).

The second reinforcing portion (20,21) comprises a
20 first reinforcing layer (20) and a second layer (21) by
which the first layer is bonded to the outwardly flanged
portion but which may, itself, comprise an amount of
reinforcing fibre as well as a bonding agent, if desired.

25 The first and second illustrative filter units can be
made by any convenient process for example as described in
either one of the co-pending patent applications mentioned
above.

30 A general process for manufacturing the mounting and
strengthening portions of the first illustrative filter unit
is, however, described with reference to Figs. 1 and 3 of
the accompanying drawings.

35 The process described with reference to Fig. 1 involves

1 forming a fluid permeable fibre fabric to provide the wall
portions (12) for example as described in either of the
above mentioned co-pending patent applications and forming
the mounting portion (16) at the other end of the filter
5 unit, namely the open end. The passages (10) have formers
(28) inserted into them, the formers having a shape
corresponding to the cross sectional shape to be imparted to
the passages. Parts of the fabric of the wall portions (12)
project beyond first presser means (30) positioned outwardly
10 of the former (28). A strip (18) of suitable fibre fabric
is then positioned round the wall portions (12) adjacent the
open end of the passages (10) such that part of this strip
of fabric (18) projects, partially, beyond the presser means
(30) and overlies the projecting parts of the fabric of the
15 wall portions (12). Thereafter, part of the fabric layer
(18) is pressed by the first presser means (30) against the
wall portion (12) supported by the former (28), thereby
causing the parts of the layer (18) and wall portion (12)
projecting beyond the presser means (30) to flare outwardly
20 as shown in Fig. 3. The first reinforcing layer (20) and
the second layer (21) of the second reinforcing portion are
then slid onto the former (28) using the apertures to locate
the layers (20,21) correctly, positioned adjacent the flared
projecting end of the layer (18) and wall portions (12) and
25 pressed against the first presser means (30) by second
presser means (32) (which is provided with an aperture (33)
through which the former passes) whereby to form the
outwardly flanged portion (16). The wall portions (12) and
the first and second reinforcing portions (18,20) are thus
30 then treated to secure them together and render them rigid
thus to provide the mounting portion. In carrying out the
illustrative process the various fabrics are heat activated
and the presser members supply heat as well as pressure to
the various fabrics whereby to bond the portions together by
35 heat and pressure thus consolidating the first and second

1 reinforcing portions (18,20) and the wall portion (12)
adjacent the open portions of the passages (30) thus to form
a mounting portion integral with the wall portions (12).
The portions (18) and (12) are consolidated (where not
5 outwardly flanged) to the same thickness as the remainder of
the wall portion (12) of the illustrative filter units.

The strengthening portion adjacent the closed end of
the passages (10) is also formed in a somewhat similar
10 manner insofar as the extreme end portions (14) of the wall
portions (12) project beyond the presser means (30) and, as
shown in Fig. 1 are deflected to provide a general L-shaped
configuration. The third reinforcing portion (24) is
positioned in alignment with the projecting portion
15 including the extremities (14) with a bonding layer (26)
interposed between part of the third reinforcing portion
(24) and the extremities (14) of the wall portion and the
third reinforcing portion is then wrapped around the
extremities (14) as shown in Fig. 1.

20

Finally the second reinforcing portion is pressed by
third presser means (34) against end faces of the formers
(28) and against the presser means 30 to activate the
bonding layer (26) and the third reinforcing portion (24),
25 to cause the third reinforcing portion to bond securely to
the fabric of the wall portions.

In carrying out this illustrative process the various
fabrics are treated by heat and pressure both to effect
30 bonding and to render them sufficiently rigid to provide the
strengthening portion (22). To effect satisfactory bonding
both the first reinforcing portion (18) and the third
reinforcing portion preferably contain a proportion of
fibres which are activated by heat and pressure to assist
35 bonding, if necessary.

1 The second illustrative filter is shown in Fig. 2 and
is generally similar in construction to the first
illustrative filter unit except that the second reinforcing
portion comprises two reinforcing layers (20) and two
5 bonding layers (21), one of the bonding layers bonding an
adjacent first reinforcing layer (20) to the outwardly
flanged part of the mounting means 16 and the other of the
second layers being sandwiched between the two first
reinforcing layers whereby to adhere them to one another.
10 The second illustrative filter unit is made in a similar way
to the first unit.

When the illustrative filter units are complete, the
mounting portions (16) are integral with the wall portions
15 (12) and provide firm and rigid support for the wall
portions (12) of the filter unit.

The first reinforcing portion (18) is especially useful
in giving good support to the wall portions (12) when the
20 illustrative filter units are positioned in a filter
assembly with the passages (10) extending horizontally as
shown in Fig. 2. Furthermore, the strengthening portion
(22) is sufficiently rigid to prevent undue flexing of the
ends of the filter unit remote from the mounting portions
25 (16).

The wall portions (12) and various reinforcing portions
are preferably made of suitable fibre fabric materials and
are selected according to the use to which the filter unit
30 is to be put.

To illustrate the invention further by way of example,
three examples of filter units in accordance with the
invention are described hereinafter as Examples 1-3.
35 However, it will be understood that fibre fabric as

1 discussed in the co-pending patent applications mentioned
above and as described in the examples thereof may be used
in the manufacture of filter units in accordance with the
present invention. Reference is directed to the above
5 mentioned co-pending applications for further information
relating to manufacturing techniques and materials suitable
for use in the manufacture of filter units in accordance
with the present invention.

10 Example 1

The first example will be described with
reference to the first illustrative filter unit shown
in Figs. 1 and 3.

15

In carrying out this example, the wall portion is
a polyester fibre fabric.

The first reinforcing portion (18) is a blend
20 consisting of one part by weight of Grilene K-170 co-
polyester melt-bonding fibre having a melting point of
about 179°C (DSC test), and two parts by weight of a
polyester fibre having a melting point of about 240°C,
that is higher than the K-170 fibre. Grilene K-170 is
25 available from EMS - Grilonsa, CH-7013 Domat/Ems. The
fabric used in forming the first reinforcing portion
(18) has a weight of 500 gsm. The second reinforcing
portion comprises a first reinforcing layer (20) of
pre-shrunk polyester fibre fabric having a weight of
30 1200 gsm (the melting point of the polyester being
about 240°C) and the second layer (21) is a
polypropylene fibre fabric having a weight of 500 gsm,
the polypropylene having a softening point of about
165°C, that is lower than the polyester. The fabric of
35 the third reinforcing portion (24) is the same as that

1 of the first reinforcing portion (18) and the layer
(26) is a polypropylene fabric layer identical with the
composition of the layer (21).

5 The blend of standard polyester fibre and Grilene
K-170 co-polyester melt-bonding fibre is used to
counter any embrittlement effects which may arise from
exposure of the polypropylene bonding layer to
prolonged high temperatures.

10 The strengthening portion 22 is intended not only
to resist bending under load of the filter unit but
also to minimise the possibility of end blow-out of the
filter unit.

15

Example 2

20 Example 2 is described with reference to Fig. 2 of
the accompanying drawings and again in this example the
body of the filter, namely the wall portions (12)
comprise a polyester fibre fabric. Polyester filter
bodies are generally suitable for use in circumstances
where the filter units will not be exposed to
25 temperatures in excess of about 120°C. The fabric used
in making the first reinforcing portion (18) is the
same as used in Example 1, namely a blend of one part
by weight Grilene K-170 and two parts by weight of
polyester fibre, the portion having a weight of 500 gsm
30 and being needled.

The first reinforcing layer (20) of the second
reinforcing portion is also a polyester fibre fabric
which is a blend of different polyester fibres and
35 which has a thickness of 3mm and is pre-shrunk at 245°C

1 for about 7 minutes to a weight of about 750 gsm. The
blend is of one third by weight 1.7 decitex fibres
about 40mm length, one third by weight 3.3 decitex
5 fibres about 50mm in length and one third by weight 5.0
decitex fibres about 60mm in length. The second layer
(21) of said portion is a polypropylene non-woven fibre
fabric defined as being about 6.7 dtex. The
polypropylene has a softening point of about 165°C.
The weight of the second layer (21) is about 500 gsm.

10

Example 3

 In example 3, the fabric of the wall portions of
(12) of the filter is a needled felt comprising
15 copolyimide fibres having a glass transition
temperature of 315°C supplied under the designation P84
by Lenzing AG.

 In the third example reference is made to Fig. 2.
20 The first reinforcing portion (18) comprises a blend of
one part by weight Ryton fibres and about two parts by
weight Nomex fibres, the first reinforcing portion
having a weight of about 300 gsm. Ryton fibres are
polyphenylene sulphide resin fibres having a melting
25 point of about 285°C manufactured by Phillips Fibres
Corporation and available from them. The Ryton fibres
are suitable for use in filter assemblies operating at
continuous temperatures of 180°C. Nomex are aramid
fibres. Nomex is heat resistant and has good
30 dimensional stability at relatively high temperatures.
Nomex does not melt but degrades rapidly at
temperatures above about 370°C. It is suitable for use
at continuous temperatures up to about 260°C. Both
Ryton and Nomex are relatively inert to most solvents
35 but Ryton fibres have a softening point so that they

1 afford a heat-bonding capability in admixture with
Nomex fibres, whilst still providing good heat
resistance in normal conditions of use.

5 The first reinforcing layer (20) of the second
reinforcing portion is provided by a non-woven fibre
fabric blend similar to the fabric of the first
reinforcing portion (18) but having a weight of 600
gsm.

10 The second layer (21) is a non-woven fibre fabric
layer consisting of a blend of four parts by weight of
Ryton fibres and one part by weight Nomex fibres. The
weight of the fabric of the layer (21) is 300 gsm.

15 In each of these various Examples whilst the non-woven
fibre fabric of the first layer or layers (20), together
with the first reinforcing portion (18), provide a
substantial part of the strength and rigidity of the
20 mounting portion, the layer or layers (21), consisting of a
greater proportion of lower softening point material serve
to bond the components together but also provide some
stiffness to the finished mounting portion.

25 The layer of fabric (18) used in forming the first
reinforcing portion is typically about 25mm in width whilst
the filter units from the mounting portion (16) to the
strengthening portion (20) are typically about 1.5 metres in
length.

30 The reinforcing portions (18,20) provide a strong
mounting portion (16) by which the filter units can be
firmly supported even when positioned with the passages (10)
lying with their axes horizontal.

35

1 Claims:

1. A filter unit having at least one passage defined by wall portions of air-permeable fibre fabric, said passage
5 being configured to prevent passage of dust and/or debris in a fluid flow drawn therethrough, said passage being closed at one end and at the other end there being an integral filter mounting portion to enable the filter unit to be incorporated in a filter assembly characterised in that said
10 mounting portion includes a first reinforcing portion arranged and secured about said wall portions of said passage, at least some of said first reinforcing portion and said wall portions secured therewith being arranged to be outwardly flanged to form an outward flange and said
15 mounting portion further includes a second reinforcing portion positioned adjacent said outward flange and secured thereto, said second reinforcing portion having an aperture formed therein to correspond to the open end of the passage.

20 2. A filter unit according to Claim 1 wherein the unit has a plurality of passages defined by rigid corrugated wall portions, secured together along the peaks of the corrugations, and wherein the second reinforcing portion has apertures therein corresponding with respective
25 open ends of the passages.

3. A filter unit according to Claim 1 wherein the first and second reinforcing portions comprise rigidised non-woven fibre fabric.

30

4. A filter unit according to Claim 1 wherein the wall portions comprise polyester fibre fabric, the first reinforcing portion is a non-woven fabric which comprises a blend of about two parts by weight of fibres of a first
35 component namely polyester and about one part by weight of a

1 second component, namely melt bonding fibres, having a lower
softening point than the first component, and a first layer
of the second reinforcing portion is a polyester fibre non-
woven fabric bonded to the outward flange portion by a
5 second layer which is a polypropylene non-woven fibre
fabric.

5. A filter unit according to Claim 1 wherein the
wall portions comprise a fibre fabric comprising polyimide,
10 the first reinforcing portion is a non-woven fabric which
comprises a blend of about two parts by weight of fibres of
a first component, namely aramid fibres and about one part
by weight of fibres of a second component, namely
polyphenylene sulphide fibres, having a lower melting point
15 than the first component, and a first layer of the second
reinforcing portion is a blend of fibres identical with the
first reinforcing portion bonded to the outwardly flanged
portion by a second layer which is a non-woven fabric
consisting of a blend of about four parts by weight
20 polyphenylene sulphide fibres to one part by weight aramid
fibres.

6. A filter unit according to Claim 1 comprising a
strengthening portion at said one closed end portion of the
25 filter unit, the strengthening portion being provided by
forming parts of the wall portions.

7. A filter unit according to Claim 6 wherein the
strengthening portion is generally L-shaped, V-shaped or T-
30 shaped.

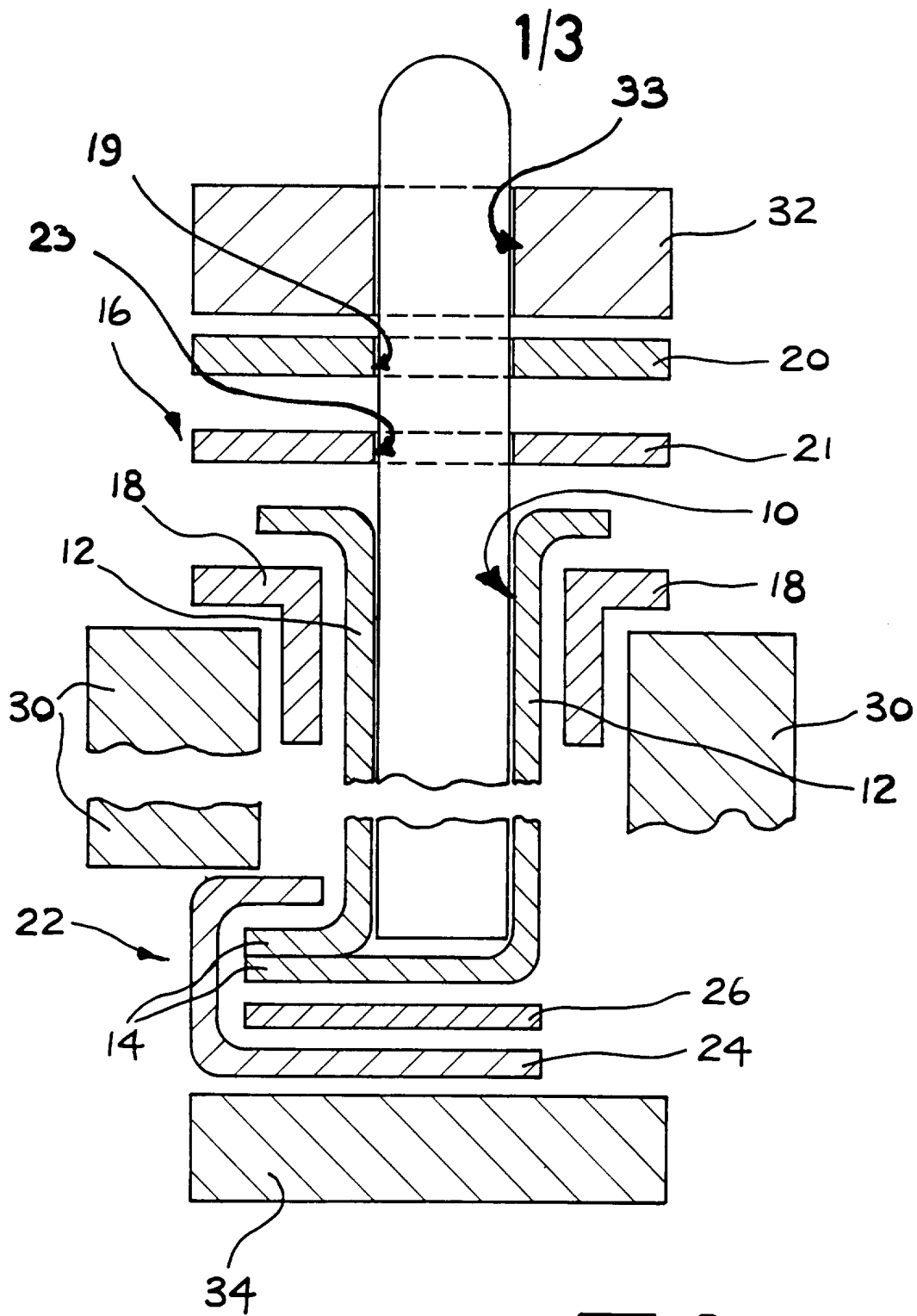
8. A filter unit according to any one of the Claims 6
or 7 wherein the strengthening portion comprises a third
reinforcing portion secured to the formed parts of the wall
35 portions.

- 1 9. A process for manufacture of a filter comprising:-
- (1) forming at least one passage from fluid
 permeable fibre fabric;
- 5 (2) closing off an end part of that passage; and,
- (3) at an open end of the passage forming a
 mounting portion by inserting a former member
10 in the passage, positioning a first
 reinforcing fibre fabric layer around said
 open portion such that at least part of the
 first reinforcing fibre layer and the passage
 extend beyond the former member, pressing the
15 first reinforcing fibre layer against said
 passage extending beyond the former member to
 bend said first reinforcing layer and said
 passage extending beyond the former member
 outwardly, positioning a second reinforcing
20 layer in alignment and adjacent with the bent
 outwardly projecting parts of said passage
 and said first reinforcing member, pressing
 said second reinforcing layer against said
 part of said first reinforcing layer and said
25 passage to form an outwardly flanged portion
 and treating said passage and said first and
 second reinforcing layers to secure them
 together and rigidise them to provide a
 mounting portion for the filter.

30

10. A process as claimed in Claim 10 wherein heat and
 pressure are used to secure and render rigid the filter
 components.

35



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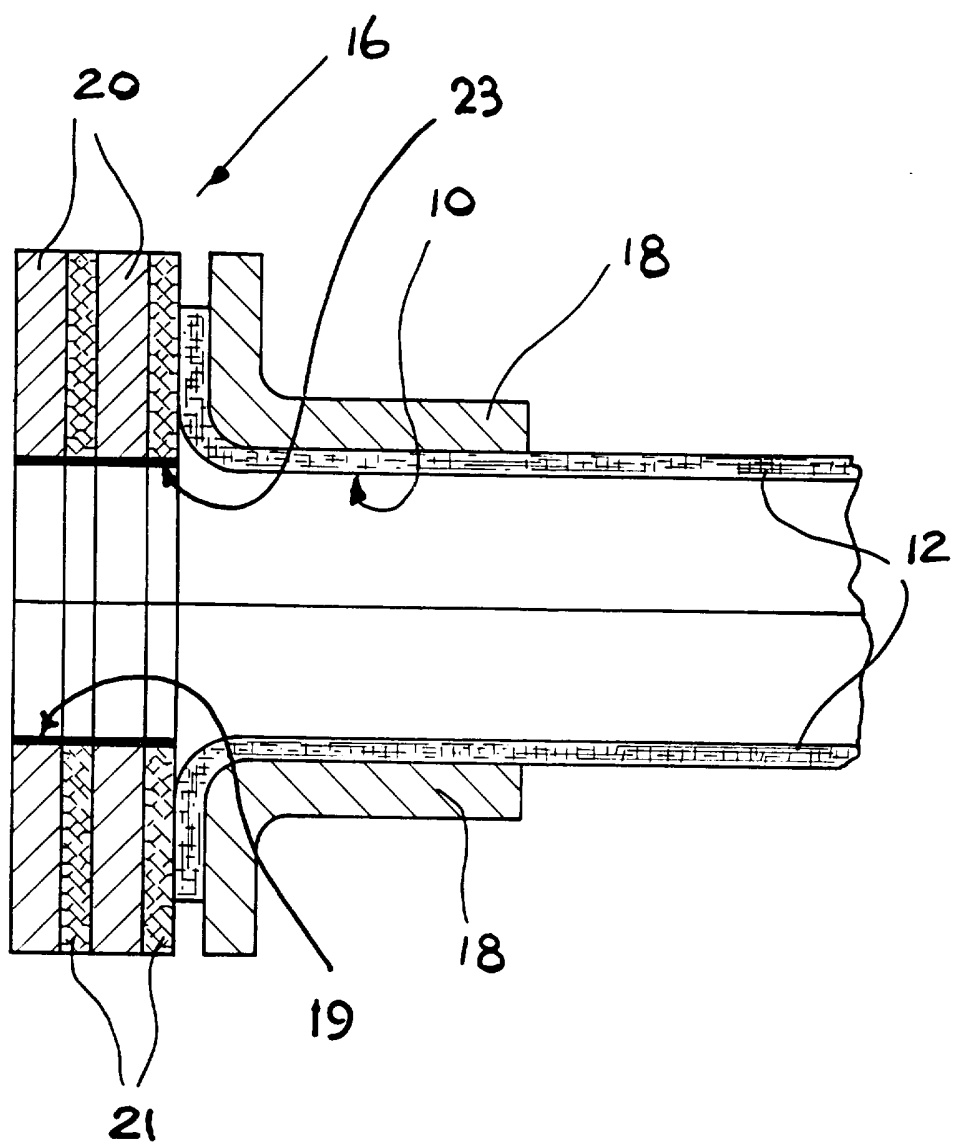


FIG-2

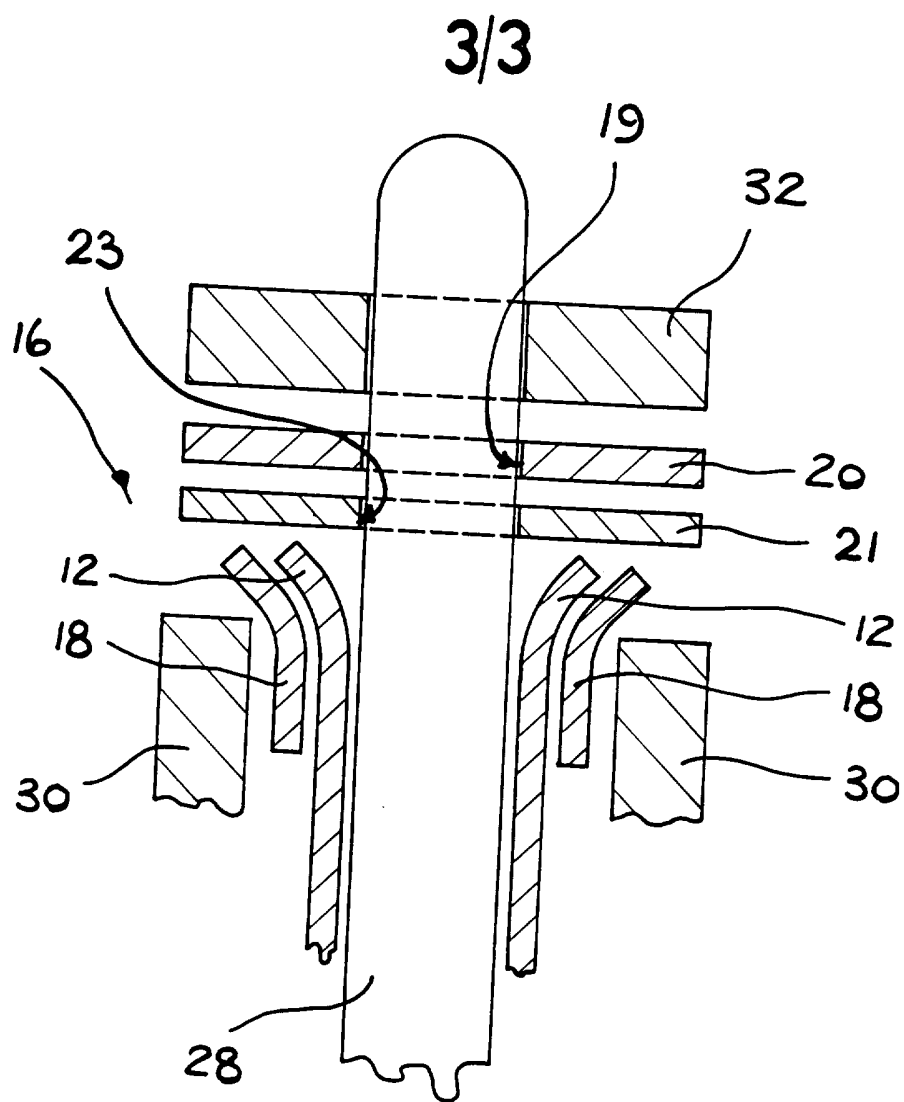


Fig-3

INTERNATIONAL SEARCH REPORT

Inter national Application No

PCT/GB 95/01825

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B01D46/02 B01D46/42 B01D39/16

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 6 B01D

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE,U,91 11 939 (DEICHMANN) 19 December 1991	1-3,6,10
Y	see the whole document ---	4,5,9
X	DE,A,24 58 030 (SEIDEL) 10 June 1976 see page 3 - page 5 see page 10 - page 11; figures 3,4 ---	1,2
Y	EP,A,0 549 105 (BRITISH UNITED SHOE MACHINERY LIMITED) 30 June 1993 cited in the application see claims 1-12 ---	4,5,9
A	EP,A,0 529 225 (HOSOKAWA MICRON INTERNATIONAL INC.) 3 March 1993 see column 5, line 45 - column 9, line 15; figures 1-4 ---	1-10
	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Int: nal Application No
PCT/GB 95/01825

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