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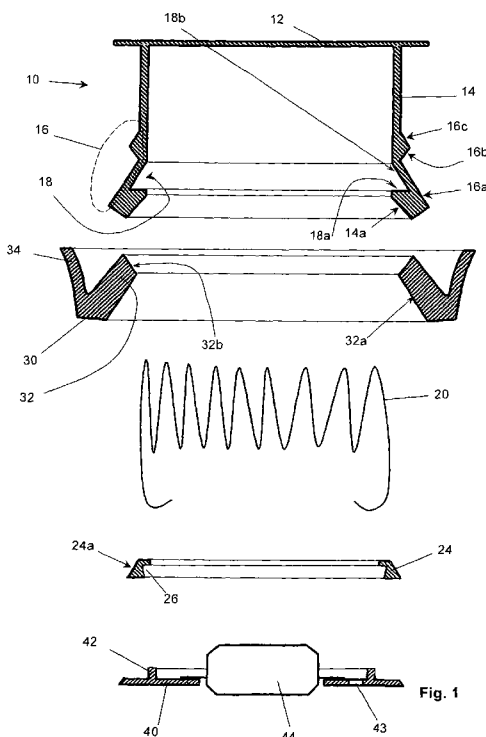
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(54) Title: AIRBAG MODULE AND PROCESS FOR ITS ASSEMBLY



(57) Abstract: An airbag module, in particular a driver front airbag module, is described. This module has a plastic cover (10) with a roof section (12) and a circumferential side wall section (14) extending from the roof section (12) in an axial direction. An airbag (20) is accommodated inside this cover. To fasten this airbag on the side wall section an inside clamping part located on the inside of the side wall section (14) and an external clamping part located on the outside of the side wall section (14), are provided, wherein a section of the airbag (20) is held in clamped fashion at least indirectly between the side wall section (14) and the inside clamping part. In order to be able to produce the components of the airbag module simply and rationally and to assemble the latter simply and rationally to the airbag module, the external clamping part is a separate external clamping ring (30), which can be brought from an assembly position into an end position by an axial movement



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Airbag module and process for its assembly

5 Description

Technical field of the invention

The invention is concerned with an airbag module in accordance with the pream-
10 ble of Claim 1 as well as with an assembly process in accordance with Claim 17.

Most front airbag modules, in particular driver front airbag modules, have a cover made of plastic with a roof section and a side wall section extending from the roof section, a base plate, a gas generator supported by the base plate, and an airbag.
15 The base plate is connected to the side wall section. The airbag's inflation opening is usually held in the area of the gas generator at a flange of the gas generator or at the base plate. For which purpose the inflation opening usually has to be strengthened and for which purpose a retainer ring is usually provided in the airbag. Two aspects are in particular disadvantageous with this type of airbag mod-
20 ules: firstly, because of the bag slap (this is the force that the deploying airbag applies to its fastening elements when the airbag reaches its fully deployed state because its movement is suddenly stopped), very high forces act on the area of the relatively small inflation opening of the airbag, which has to be strengthened appropriately in order to prevent the danger of tearing. In addition, the assembly
25 of the airbag module is relatively complicated and is only partly automatable.

Prior art

The category-defining DE 44 25 495 A1 proposes an airbag module in which the
30 airbag is held in clamped fashion between the base plate and the side wall section. To generate this clamping the base plate extends in sections around a bottom end of the side wall section in order to form an outer clamping section in

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this way. For this purpose, the base plate must be a very complicatedly shaped bent sheet metal part; assembly takes place through plastic deformation of sections of this base plate. Both the production of the base plate and the assembly of the airbag module are relatively expensive.

5

Summary of the invention

Starting from this, the present invention is concerned with the problem of improving an airbag module of this type such that its individual parts are easy and cost effective to produce and that its assembly is very simple and is automatable to a high degree.

10

This problem is solved by an airbag module with the characteristics of Claim 1.

15 An assembly process, which is in particular wholly or partially automatable, is defined in Claim 17.

In accordance with the invention a separate external clamping ring is provided that is not connected in one piece with either the side wall section or with any base part that may be present. This separate external clamping ring can be brought from an assembly position into an end position by an axial movement. The assembly position is preferably closer to the roof section of the cover than the end position.

20

25 Through the measure in accordance with the invention all the required individual parts of the airbag module can be produced very easily. In particular, the external clamping ring can be an injection-moulded plastic part. The assembly is also greatly simplified by the fact that the external clamping ring is not connected to a component that lies on the inside of the cover.

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An additional advantage is that a base part (base plate) can be present but does not have to be. It is namely possible to use a section of the airbag instead of a base part, which leads to a reduction in weight.

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An additional advantage is that the external clamping ring can also be used for the assembly of the airbag module to a steering wheel. The forces that are transmitted on the expansion of the airbag - and in particular because of the bag slap -
5 from the airbag module to the steering wheel are in this case transmitted through the external clamping ring into the steering wheel.

An additional advantage is that the airbag module can be easily designed such that the forces that take effect on the bag slap lead to a strengthening of the
10 clamping, so that there is no danger that the airbag will separate.

Additional advantages and preferred embodiments of the invention result from the further sub-claims and from the embodiments explained in detail with reference to the Figures. Hereby:

15

Brief description of the drawings

- Figure 1 shows all individual parts of a first embodiment of the airbag module in accordance with the invention in a non-assembled state,
- 20 Figure 2 shows what is shown in Figure 1 after two first assembly steps have been carried out,
- Figure 3 shows what is shown in Figure 2 after a further assembly step has been carried out,
- Figure 4 shows what is shown in Figure 3 after completion of the assembly
25 of the airbag module,
- Figure 4a shows a variant of what is shown in Figure 4,
- Figure 5 shows what is shown in Figure 4 after the airbag module has been mounted in a steering wheel,
- Figure 6 shows a second example of the first embodiment of the invention in
30 a greatly schematised partial view, wherein the airbag module is in an assembly state corresponding to Figure 2,
- Figure 7 shows what is shown in Figure 6 in an assembly condition corresponding to Figure 3,

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- Figure 8 shows what is shown in Figure 6 in an assembled condition corresponding to Figure 4,
- Figures 9-13 show an automatic assembly of the airbag module of the Figures 6 to 8,
- 5 Figure 14 shows a third example of the first embodiment in a perspective view,
- Figure 15 shows a cross section along plane A-A in Figure 14,
- Figure 16 shows a second embodiment of the airbag module in accordance with the invention in a representation corresponding to Figure 1,
- 10 Figure 17 shows what is shown in Figure 16 after a first assembly step has been carried out (corresponds basically to Figure 2),
- Figure 18 shows what is shown in Figure 17 after a further assembly step has been carried out,
- Figure 19 shows the airbag module of Figure 18 after completed assembly and
- 15 Figure 20 shows a mixed form between the embodiment example shown in Figure 4 and the second embodiment shown in Figure 19.

Detailed description of preferred embodiments

20

Figure 1 shows all individual parts of a first embodiment of the airbag module in accordance with the invention. In the state shown in Figure 1 these individual parts are completely unassembled, with one exception (base part and gas generator). The airbag module has a cover 10, an external clamping ring 30, an inside

25 clamping ring 24, an airbag 20, a rigid base part 40 and a gas generator 44. The gas generator 44 is firmly connected to the base part 40, as shown in Figure 1 (as already mentioned). It would also be possible to design the gas generator and the base part as a single component, in particular in such a way that the base part is a large gas generator flange.

30

The cover 10 has a roof section 12 and a circumferential side wall section 14 extending from the roof section 12 in an axial direction. So, the cover 10, which is

- 5 -

preferably an injection-moulded part made of plastic, forms a type of pot. The side wall section 14 forms preferably a ring with an essentially circular cross-section.

The side wall section 14 has an outer contour 16 and an inner contour 18. The
5 inner contour 18 forms a groove with a horizontal surface section 18a and a surface section 18b running upwards. The outer contour has a first upward pointing surface section 16a and a wedge adjoining the first upward pointing surface section 16a in the direction of roof section 12. The wedge has a downwards pointing surface section 16b and a second upwards pointing surface section 16c. Here,
10 "pointing upwards" and "pointing downwards" means pointing slantwise upwards or downwards respectively, so that the respective surface normals have an axial and a radial portion. The first upwards pointing surface section 16a is basically opposite the inner contour 18, wherein the upwards pointing surface section 18b of the inner contour 18 and the first upwards pointing surface section 16a of the
15 external contour 16 extend parallel to one another.

The lower edge region of side wall section 14 has a coning section 14a, wherein the corresponding cone tapers upwards. In this application "upwards" means "in the direction of the roof section". The lower edge region can have slits extending
20 in radial direction in order to increase the elasticity of this region. In this case, the coning section 14a is divided into several sections.

The external clamping ring 30 has a ring rail with an essentially V-shaped cross-section with an inner leg 32 and an outer leg 34. A surface 32a of the external
25 clamping ring 30 that points inwards is inclined and dimensioned in such a way that it can be brought to rest on the upwards pointing surface section 16a of the external contour 16, as will be seen below. In addition, the external clamping ring 30 has an upwards pointing surface 32b, which is inclined and dimensioned in such a way that it can be brought to rest on the downwards pointing surface section 16b of external contour 16; this will also be seen below.
30

The inside clamping ring 24 is shaped and dimensioned so that it fits into the inside contour 18 together with an outer edge of the base part 40. For this purpose

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it has an outwards pointing surface 24a. In addition, the inside clamping ring 24 has an indentation 26 on the inside. The inside clamping ring 24 is also preferably an injection-moulded plastic part.

5 The base part 40, which can be designed as a sheet metal or plastic part, has an upwards extending ring-shaped protrusion 42, which extends in an assembled state into the indentation 26 of the inside clamping ring 24, which will soon be seen with regard to Figure 2. The base part 40 also has a central opening, through which the gas generator 44 projects into the inside of the airbag 20. Fi-
10 nally, a ventilation opening 43 is provided between the ring-shaped protrusion 42 and the central opening for the gas generator 44.

Figure 2 shows what is shown in Figure 1 after two initial assembly steps that are independent of each other have been carried out: The external clamping ring 30
15 has been pushed onto the side wall section 14, wherein it is held in place by the second upwards pointing surface sections 16c of external contour 16. In order to be able to achieve this pushing onto the side wall section 14, the lower area of side wall section 14 and/or the external clamping ring 30 must have a certain amount of elasticity, for which purpose, as already mentioned, radial slits can be
20 provided in the lower edge region of side wall section 14.

In addition, the airbag 20 has been attached to the base part 40 by means of the inside clamping ring 24, wherein an edge of the airbag 20 is clamped between the inside clamping ring 24 and the ring-shaped protrusion 42. However, without addi-
25 tional measures this clamping would be insufficient to hold the airbag 20 at the base part 40 when the airbag is filled.

Figure 3 shows a subsequent assembly state. Here the airbag 20 has been folded into the cover 10 and the base part 40 has been slid into the side wall section 14
30 together with the inside clamping ring 24 until an outer edge of the base part 40 and the outward pointing surface 24a of the inside clamping ring 24 came to lie in the inner contour 18.

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To finish the assembly of the airbag module the external clamping ring 30 is pushed downwards in a radial movement (that is, away from roof section 12) until the status shown in Figure 4 is reached.

5 As can be seen in Figure 5, the outer leg 34 of the external clamping ring 30 can be used together with not shown, in axial direction operating horn springs to hold the airbag module on retaining parts 50 on the steering wheel side. The force path that leads from the airbag 20 into the retaining parts 50 on the bag slap can be seen directly in Figure 5. It can also be seen directly in Figure 5 that when the bag
10 slap occurs the clamping force of the external clamping ring 34 on the side wall section 14; and thus the clamping force of the side wall section 14 on the inside clamping ring 24 and the base part 40, is increased; this means that the clamping force is increased when it is required, so that loosening of the airbag 20 from the side wall section 14 is ruled out. In this example the inside clamping ring 24
15 serves as an inside clamping part.

Figure 4a shows a variant in which the ventilation opening 43 is a part of a Venturi nozzle. For this purpose an air conducting element 43a is located on the inside of the base part 40 and forms a Venturi tube together with a section of the base part.
20 Said Venturi tube has its smallest diameter at the position of the ventilation opening 43. One face side of the Venturi tube points towards an outlet opening 44a of the gas generator 44, the other face side towards the inside of the airbag. In this way the ventilation opening 43 does not serve for the ventilation while the airbag is deployed; on the contrary, additional external air is sucked in. After the gas
25 generator 44 has burned out the ventilation opening 43 is used for ventilation.

With the example described above having a rigid base part 40 it would be possible in principle to do without an inside clamping ring 24, so that the airbag is clamped exclusively between the rigid base part 40 and the inside contour 18 of
30 the side wall section 14. However, because of the simpler mounting process alone, an additional inside clamping ring 24 is preferred.

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Figures 6 to 8 show a variant of the example just described, wherein only one part of the airbag module is illustrated. The differences to the first example are as follows: inner contour and outer contour are formed as inner groove 18d and outer groove 16d opposing each other, wherein each of the two grooves has a basically rectangular cross-section. The second difference is that the airbag 20 is not directly clamped between the side wall section 14 and the base part 40 that serves as inside clamping part but indirectly, because the lower edge of the airbag 20 is held completely between the inside clamping ring 24 and the base part 40. According to the definitions chosen in this application the inside clamping ring 24 is not used as an inside clamping part but as a force transmission element between the side wall section 14 and the rigid base part 40.

Figures 9 to 13 show how the airbag module described above can be assembled fully automatically by means of an automatic assembly machine 60. This automatic assembly machine 60 has a ring-shaped stationary element 62, a vertically movable element 64 held in the central opening of the stationary element 62, first horizontally movable elements 66a, 66b located above the stationary element 62 and second horizontally movable elements 68a, 68b with wedge-shaped projections 69a and 69b located above these first horizontally movable elements. Finally, there is a holding element 70 (illustrated in Figures 12 and 13 only).

Figure 9 shows an initial assembly state in which the airbag 20 is fastened to the base part 40 by means of the inside clamping ring, wherein the gas generator 44 is already mounted at the base part 40. This assembly state corresponds to what is shown in the lower part of Figure 6. The automatic assembly machine 60 is in a state in which the vertically movable element 64 is in its lowest position, the two first horizontally movable elements 66a, 66b are open, and the second horizontally movable elements 68a, 66b are closed. First of all (Figure 7) the two first horizontally movable elements 66a, 66b are closed. By this movement the airbag 20 is compressed and thus packed. The first two horizontally movable elements 66a, 66b each have a semicircular recesses pointing towards each other, so that in the closed state of Figure 10 a cylindrical packing space for the airbag 20 is formed. The two second horizontally movable elements 68a, 68b are now opened

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(Figure 11). Following this, the cover 10 is positioned above the packed airbag 20 by means of the holding element 70 and lowered towards the horizontally movable elements 66a, 66b. This movement causes the coning section 14a of the lower edge region of the side wall section 14 to slide on the wedge-shaped projections 69a, 69b and the lower edge region to be widened, enabling the base part 40 with the inside clamping ring 24 to enter the inside groove 18d. In this state the vertically movable element 64 is moved upwards.

As shown in Figure 13, the holding element 70 is now moved upwards and the vertically movable element 64 is moved downwards, causing the lower edge of the side wall section 14 to return to its original shape. At the same time, or following this, the external clamping ring 30 is pushed downwards. This can also take place automatically, but this is not shown in detail.

Figures 14 and 15 show a third example of the first embodiment. As in the first example, the external clamping ring 30 is also used for the assembly of the airbag module in a steering wheel body. For this purpose, the external clamping ring has lugs 36 each with an opening 36a that can latch in corresponding hook elements of the steering wheel body (not illustrated) by means of their contact surfaces 36b. The lugs extend downwards, so that the connection of the airbag module at the steering wheel body can take place at the level of the gas generator or under the gas generator. In addition, there are supporting sections 38 formed on the external clamping ring 30 on which the horn springs 52 are in contact.

The area of the side wall section 14 in which the clamping takes place is practically without contours here, as can be seen in Figure 15. The airbag 20 is clamped directly between the side wall section 14 and the base part and between the base part 40 and the inside clamping ring 24. Above the inside clamping ring 24 protrusions 15 extend from the side wall section 14 to the inside that define the assembled position of the inside clamping ring 24 and that can transfer forces on the occurrence of the bag slap. In order to define the assembled position of the external clamping ring, snap-in noses 30a extend from the latter into corresponding lock-in recesses 17 of the side wall section 14.

All three previously described examples is in common that the side wall section 14 and the inside clamping ring 24 only have to transfer pressure forces, so this components can be made from cost-effective unreinforced plastic material.

5

Figures 16 to 19 show a second embodiment of the invention in a representation according to Figures 1 to 4. The difference is that there is no rigid base part 40. Instead, the base is formed by a base section 20c of the airbag 20 and the airbag is clamped in the inside contour 18 exclusively by means of the inside clamping ring 24. The base section 20c of the airbag can be a separate fabric element, which is sewn in such a way that the seam separates a main section 20a from a connecting section 20b of the airbag. This connecting section 20b is connected to the inside clamping ring 24 by means of a retaining ring 21, wherein this retaining ring 21 lies in a groove 28 of the inside clamping ring 24. In the assembled state (Figure 14) groove 28 and inside clamping ring 24 are located in the transition area between the horizontal surface section 18a and the upward running surface section 18b of the inner contour 18. The base section 20c has an opening through which the gas generator projects into the inside of the airbag. The connection between gas generator 44 and base section 22 is made by means of a fastener ring 23, which clamps an edge region of the airbag 50 on a fastener flange 46 of the gas generator 44. In addition, a ventilation opening is provided in the base section.

Figure 20 shows a hybrid of the two previously described embodiments. The basic structure is very similar to the one shown in Figure 4 with the difference that the component that corresponds to the rigid base part 40 is ring-shaped and does not extend to the gas generator 44. This component is referred to as ring-shaped inside clamping part 41. The clamping between this component, the inside clamping ring 24 and the sidewall section 14 corresponds to the first example of the first embodiment. In contrast to the latter the airbag 20 extends by means of its base section 20c to the gas generator 44 and bears it, as in the second embodiment.

List of reference signs

- 10 Cover
- 12 Roof section
- 5 14 Side wall section
- 14a Coning section
- 15 Protrusion
- 16 outer contour
- 16a First upward pointing surface section
- 10 16b Downward pointing surface section
- 16c Second upward pointing surface section
- 16d Outer groove
- 17 Lock-in recess
- 18 Inner contour
- 15 18a Horizontal surface section
- 18b Upward pointing surface section
- 18d Inner groove
- 20 Airbag
- 21 Retaining ring
- 20 20a Main section
- 20b Connecting section
- 20c Base section
- 22 Ventilation opening
- 23 Fastener ring
- 25 24 Inside clamping ring
- 24a Outward pointing surface
- 26 Indentation
- 28 Groove
- 30 Outer clamping ring
- 30 30a Snap-in nose
- 32 Inner leg
- 32a Inward pointing surface
- 32b Upward pointing surface

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- 34 Outer leg
- 36 Lug
- 36a Opening
- 36b Contact surface
- 5 38 Support section
- 40 Base part
- 41 Ring-shaped inside clamping part
- 42 Ring-shaped protrusion
- 43 Ventilation opening
- 10 43a Air conducting element
- 44 Gas generator
- 46 Fastening flange
- 50 Retaining part on the steering wheel side
- 52 Horn springs
- 15 60 Automatic assembly machine
- 62 Stationary element
- 64 Vertically movable element
- 66a,b First horizontally movable elements
- 68a,b Second horizontally movable elements
- 20 69a,b Wedge-shaped projections
- 70 Holding element

Patent claims

1. Airbag module, in particular driver front airbag module, with
a cover (10) made of plastic with a roof section (12) and a circumferential
5 side wall section (14) extending from the roof section (12) in an axial direc-
tion,
an airbag (20) accommodated in the cover,
an inside clamping part located on the inside of the side wall section (14)
and
10 an external clamping part located on the outside of the side wall section
(14), wherein
a section of the airbag (20) is at least indirectly held in a clamped fashion
between the side wall section (14) and the inside clamping part,
characterised in that
15 the external clamping part is a separate external clamping ring (30), which
can be brought from an assembly position into an end position by an axial
movement.
2. Airbag module according to claim 1, characterised in that the external
20 clamping ring (30) applies in its end position a radial force on the side wall
section (14).
3. Airbag module according to claim 1 or claim 2, characterised in that the
assembly position of the external clamping ring (30) lies closer to the roof
25 section (12) than the end position.
4. Airbag module according to one of the preceding claims, characterised in
that the side wall section (14) has an outer contour (16), for example in the
form of an outer groove (16d).
30
5. Airbag module according to claim 4, characterised in that the external
clamping ring (30) snaps in the end position into the outer contour (16).

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6. Airbag module according to one of the preceding claims, characterised in that the side wall section (14) has an inner contour (18), for example in the form of an inner groove (18d), in which the inside clamping part is accommodated in sections.
- 5 7. Airbag module according to claim 4 or claim 5 and claim 6, characterised in that the outer contour (16, 16d) and the inner contour (18, 18d) are opposite each other.
- 10 8. Airbag module according to one of the preceding claims, characterised in that the external clamping ring (30) has at least one contact surface (36b) to hold the airbag module in a steering wheel.
9. Airbag module according to claim 8, characterised in that the contact surface (36b) points in the direction of the roof section (12).
- 15 10. Airbag module according to one of the preceding claims, characterised in that the inside clamping part comprises an inside clamping ring (24).
- 20 11. Airbag module according to one of the preceding claims, characterised in that the inside clamping part comprises a basically rigid base part (40) that bears a gas generator.
12. Airbag module according to claim 11, characterised in that a ventilation opening (43) is provided in the rigid base part (40).
- 25 13. Airbag module according to claim 12, characterised in that the ventilation opening (43) is s part of a Venturi nozzle.
- 30 14. Airbag module according to claim 10 and one of Claims 11 to 13, characterised in that a section of the airbag is also held in clamped fashion between the inside clamping ring (24) and the rigid base part (40).

- 15 -

15. Airbag module according to one of the claims 1 to 10, characterised in that a base section (20c) of the airbag (20) extends between the inside clamping part and a gas generator (44), so that the gas generator (44) is held by this base section (20c).
- 5
16. Airbag module according to one of the preceding claims, characterised in that the clamping of the airbag between the side wall section and the inside clamping part is direct at least in sections.
- 10
17. Process for the assembly of an airbag module in accordance with one of the preceding claims, wherein at first the external clamping ring (30) is located in its assembly position on the side wall section (14), subsequently the airbag (20) and the inside clamping part are located in the cover (10) and finally the external clamping ring (30) is brought into its end position by an axial movement.
- 15

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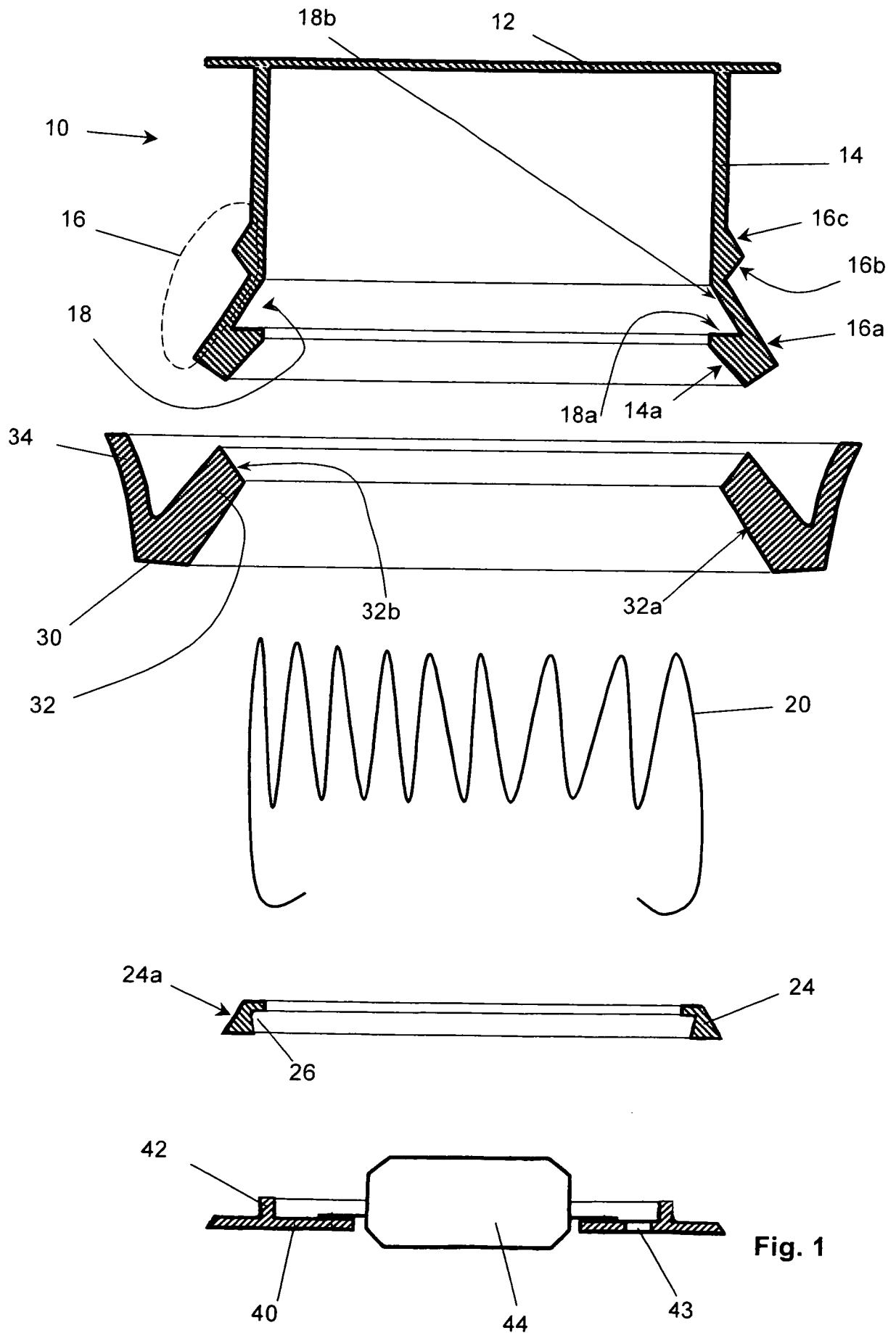


Fig. 1

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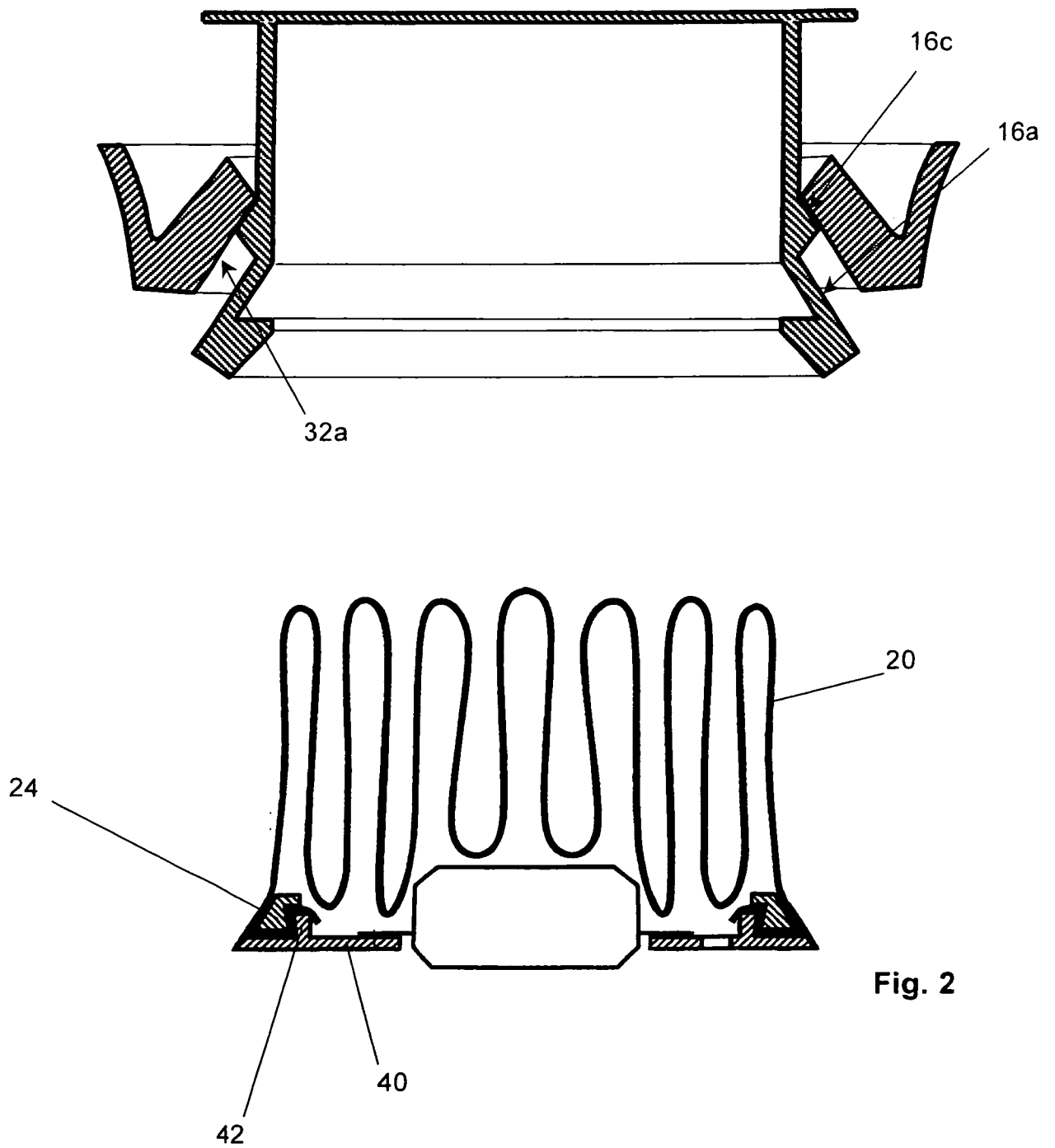


Fig. 2

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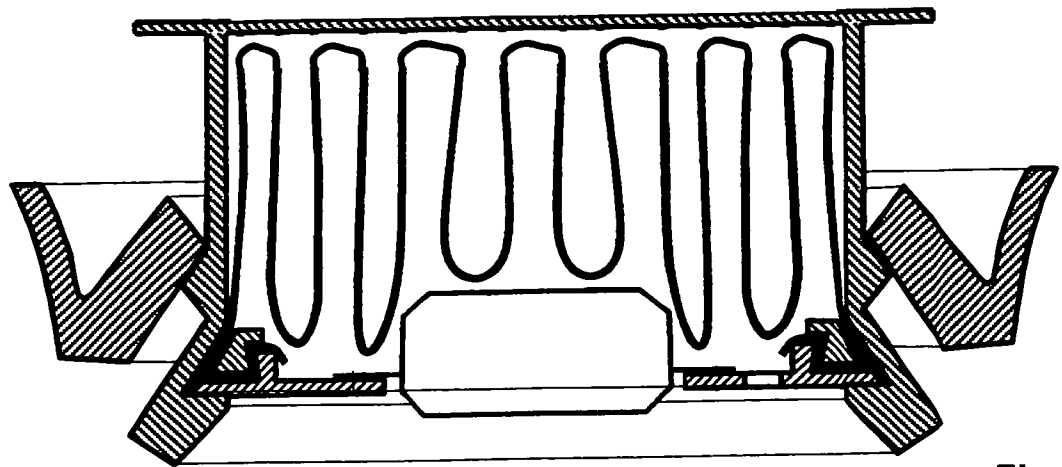


Fig. 3

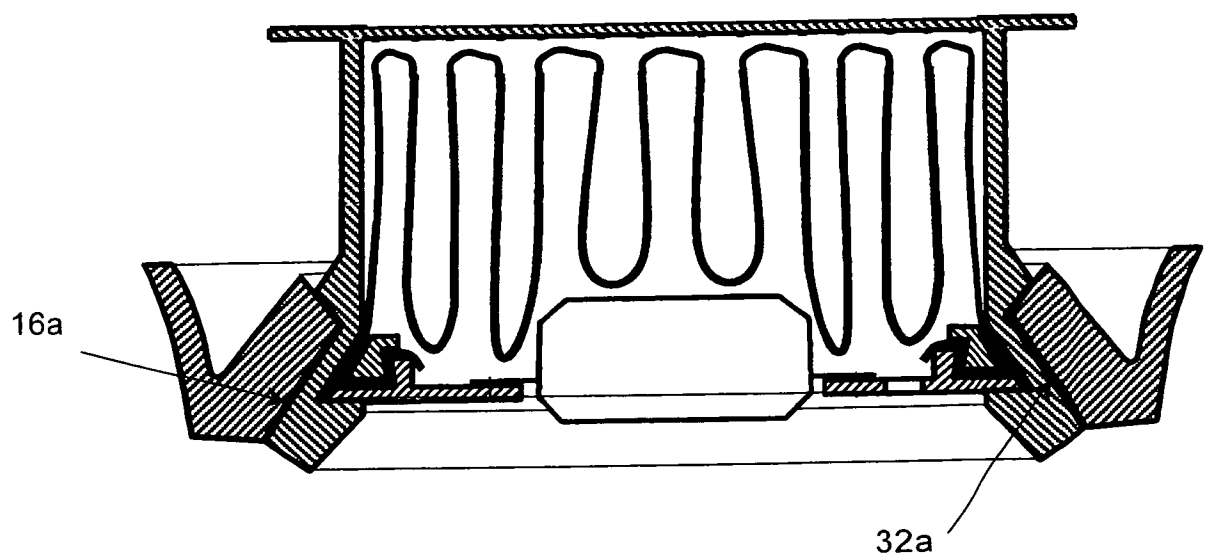


Fig. 4

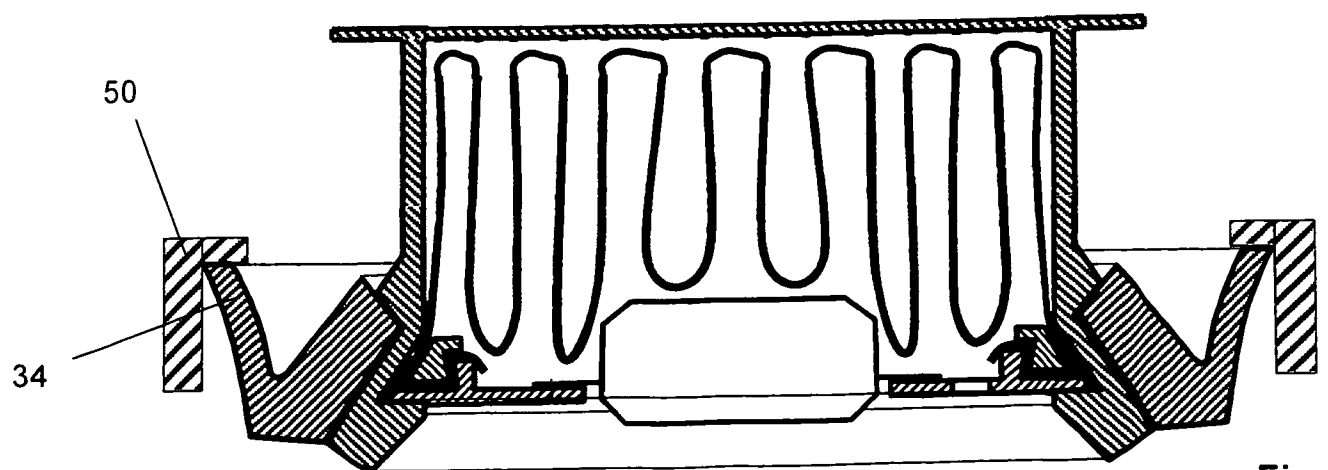


Fig. 5

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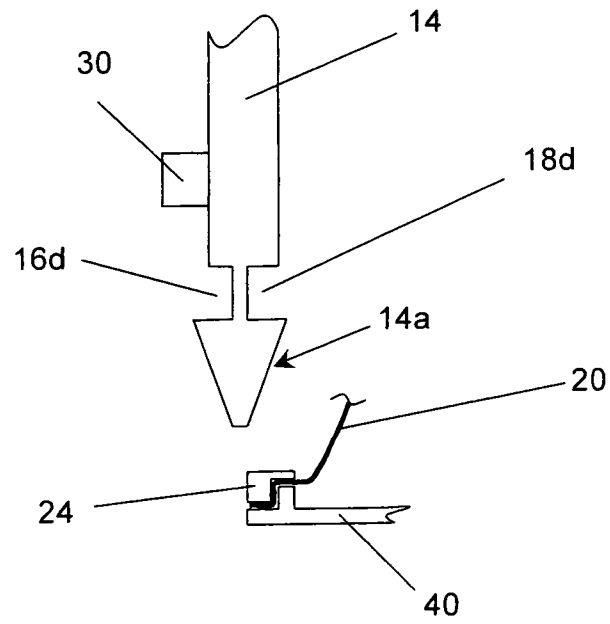


Fig. 6

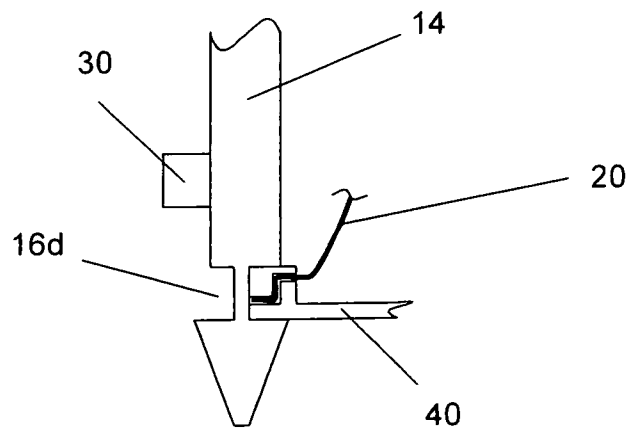


Fig. 7

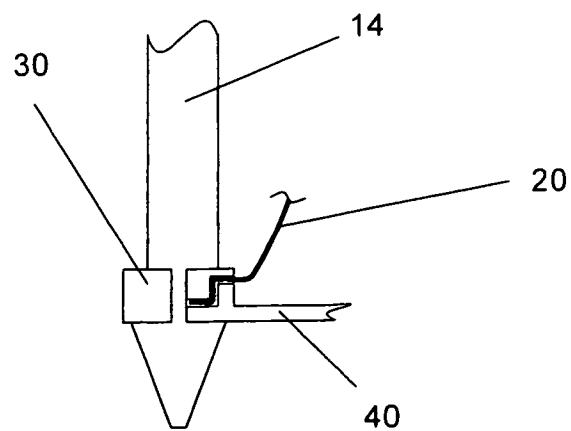


Fig. 8

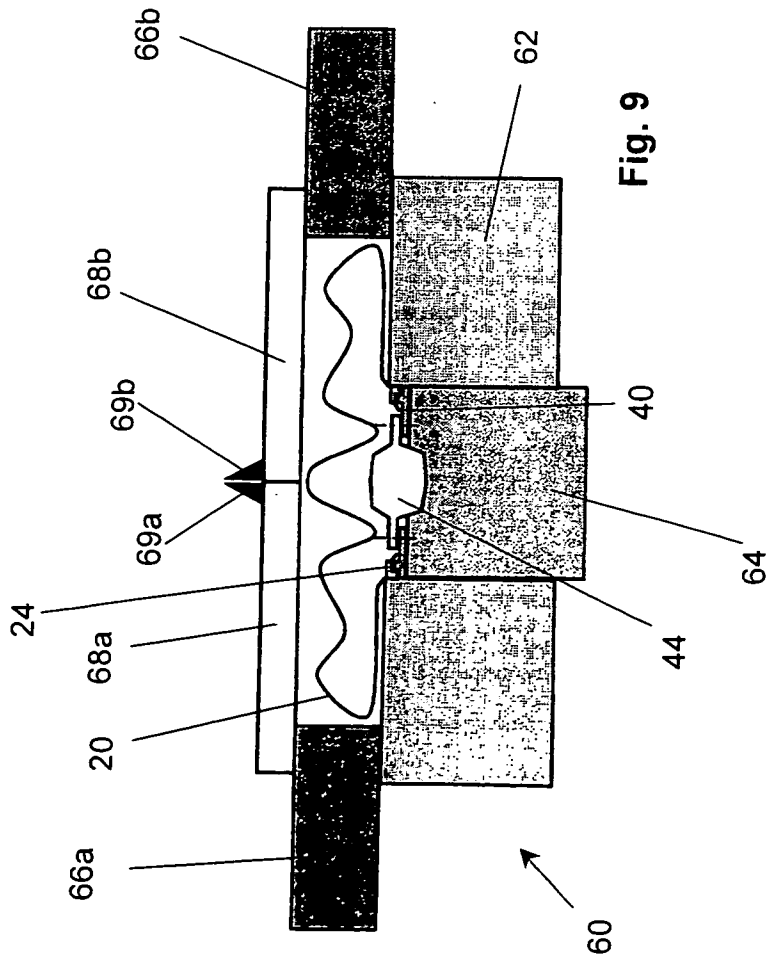


Fig. 9

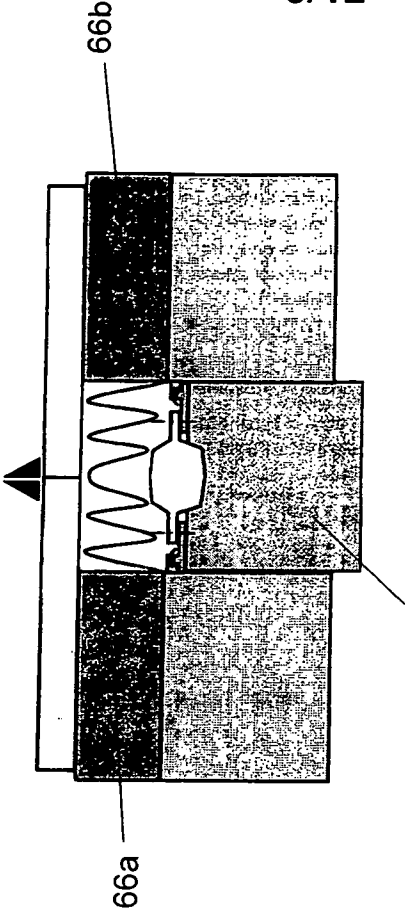


Fig. 10

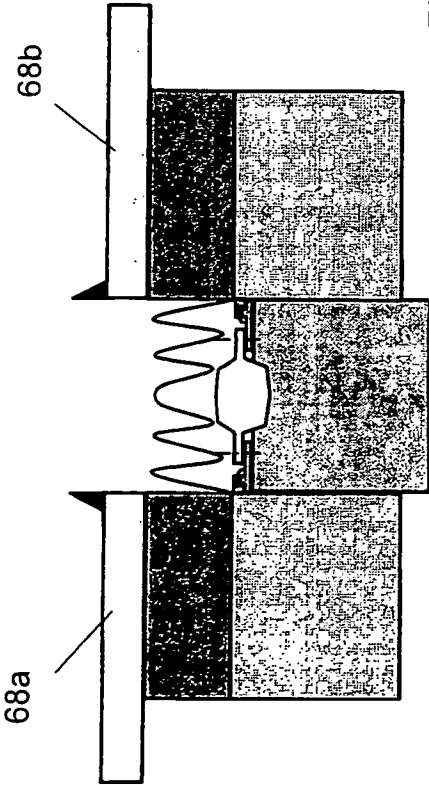


Fig. 11

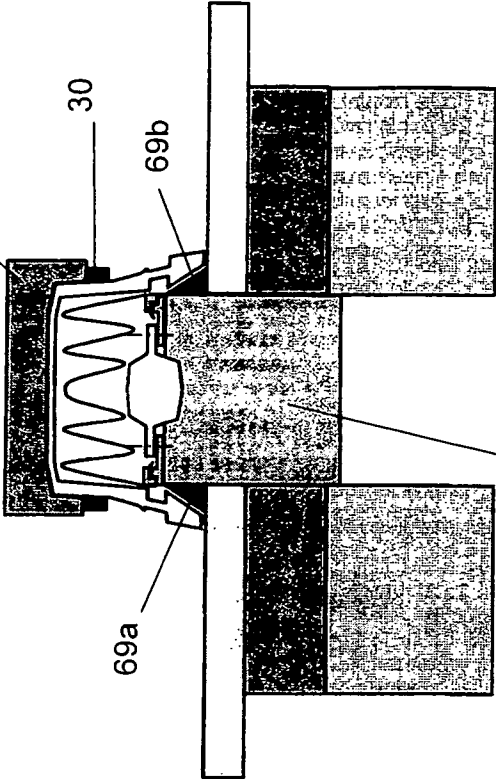


Fig. 12

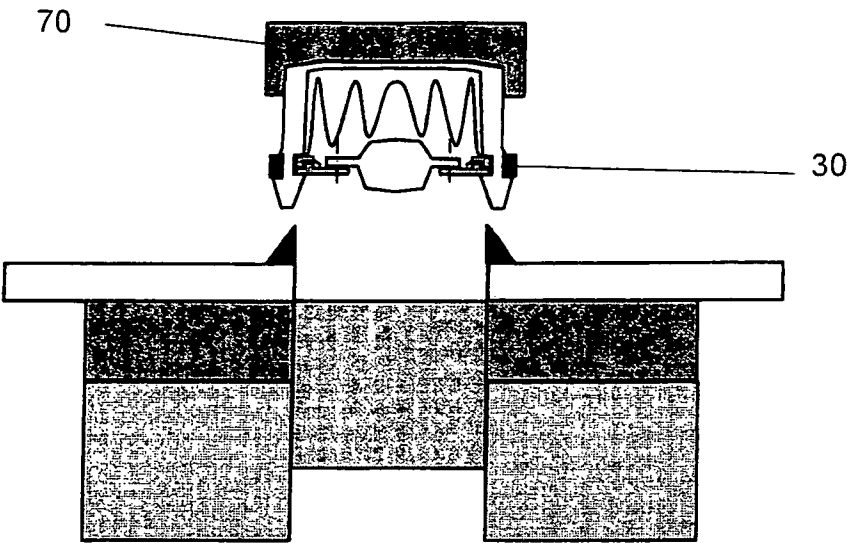
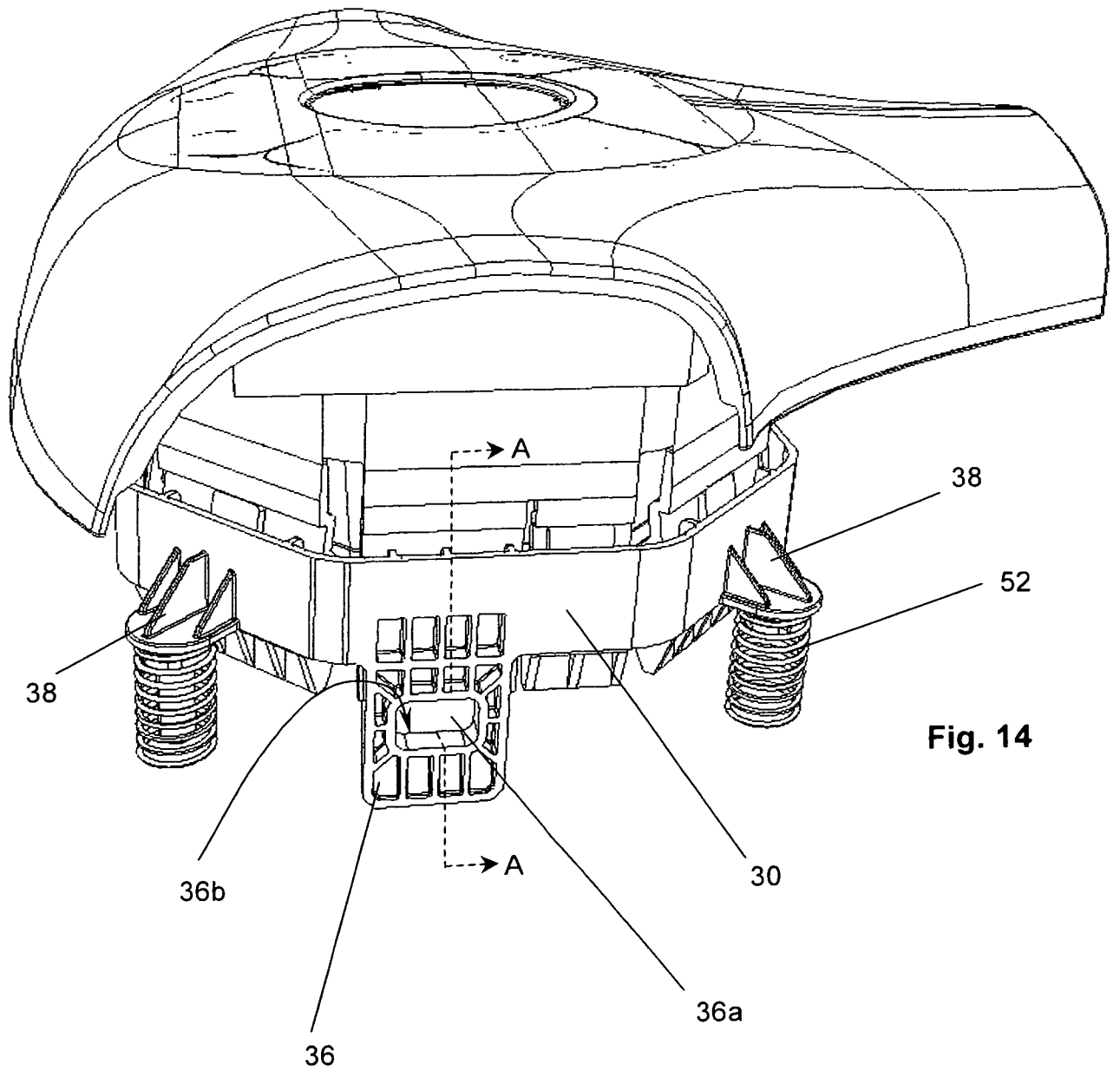
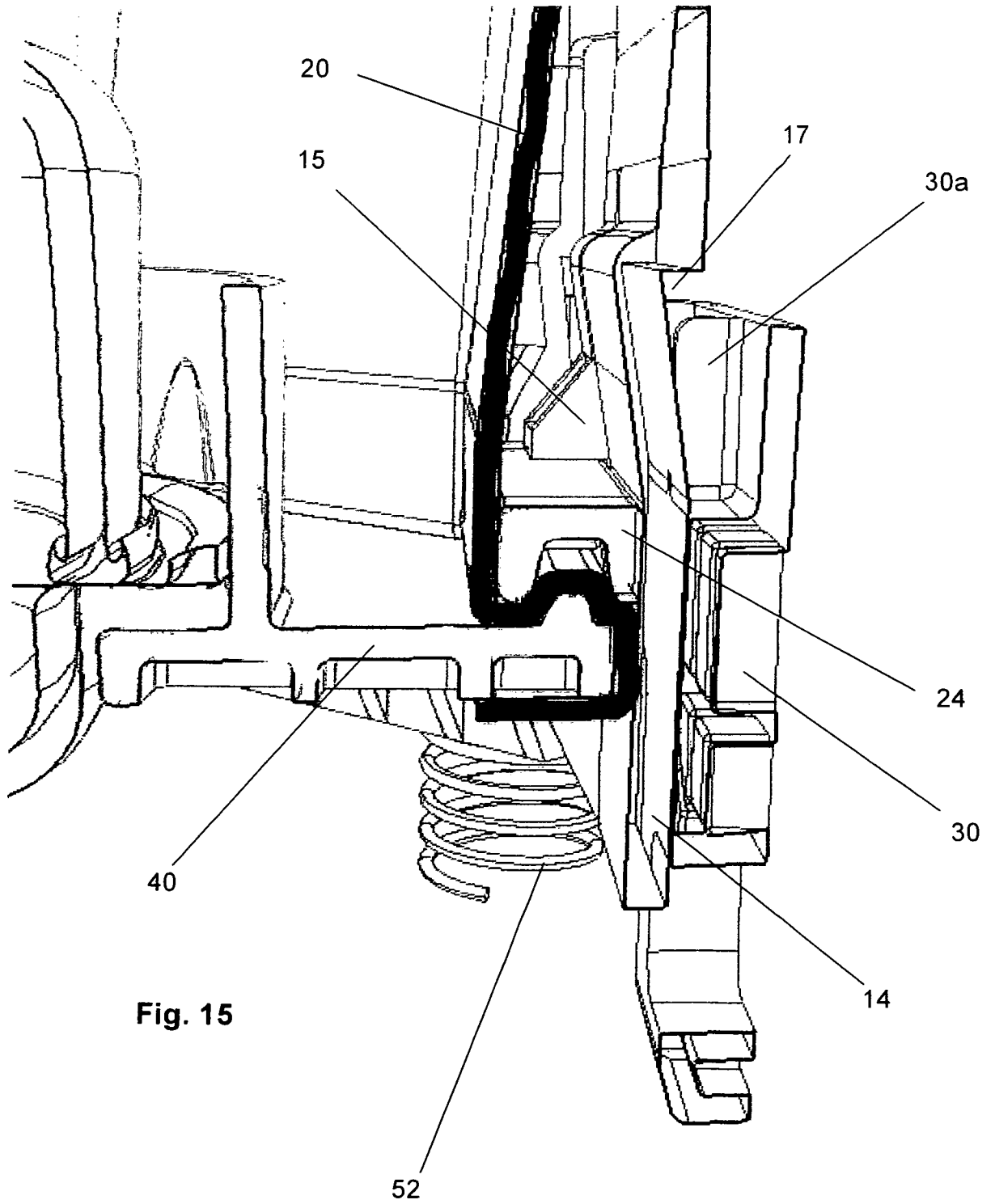


Fig. 13

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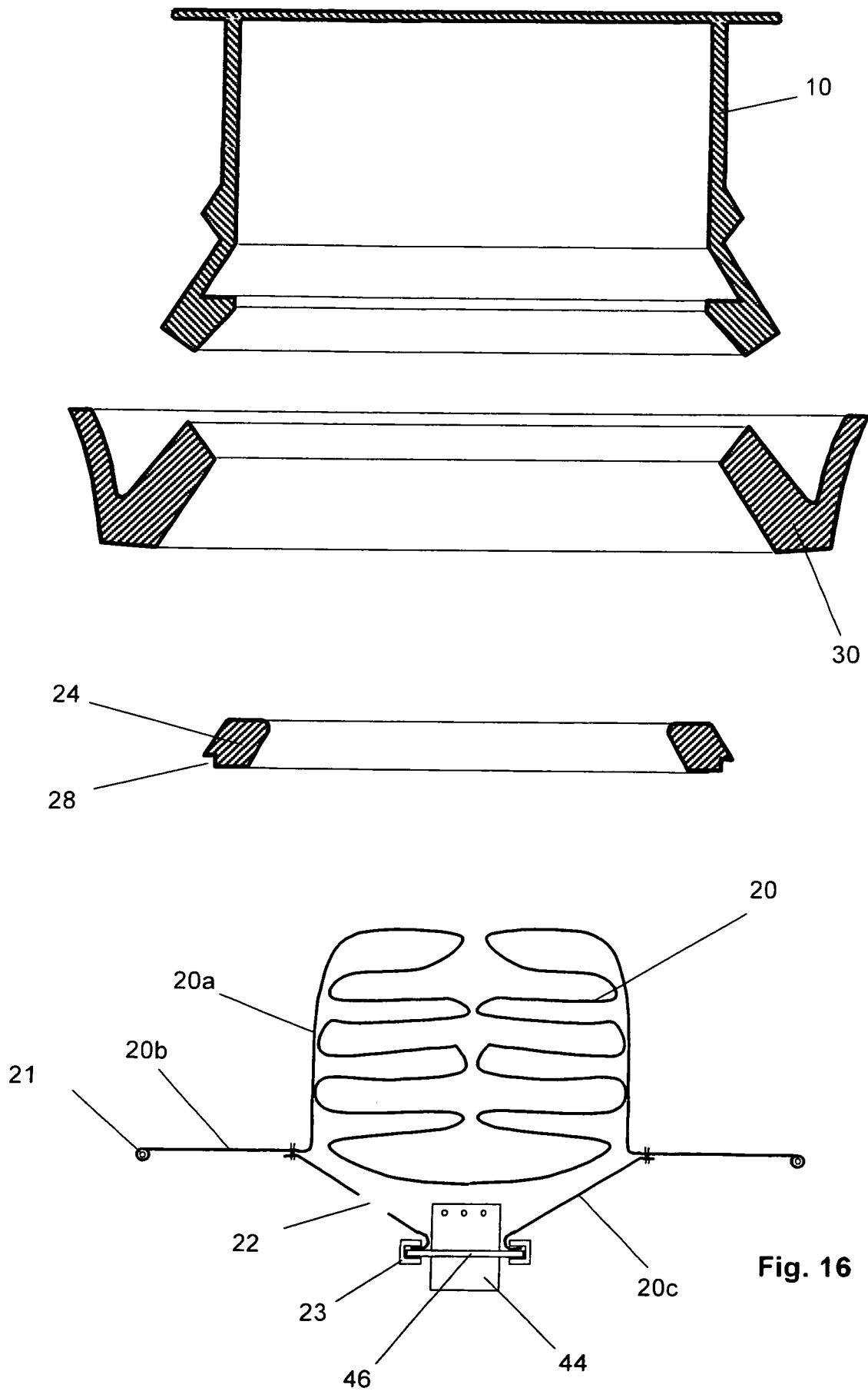


Fig. 16

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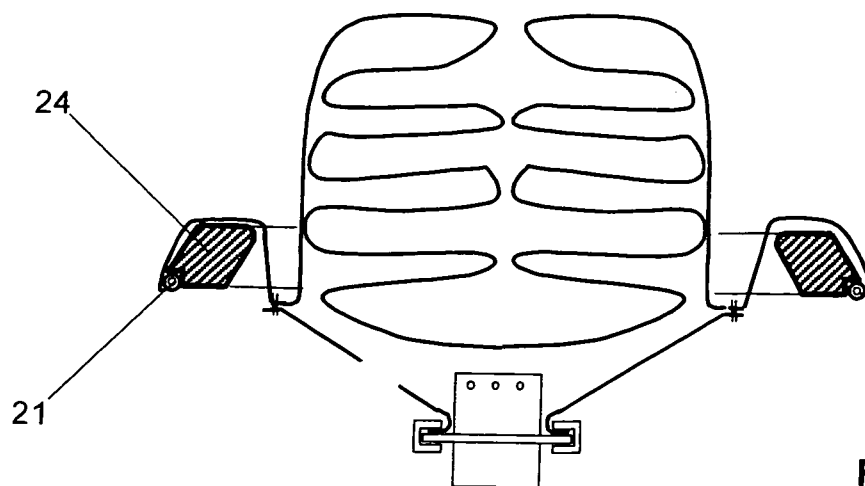
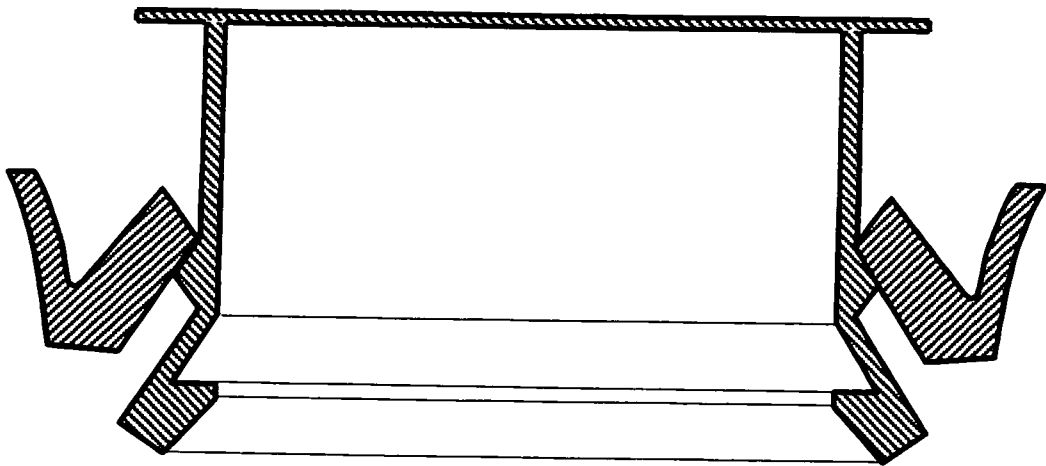


Fig. 17

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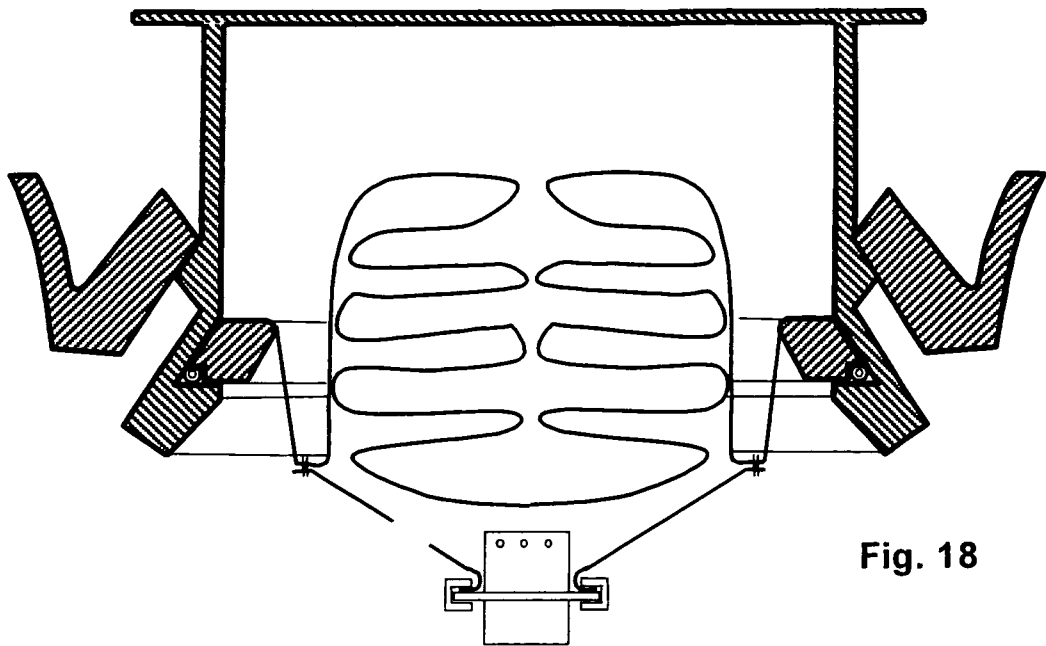


Fig. 18

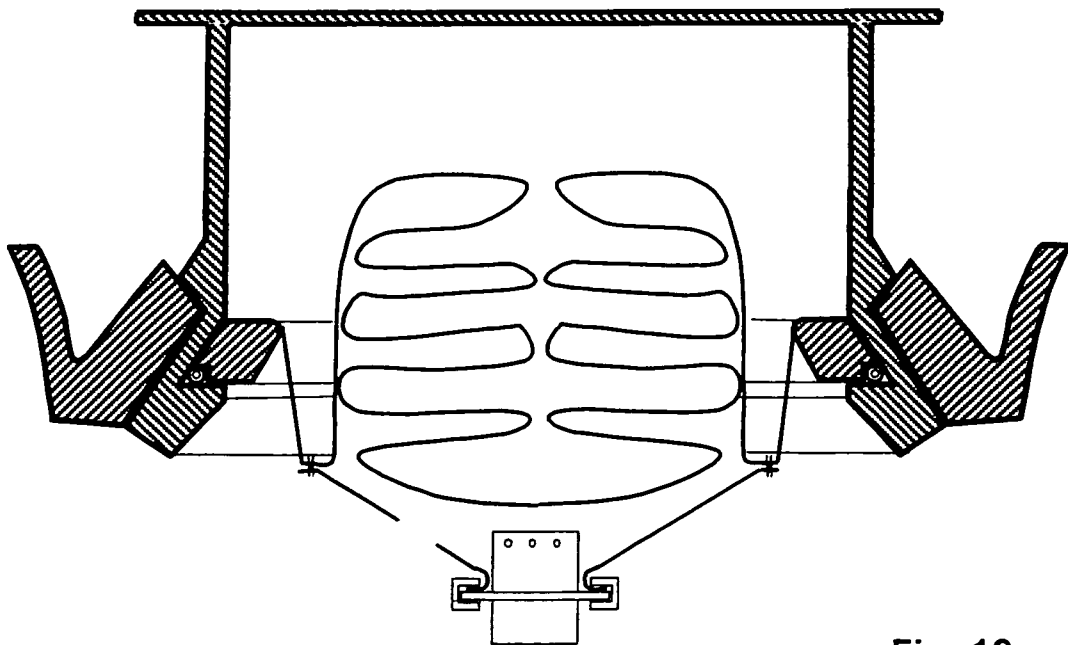
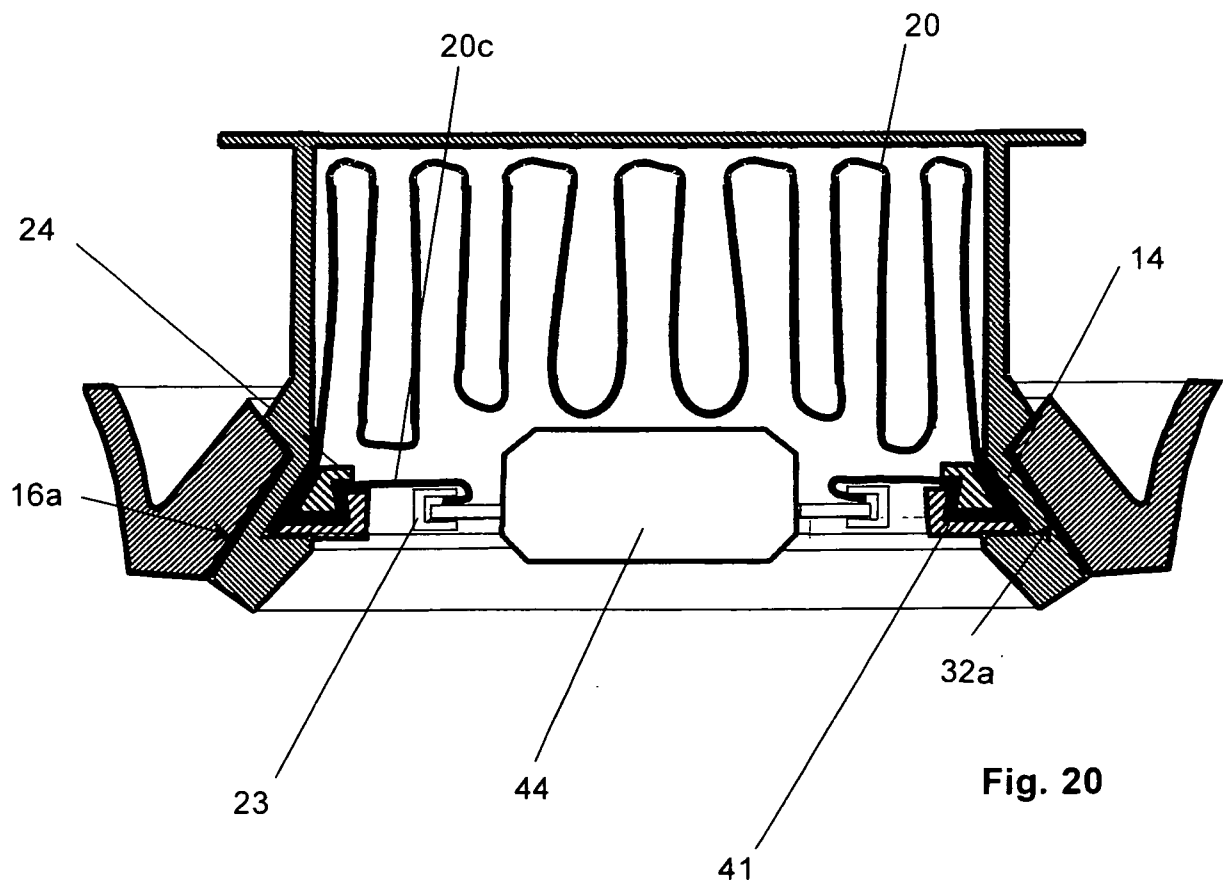
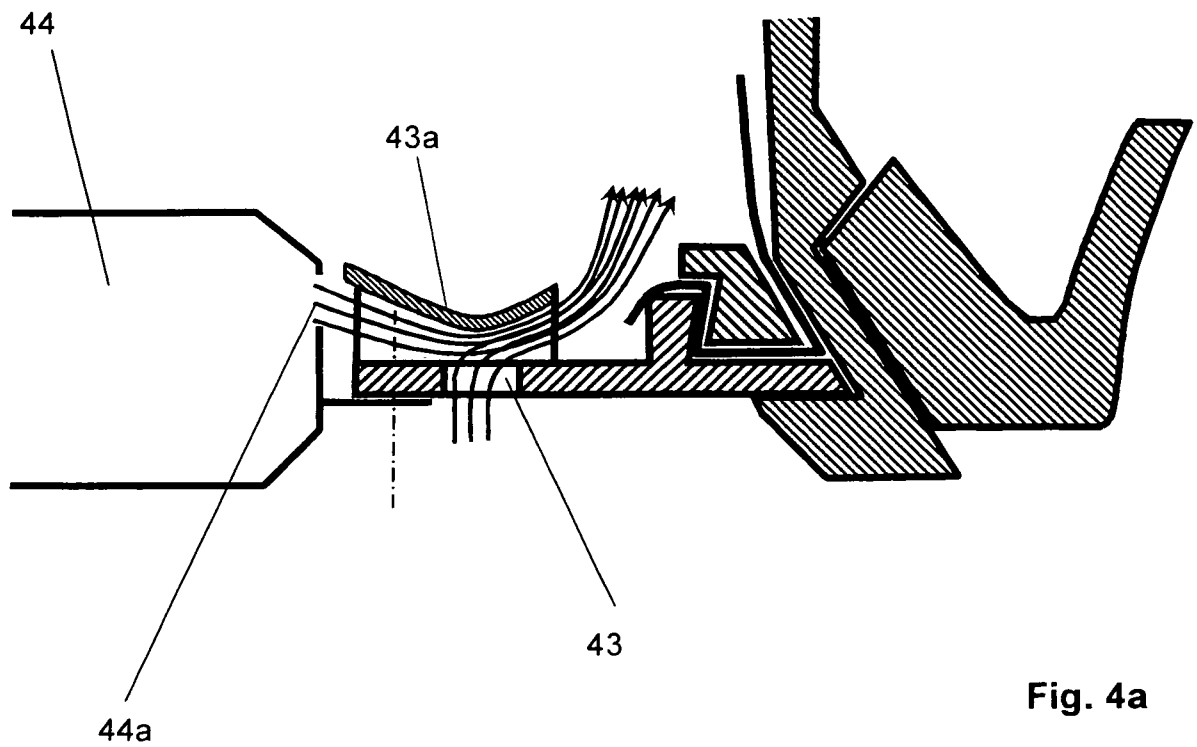


Fig. 19

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/003170

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R21/217
ADD.

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)
B60R

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 practicable, 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.
X	DE 201 06 695 U1 (TRW AUTOMOTIVE SAFETY SYS GMBH [DE]) 23 August 2001 (2001-08-23)	1,17
Y	figure 1	11,12
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Y	US 6 082 765 A (BOWERS PAUL A [US] ET AL) 4 July 2000 (2000-07-04)	11,12
A	US 6 367 835 B1 (MAGUIRE WILLIAM J [US]) 9 April 2002 (2002-04-09)	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

23 November 2012

Date of mailing of the international search report

30/11/2012

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Kyriakides, Leonidas

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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