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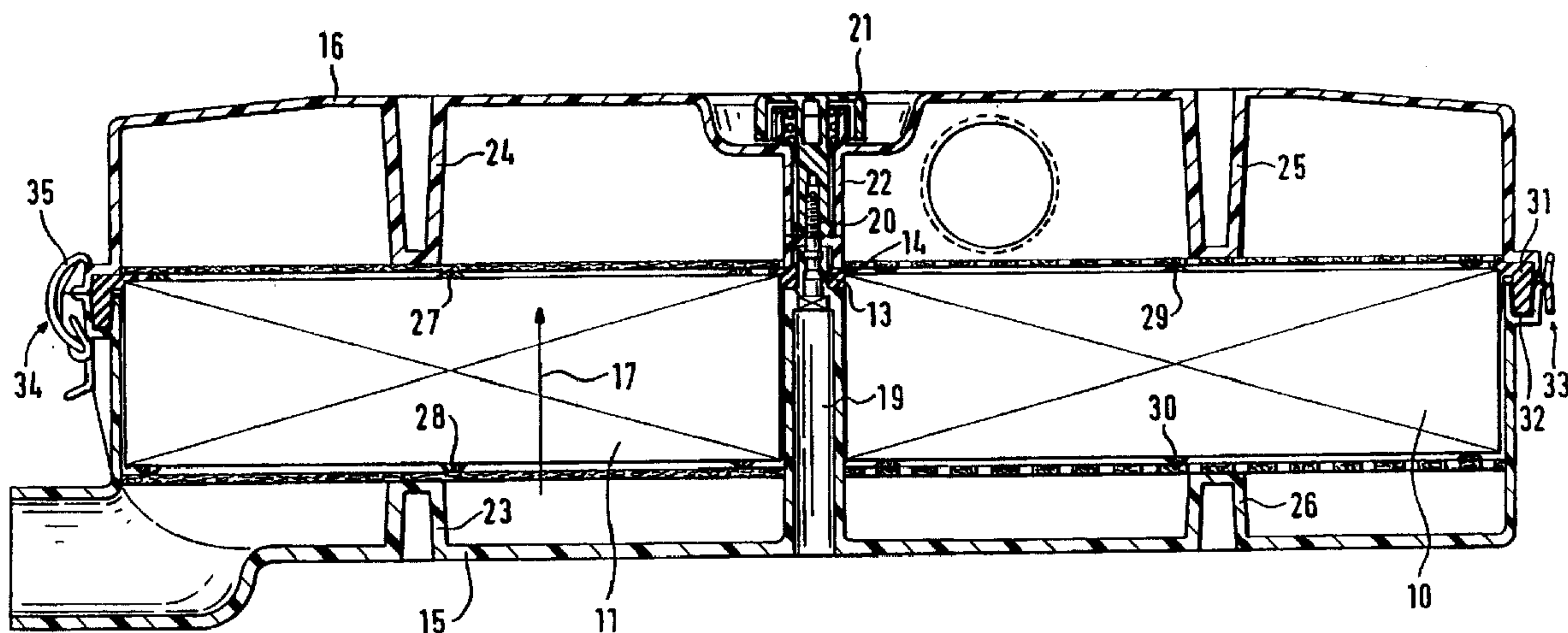
(72) Inventeurs/Inventors:
ERNST, VOLKER, DE;
KLOTZ, ARTHUR, DE;
LEIPELT, RUDOLF, DE

(73) Propriétaire/Owner:
FILTERWERK MANN & HUMMEL GMBH, DE

(74) Agent: BORDEN LADNER GERVAIS LLP

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(54) Title: FILTER SYSTEM, ESPECIALLY FOR FILTERING THE AIR INTAKE OF AN INTERNAL COMBUSTION ENGINE



(57) Abrégé/Abstract:

A filter system for filtering the air intake of an internal combustion engine comprising a housing having a bottom half and a cover half, at least two filter inserts each consisting of pleated filter paper or filter batting, and a circumferential gasket. The two filter inserts are connected by a junction strip which simultaneously seals the raw air chamber from the clean air chamber between the two filter inserts.



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Abstract of the Disclosure

5 A filter system for filtering the air intake of an internal combustion engine comprising a housing having a bottom half and a cover half, at least two filter inserts each consisting of pleated filter paper or filter batting, and a circumferential gasket. The two filter inserts are connected by a junction strip which simultaneously seals the raw air chamber from the clean air chamber between the two filter inserts.

FILTER SYSTEM, ESPECIALLY FOR FILTERING THE AIR
INTAKE OF AN INTERNAL COMBUSTION ENGINE

Background of the Invention

This invention relates to a filter system, especially for filtering the air intake of an internal combustion engine.

5 Kishi et al., U.S. Patent No. 4,925,468 discloses a filter system consisting of a filter with a plurality of filter elements, each of which has at least one connecting surface parallel to the direction of the air flow, so that the filter elements are movable relative to one another.
10 The filter system described therein is designed for installation in an air conditioning system and filters foreign substances from the air flowing through the air duct.

15 In filter systems used in motor vehicles it must be assured that no unfiltered leakage air passes between the filter insert and the housing. It is especially important that a tight seal be provided in a filter for the air intake of an internal combustion engine. Leaks in the filter system result in dust and dirt particles being sucked into
20 the engine which may lead to the destruction of the engine.

 Prior art filters which have a plurality of filter elements do not assure a secure seal between the raw air side and the clean air side of the filter.

Summary of the Invention

It is the object of the invention to provide an improved filter system which uses at least two filter elements.

5 It is also an object of the invention to provide a filter system which assures a reliable seal between the raw air side and the clean air side of the filter.

10 A further object of the invention is to provide a filter system which is particularly adapted for use in the air intake of an internal combustion engine.

Another object of the invention is to provide a filter system which is easy and economical to manufacture.

15 These and other objects of the invention are achieved by providing a filter arrangement comprising a housing comprising a housing bottom and a housing cover; a first filter insert disposed in the housing and comprising a pleated filter paper or filter batting and having a gasket extending at least partially around an outer margin thereof; a second filter insert disposed in the housing with one side adjacent a parallel side of the first filter insert, the second filter insert comprising a pleated filter paper or filter batting and having a gasket extending at least partially around a circumferential margin thereof; and a junction strip joining the adjacent parallel sides of the first and second filter inserts and sealing a raw air chamber on one side of the filter inserts from a clean air chamber on an opposite side of the filter inserts.

20 An important advantage of the invention lies in the ease of the manufacture of the filter inserts. Thus, filter inserts up to a certain width can be produced on a conventional folding machine. Filter systems, especially for use in trucks or heavy machinery, require a very large filter area, which can be achieved only by increasing the width of the filter insert. In the past it has been necessary to use special machines to manufacture such a filter insert, and consequently it has been uneconomical.

Through the use of filter inserts with a standardized width the cost of production can be considerably reduced, but an effective sealing of the entire filter system must be provided. Due to the junction strip running between the filter inserts, which is integrated into the gasket at its extremities, a reliably working filter system of this kind can be manufactured.

The junction strip and gasket can be manufactured in a single operation and from the same material, thereby permitting an additional cost reduction.

In accordance with one preferred embodiment of the invention, the upper part of the housing is supported on the bottom part thereof in the area of the center of the filter system. Such a support serves to prevent the upper part of the housing from vibrating due to pulsation of the intake air and lends stability to the upper part. An opening is provided in the junction strip for this support. A fastening means in the form of a staybolt disposed on the bottom part of the housing extends through this opening. A counterpiece for the fastening means is provided on the upper part of the housing. Joining the two housing parts together simultaneously seals the opening in the junction strip.

Another preferred embodiment of the invention is characterized by the fact that the surrounding gasket is given a hook-shaped cross section. The gasket may advantageously be composed of polyurethane foam or silicone foam and is disposed directly on the filter paper or filter batt. The cross section is approximately frustoconical in shape, and a groove with a matching female cross-sectional shape is provided in the housing bottom piece in which the frustoconical hook is hung. The shape of the cross section prevents the filter insert from slipping off when it is being installed.

Another embodiment of the invention is particularly advantageous where there is a filter housing which has an

irregular geometry to which it is necessary to adapt the filter. In such a case it is possible to provide the individual filter inserts with different pleat widths so that the available space within the filter housing is optimally utilized.

The two housing halves are joined together by a snap fastener. In filter housings it has proved advantageous to use a toggle fastener. However, it is also possible to connect the housing parts together by means of a quarter-turn fastener or a simple threaded fastener.

Another embodiment of the invention relates to the easier handling of the filter. In this case, the junction strip is advantageously in the form of a film hinge. This makes it possible to fold the two filter inserts against one another so that they can be transported as a compact unit.

The various features of the preferred embodiments described in this specification and/or shown in the accompanying drawings may be used individually or in various combinations and/or subcombinations, all of which are intended to be protected as independently patentable parts of the present invention.

Brief Description of the Drawings

The invention will be described in further detail hereinafter with reference to illustrative preferred embodiments shown in the accompanying drawings in which:

Figure 1a is a schematic representation of a filter insert consisting of two individual filter elements;

Figure 1b is a partially sectional side view taken along line Ib-Ib of Fig 1a;

Figure 2a is a cross-sectional view of a filter system;

Figure 2b is an enlarged detail view of the central portion of Figure 2a showing the connection between the parts of the housing;

Figure 3 is a sectional view of a fastener for a filter system, and

Figure 4 is a sectional view of an alternate embodiment of a fastener for a filter system.

Detailed Description of Preferred Embodiments

5 The schematic representation in Figure 1a shows a first
filter insert 10, a second filter insert 11, and a
circumferential gasket 12. The two filter inserts are
joined together by a junction strip 13. As the cross-
section in Figure 1b shows, the pleats in filter insert 11
10 are narrower than those of the filter insert 10. The
possibility of using different pleat widths is advantageous
wherever the available space on both sides of the filter is
different so that it is necessary to adapt the filter to the
available space. An opening 14 is provided in the junction
15 strip 13; the purpose of this opening will be explained in
connection with Figure 2. The junction strip 13 may be a
film hinge, thereby enabling one of the filter inserts to be
folded against the other filter insert.

 The cross section in Figure 2a shows a filter system
20 with a housing bottom half 15, a housing top half 16, and
filter inserts 10 and 11 disposed between the housing
halves. The air flows through the filter inserts as
indicated by arrow 17 and passes into the intake duct of an
internal combustion engine. A detail view of the central
25 fastening between the top half 16 and bottom half 15 is
shown in Figure 2b. Between the two filter inserts 10 and
11 is a junction strip 13. To support the top half 16 of
the housing on the bottom half 15, a fastening means in the
form of a staybolt is disposed on the bottom half 15. This
30 staybolt has at its upper end a screw thread 20. The
staybolt furthermore comprises a first abutment surface 43
for the junction strip 13 and a second abutment surface 44.
On this second abutment surface 44 lies a spacer 45 of the
housing's top half 16. These abutment surfaces and the
35 spacer establish a set spacing between the bottom and top of
the housing. The connection is established by means of a

manually turned nut 21 arranged in a receptacle 22 in the top half of the housing. This nut 21 engages the thread 20 of the staybolt and produces a rigid connection in the central part of the filter system.

5 Particularly in very large filter systems, it is advantageous to provide additional supporting means in order to avoid pulsating vibrations both of the filter inserts and of the housing. These are also shown in Figure 2a. Both on the bottom and on the top halves of the housing, posts 23, 10 24, 25 and 26 are provided, which extend all the way directly to the respective filter insert.

The posts 23, 24, 25 and 26 thus stiffen the housing transversely of the folding direction of the pleats of the filter inserts 10 and 11. To fix the spacing of the pleats 15 in these filter inserts, beads of glue 27, 28, 29 and 30 are provided. The glue beads prevent the pleats from packing, i.e. sticking together, at a high air throughput, both on the upstream side and on the raw air side. To protect the pleats of the filter inserts, a non-woven batt can be 20 arranged over the full-surface of both sides of the filter insert. This batt is, for example, perforated on the upstream side and is held in place by the glue beads. The glue beads may extend underneath the posts and in this manner, in conjunction with the batt, any contact between 25 the posts and the filter insert can be prevented.

The filter inserts 10 and 11 are provided with a circumferential gasket with a hook-shaped cross section 31. This gasket is hooked into a circumferential groove 32 in the bottom half of the housing. The hook shape prevents 30 exterior air from entering into the clean air space of the housing top and also unfiltered air from the raw air chamber from entering into the clean air chamber. The junction strip 13, particularly the opening 14, also is configured in conjunction with the staybolt 19 in such a way that 35 unfiltered air is effectively prevented from entering the clean air space.

The housing top half and bottom half are provided with catches 33, with which the two housing halves are fixed in the correct position. The precise assembly of the halves is thus considerably facilitated. The housing halves are additionally joined together by means of a toggle fastener, which is fastened to the bottom half of the housing. The hook 35 engages in an opening or recess in the housing top and securely closes the filter system under constant tension.

As an alternative, a quarter-turn fastener can be used. This consists, as shown in Figure 3, of a pin 36 provided with a cross pin 37 at its bottom end. The end provided with the cross pin 37 is fitted into a bore 38 of matching shape in the housing bottom. A quarter turn of the pin 36 locks the two housing halves together. The tension of this fastener is precisely adjustable by means of a spring 39.

Another variant fastener is shown in Figure 4. Both in the housing bottom 15 and in the top 16 there are inset metal bushings 40 and 41 set in bores aligned with one another. Each of the individual bushings is provided with a screw thread, the thread of the one bushing 40 serving to fasten an Allen screw 42 and the thread in the other bushing 41 serving to prevent the loss of this screw. The bushings 40 and 41 provide a metal contact surface between the housing top and bottom. This kind of screw fastening avoids the disadvantage of using screws in direct contact with the plastic, which of course results in the creeping of the plastic and with it a loosening of the connection.

The foregoing description and examples have been set forth merely to illustrate the invention and are not intended to be limiting. Since modifications of the described embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed broadly to include all variations falling within the scope of the appended claims and equivalents thereof.

CLAIMS:

1. A filter arrangement comprising:

a housing comprising a housing bottom and a housing cover;
a first filter insert disposed in said housing and comprising a pleated filter paper or filter batting and having a gasket extending at least partially around an outer margin thereof;

a second filter insert disposed in said housing with one side adjacent a parallel side of said first filter insert, said second filter insert comprising a pleated filter paper or filter batting and having a gasket extending at least partially around a circumferential margin thereof; and

a junction strip joining the adjacent parallel sides of said first and second filter inserts and sealing a raw air chamber on one side of said filter inserts from a clean air chamber on an opposite side of said filter inserts;

wherein said housing bottom carries a fastener for connecting said housing bottom to said housing cover, said fastener being aligned with an opening in said junction strip and extending through said opening to sealingly close said opening.

2. A filter system according to claim 1, wherein said housing bottom is provided with a circumferential groove, and said gaskets, which extend at least partially around circumferential margins of said filter inserts, have a hooking profile which is received in said circumferential groove.

3. A filter system according to claim 2, wherein said hooking profile is formed of polyurethane foam or silicone foam, which is cast directly onto filter paper or filter batting.

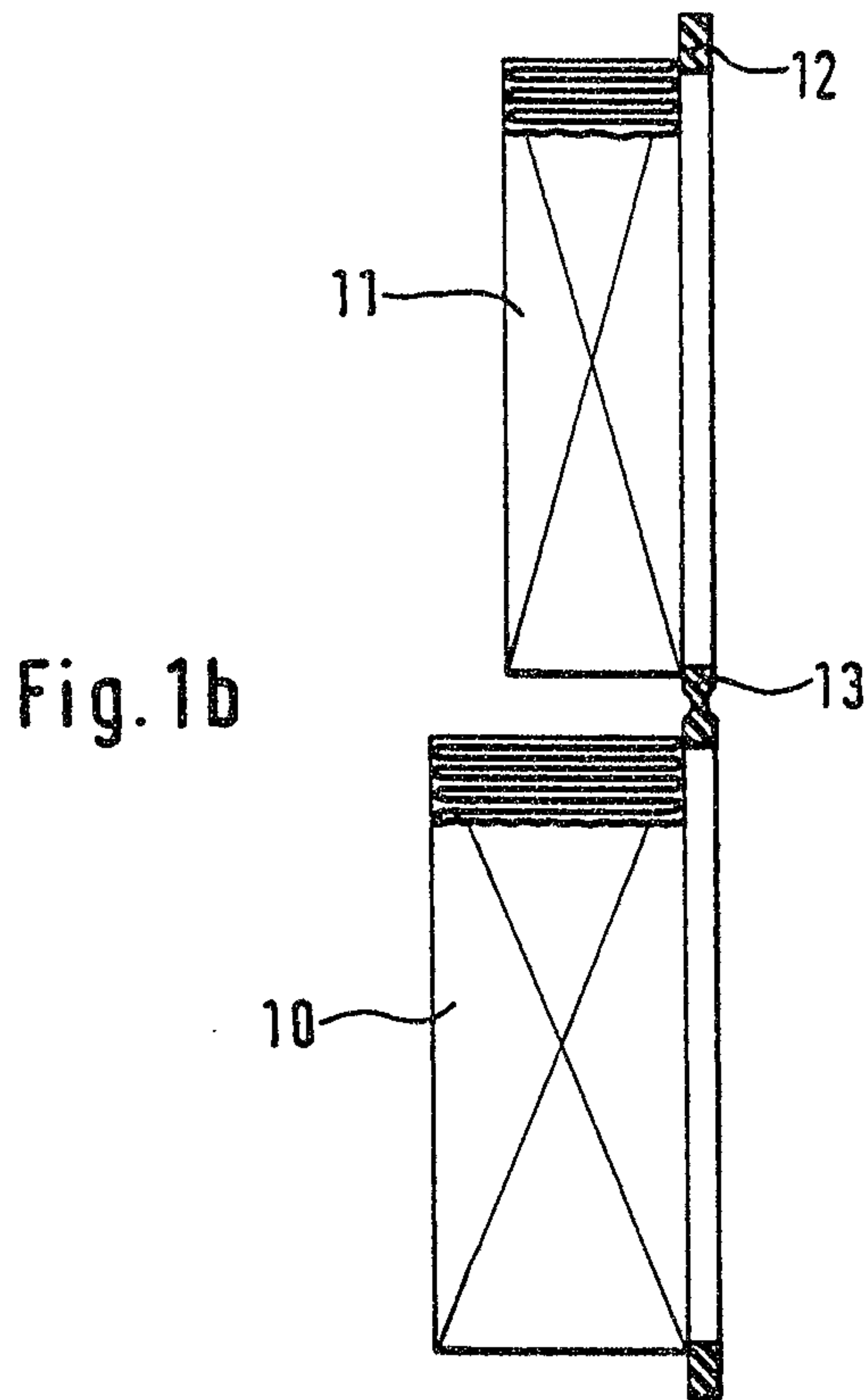
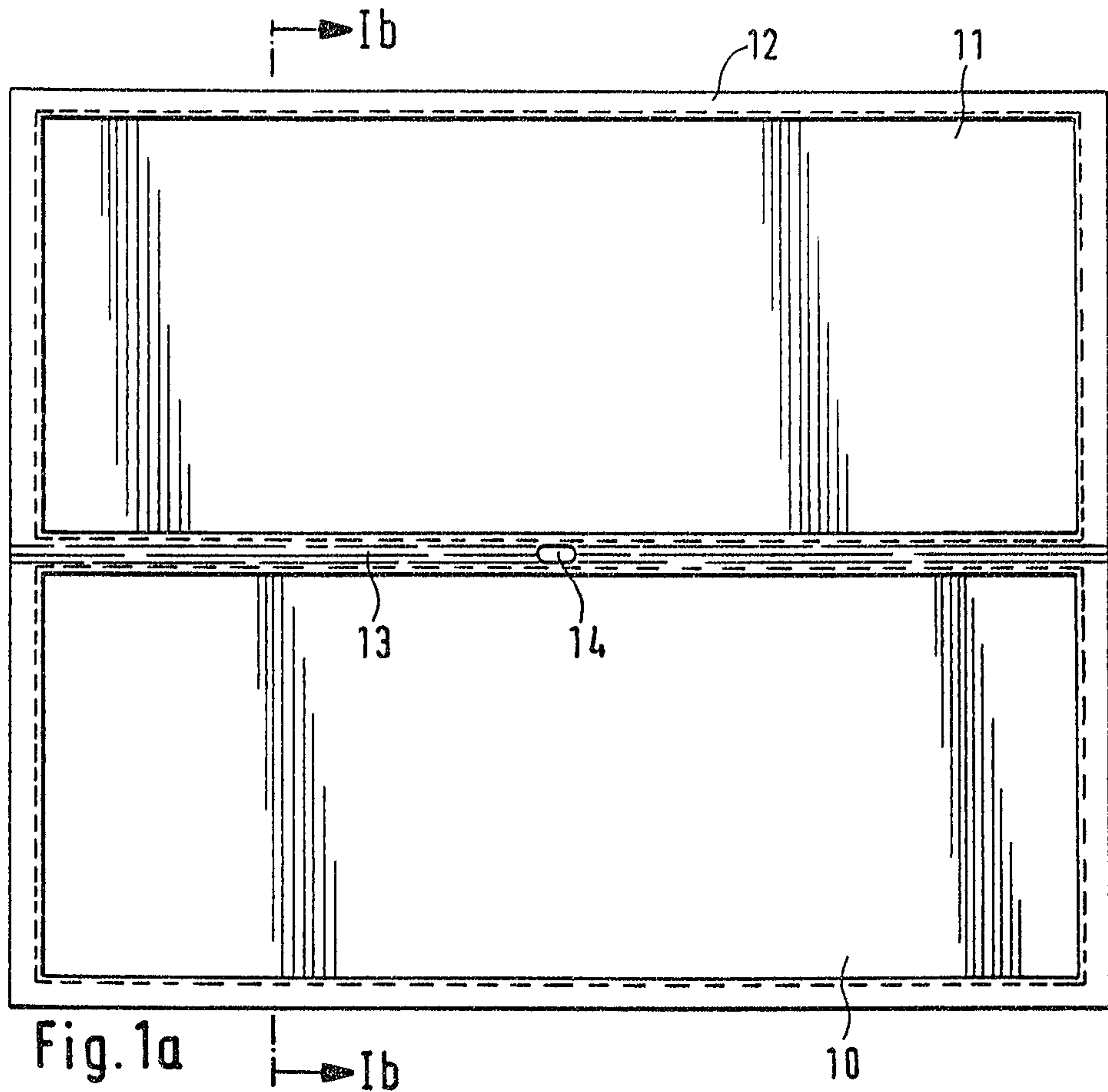
4. A filter system according to claim 3, wherein said hooking profile and said circumferential groove have matching tapered cross sectional configurations.

5. A filter system according to claim 1, wherein said first and second filter inserts comprise pleated filter papers which have different pleat widths.

6. A filter system according to claim 1, wherein said housing bottom is connected to said housing cover by at least one fastener selected from the group consisting of screw fasteners, quarter-turn fasteners and toggle fasteners.

7. A filter system according to claim 1, wherein said junction strip is configured as a thin film hinge, whereby said first and second filter inserts can be folded flat against each other.

8. A filter system according to claim 1, wherein said housing is connected to an air intake duct for an internal combustion engine.



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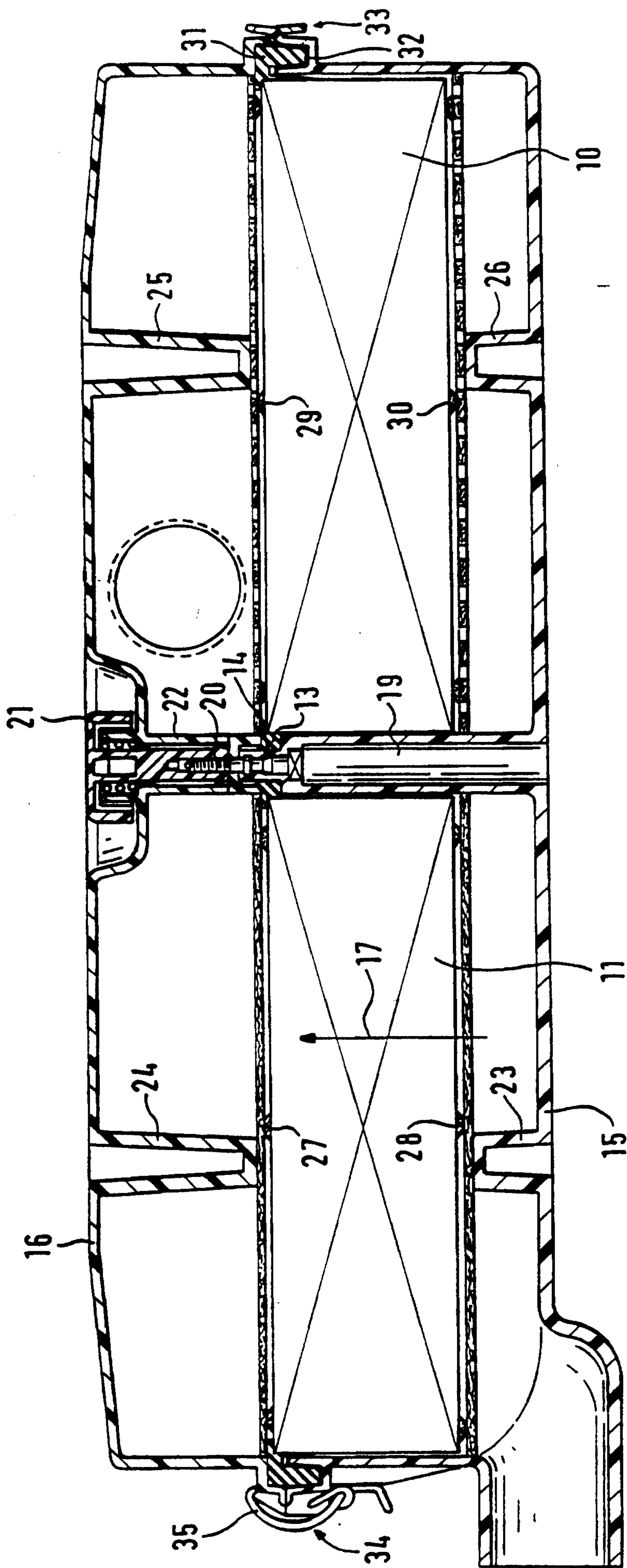


Fig. 2a

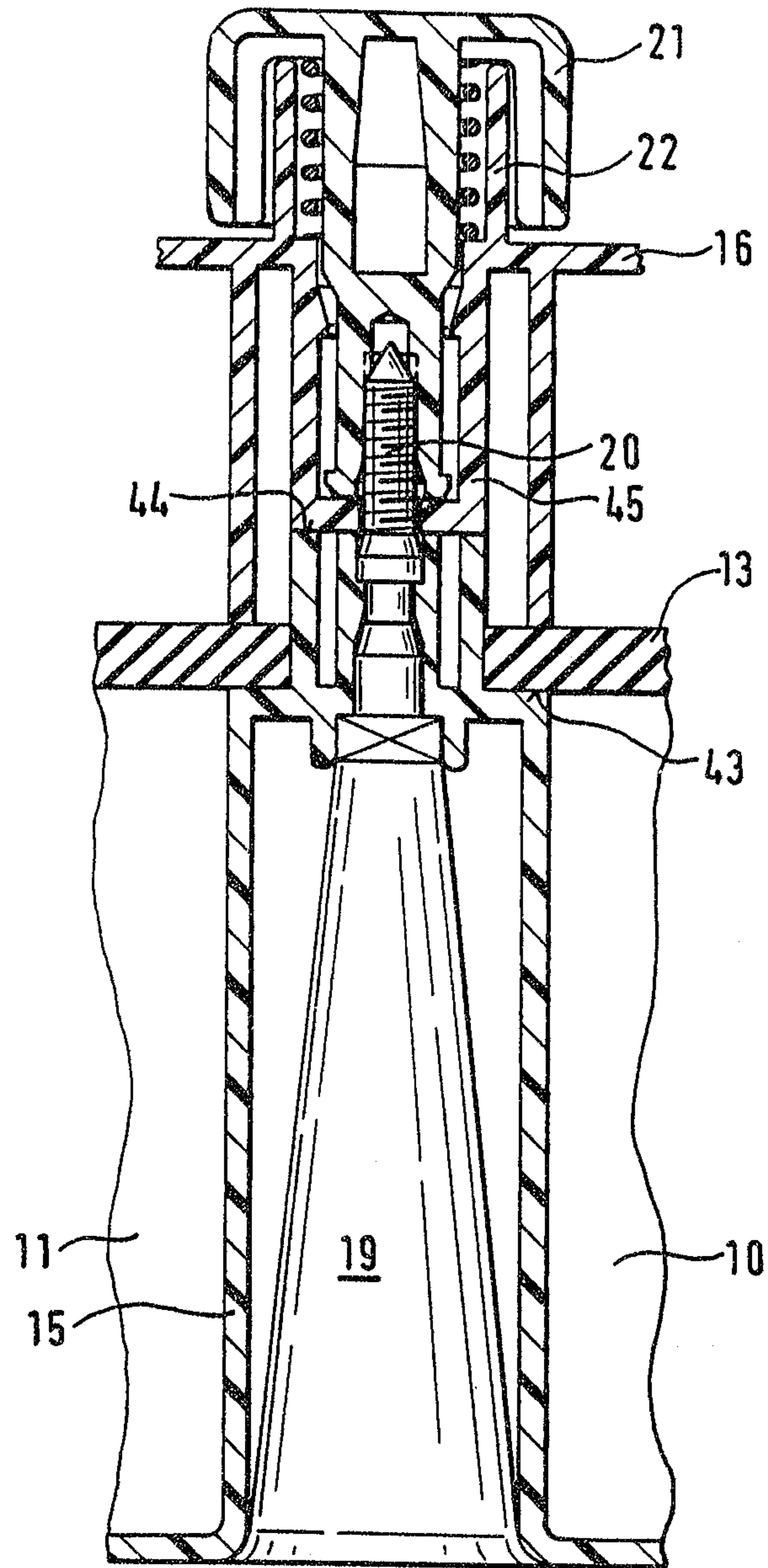


Fig. 2b

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Fig. 3

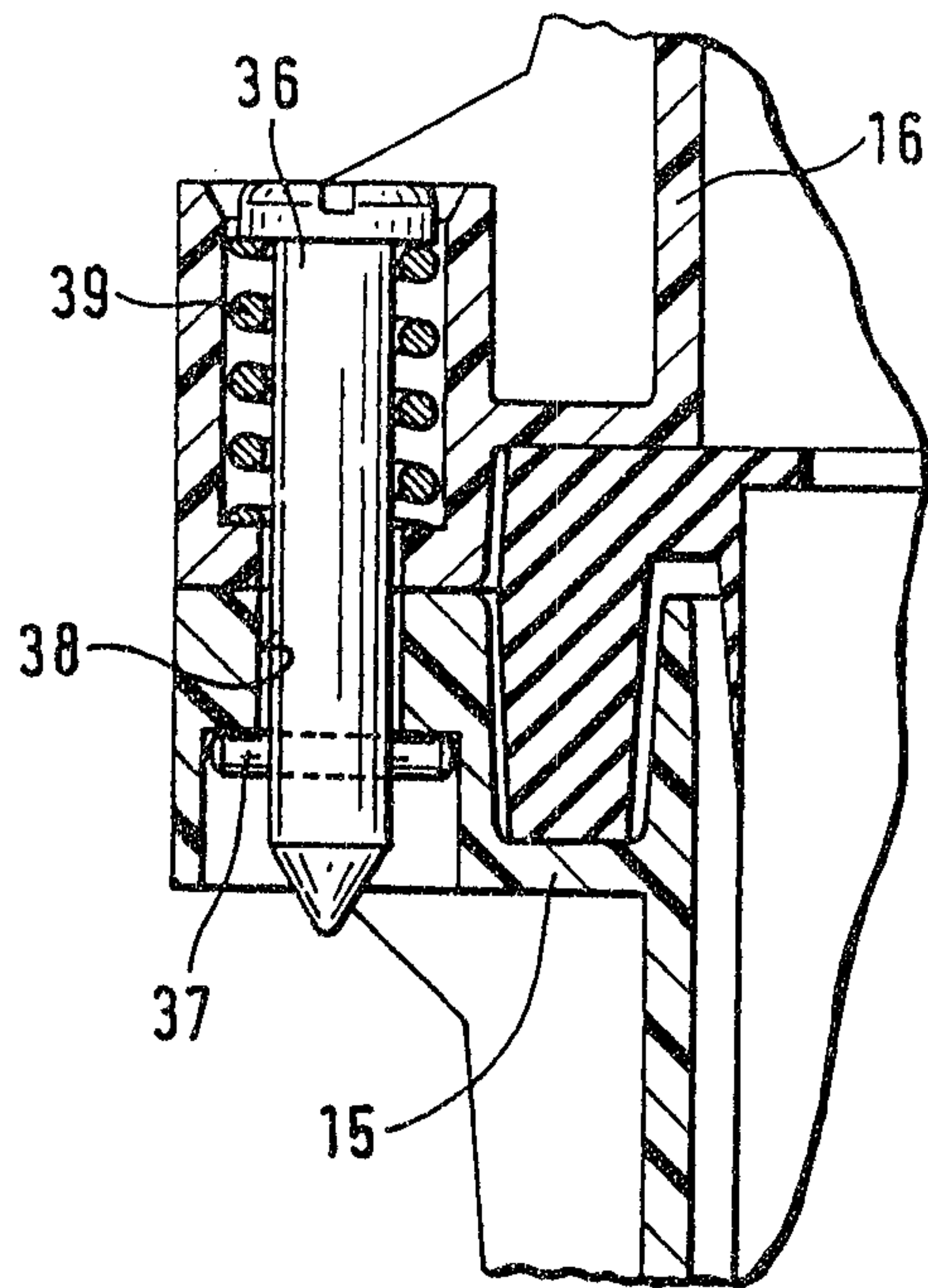
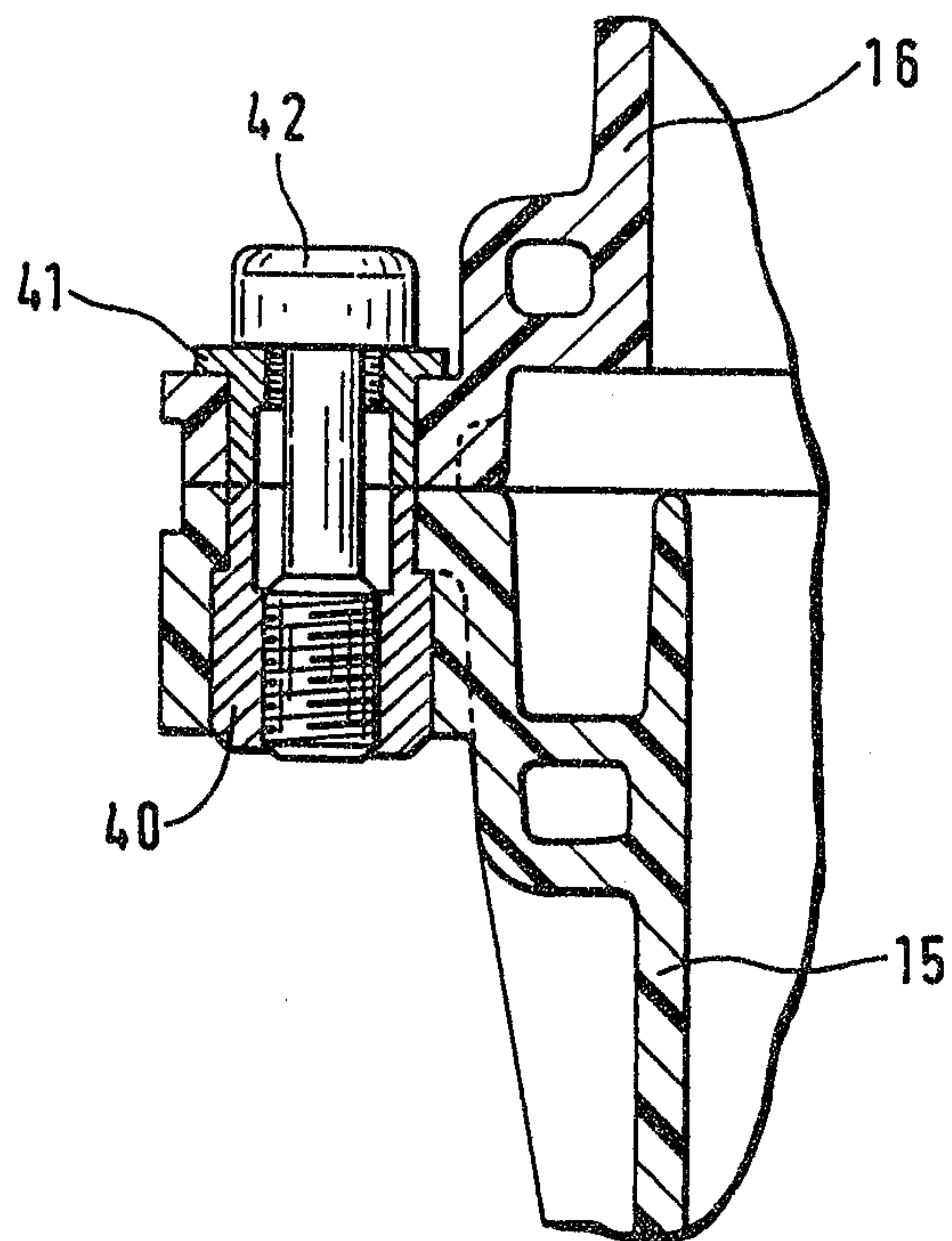


Fig. 4



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