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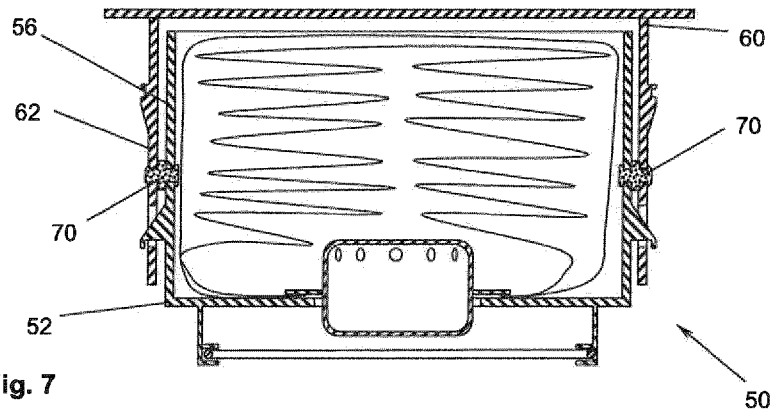

Fig. 7

(57) Abstract: A steering wheel and an airbag module (50) as a part of the steering wheel are described. The airbag module (50) comprises a housing (52) and cover (60) and a part of the airbag module (50) serves as a damper mass of a damper system. In order to obtain a compact and easy to assemble airbag module (50), at least one elastic damper element (70) is provided between the housing (52) and the cover (60) such that the housing (52) can move relative to the cover (60) under deformation of this elastic damper element (70).

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Steering wheel comprising an airbag module

Description

The invention relates to a steering wheel comprising a steering wheel body and an airbag module being located in a hub area of this steering wheel body according to the preamble of claim 1 and to an airbag module for use as a part of such a steering wheel according to claim 21.

Most steering wheels of today's cars, buses and trucks are comprised of a steering wheel body and an airbag module being located in the hub area of this steering wheel body. For this purpose the steering wheel body has a recess in its hub area. The airbag module usually comprises an airbag (sometimes also referred to as "airbag cushion"), a housing, a cover attached to this housing, such that the housing and the cover constitute an enclosure for the airbag, and an inflator.

It is a known problem in the field of vehicle technology that vibrations - for example coming from the motor - are transferred to the steering wheel via the steering column. Having a vibrating steering wheel in hands is of course unpleasant for the driver. In order to oppress, or at least reduce the vibrations, a damper system can be integrated in the steering wheel. Such a damper system always comprises a damper mass element and at least one elastic element by which the damper mass element is directly or indirectly coupled to the steering wheel body. Since in most cases more than one elastic damper element is used, reference is now made to this case. As vibrations are introduced into the steering wheel, the damper mass element starts to swing relative to the steering wheel body under deformation of the elastic damper elements. The deformation of the elastic damper elements dissipates energy and so the vibration of the steering wheel as a whole is damped. In order to maximize this effect, it is usually desired to use a damper mass element with a large mass.

Since it is usually not desired to add additional mass to a vehicle and since the space inside a steering wheel body is limited, the airbag module or a part of the airbag module can be used as the damper mass element. For example, the following concepts are known:

In one concept, only the inflator serves as the damper mass element. In this case, the inflator is usually coupled to the housing by means of the elastic damper element(s). It is often necessary to provide a diffuser spanning over the inflator in order to prevent the airbag from being damaged by the vibrating inflator. This diffuser of course reduces the available packing space for the airbag inside the housing. Further, only the mass of the inflator is used for the damping purpose.

In another concept, the whole airbag module serves as a damper mass element. This has the drawback that the cover an especially its roof moves relative to the steering wheel body.

Starting from this prior art it is an object of the invention to improve a steering wheel of the generic type in such a way that is easy to manufacture. A further object of the invention is to reduce the space-consumption.

This task is fulfilled by a steering wheel having the features of claim 1. An airbag module for use as a part of such a steering wheel is defined in claim 15.

According to the invention, at least one elastic damper element, preferably a plurality of elastic damper elements, acts between the cover and the housing, so that the housing can move relative to the cover under deformation of the at least one elastic damper element. By doing so, the outer enclosure of the airbag module can exclusively be comprised of the cover and the housing and this is preferred. By this measure, the airbag module can be both: compact and easy to assemble.

In one preferred structure, the at least one elastic damper elements extend between a housing sidewall and a cover sidewall basically perpendicular to the axial direction of the steering wheel. The cover sidewall and the housing sidewall extend preferably essentially parallel to one another and the damper elements extend perpendicular to those sidewalls. The elastic damper elements define a gap between the two sidewalls allowing the sub-assembly comprising the housing, the airbag and the inflator to move relative to the cover.

In order to achieve a simple assembly process, the at least one damper element can be clipped into the housing sidewall as well as into the cover sidewall. For this purpose, the elastic damper element preferably comprises two annular grooves, a first one in contact with the cover sidewall, and the second one in contact with the housing sidewall.

A damper element for the inventive purpose can easily be manufactured as a one-pieced part. Preferably it consists of a silicone-based material.

Alternatively, the damper element can be molded to either the housing sidewall or the cover sidewall. Also in this case it can consist of a silicone-based material.

In another preferred structure, the damper element is connected to either the housing sidewall or the cover sidewall and a protrusion extends between the housing sidewall and the cover sidewall, wherein one end of the protrusion is held by the damper element.

Since it is desired that the airbag does not contact the cover, a wrapper enclosing the airbag at least partially can be provided such that the airbag and the wrapper form an airbag package. The wrapper can compress the airbag.

The positioning of the airbag module can be achieved by means of a positioning system that acts exclusively between the cover and the steering wheel body. This

leads to small tolerances between the cover and the steering wheel body. Such a positioning system comprises at least one steering-wheel-body-side positioning feature and at least one cover-side positioning feature co-operating with said steering-wheel-side poisoning feature.

A further advantage of the inventive steering wheel is that it is possible to construct it as a "floating module" steering wheel meaning that the whole airbag module can be pressed down against the steering wheel body in an essentially axial direction in order to actuate the vehicle horn. Even in this case it is possible to use a positioning system acting between the steering wheel body and the cover.

As an alternative it is also possible to connect the cover rigidly to the steering wheel body.

The invention will now be described by means of a preferred embodiment in view of the figures.

The figures show:

Figure 1: most elements of an embodiment of an inventive steering wheel in a schematic exploded cross sectional view,

Figure 2: the parts of the carried element shown in Figure 1 in an enlarged view showing more details,

Figure 3: the carried element of Figure 2, including two electrical contacts and a spring element in a detailed perspective explosive view,

Figure 4: the cover-side positioning feature in a detailed perspective view,

Figure 5: a damper element of Figure 1 in an enlarged representation,

Figure 6: the sub-assembly being formed by the housing, the inflator and the airbag package with the damper elements and the retention spring being mounted to this sub-assembly as well as the cover in a representation according to Figure 1,

Figure 7: the items shown in Figure 6 being assembled to the airbag module,

Figure 8: an airbag module similar as the one shown in Figure 7 in a more detailed, perspective representation,

Figure 8a a reinforcement element of the cover,

Figure 9: the basic structure of the steering wheel body, the carrier elements, the carried elements and the spring elements shown in Figure 1 being assembled to the steering wheel body,

Figure 10: the detail D1 of Figure 9 in a perspective detailed representation according to Figure 3,

Figure 10a: a sectional view of the items shown in Figure 10,

Figure 11: the completely assembled steering wheel in a representation according to for example Figure 9,

Figure 12: the detail D2 in Figure 11 in a detailed perspective representation essentially in a view from direction R in Figure 11

Figure 13: the housing of a second embodiment of the invention,

Figure 14: the completely assembled steering wheel of a second embodiment of the invention in a representation according to Figure 11,

Figure 15 a variation of the second embodiment in a representation according to Figure 14 ,

Figure 16 the cover and a damper element of a third embodiment in a representation according to Figure 8,

Figure 16a a sectional view of the damper element of Figure 16,

Figure 17 what is shown in Figure 16 with the damper element being mounted to the cover,

Figure17a what is shown in Figure 17 in a representation according to Figure 16a,

Figure 18 what is shown in Figure 18 after the cover has been moun+ted to the housing, and

Figure 19 a third embodiment of the invention in a representation according to Figure 18.

The invention will now be described basically by means of a single embodiment in view of the figures wherein it is to be noted that some of the figures are schematic and other figures are more detailed. Additionally, it is to be noted that Figure 8 shows (and that is preferred) that some elements (namely the elastic damper elements, the second retention system and the cover-side positioning features) are essentially arranged in one radial plane. This is not shown in the schematic cross-sectional views because it would then not be possible to show all of those elements simultaneously.

Figure 1 shows nearly all elements of the described embodiment of the inventive steering wheel. As will be described later, the steering wheel can be looked at as being comprised of a steering wheel body and an airbag module being located in the hub area of this steering wheel body. In Figure 1 neither of the steering wheel body and the airbag module is completely assembled. First, the elements of the airbag module are described:

As is usual with airbag modules, a housing 52 is provided. This housing 52 has a housing floor 53 and a housing sidewall 56. An inflator 82 is held at the housing floor 53 and an airbag package is located inside the housing 52. This airbag package is comprised of a folded airbag 80 and a wrapper 81 surrounding the folded airbag 80. Usually the folded airbag 80 is held by the wrapper 81 in a compressed state. The term "folded" is to be understood to include regular folded as well as chaotic folded airbags.

A retention wire 55 is provided and holding elements 54 for this retention wire 55 extend from the housing floor 53. These holding elements 54 are usually one-pieced with the housing 52. The retention wire 55 and the holding elements 54 together form the housing-side features (or more general: the module-side features) of a first retention system.

Retention protrusions 58 extend from the housing sidewall 56. These retention protrusions 58 are also usually one-pieced with the housing 52. These retention protrusions 58 form the housing-side features of a second retention system.

Further, the housing sidewall 56 shows openings 57 for damper elements 70. The damper elements 70 are described later in more detail in view of Figure 5.
The cover 60 has (of course) a roof 61 and a cover sidewall 62. This cover sidewall 62 shows a retention opening 68 for each retention protrusion 58 and an opening 67 for a damper element 70 for each respective opening 57 of the housing side wall.

Further, cover-side positioning features 63 are provided on the cover sidewall 62. These cover-side positioning features 63 are usually one-pieced parts of the cover 60, which is usually an injection-molded plastic part. In Figure 4 one of the cover-side positioning features 63 is shown in more detail:

The cover-side positioning feature 63 has a U-shaped surrounding 64 with the "U" being open to the bottom. As is shown in Figure 4 and Figure 8 (but not in the schematic cross sectional views) it is preferred that each cover-side positioning feature extends until the lower edge of the cover sidewall 62. Inside this U-shaped surrounding 64 a ramp 65 is located. This ramp 65 is followed by a hutch 66. By this geometry a snap-in feature is formed.

All cover-side positioning features 63 have the same shape and it is usually preferred to provide three cover-side positioning features (and consequently of course also three steering-wheel-body-side positioning features) in order to completely define the position of the module and in order to avoid a static over-determination.

As can be seen from Figures 8 and 8a the cover 60 of the embodiment is made of two parts, namely a main body 60m and a reinforcement element 60r. The main body 60m comprises the roof 61 and a sidewall section and the reinforcement element 60r is attached to the sidewall section of the main body 60m. The main body 60m is made of a relatively soft standard plastic material for a cover giving a pleasant appeal when touched by the driver. The reinforcement element 60r is made of a more rigid material, for example a rigid plastic material or a fiber reinforced plastic material. Thus, horn activation efforts are well transmitted to the entire airbag module and vibrations coming from the steering wheel body do not deform the cover 60. This reinforcement element 60r comprises the force-transmitting parts, namely the holes into which the elastic elements are snapped, and the cover-side positioning features 63. Furthermore, the reinforcement element 60r ensures the form stability of the cover border shape which is closest to the

steering wheel body 5 and in particular the at least one steering-wheel body side positioning feature 20. By this reinforcement, the tolerances of the cover shape shall be reduced which is essential to allow a minimum gap between cover outer shape and the steering wheel body 5 and in particular the at least one steering-wheel-body-side positioning feature 20.

The assembly of the module will be described later and now the elements of the steering wheel body are described:

According to the definitions chosen here, the steering wheel body can be looked as being comprised of a basic structure 10 and additional elements attached to this basic structure 10 of the steering wheel body. The basic structure 10 comprises a skeleton 12 and a cladding 14, which can for example be in form of a foam. A recess 15 is provided in the hub area of the basic structure 10 and hooks 16 forming the steering-wheel-body-side features of the first retention system extend from the skeleton 12 into this recess 15 basically in the axial direction A of the steering wheel.

Mounting holes 18 extend from the upper surface of the cladding 14 into the cladding.

Additionally to the basic structure 10, a plurality of steering-wheel-body-side positioning features 20 are provided. These steering-wheel-body-side positioning features 20 are themselves made of several elements. Most of them are very schematically shown in Figure 1 and will now be described in view of Figures 1, 2 and 3:

Each steering-wheel-body-side positioning feature 20 comprises a carrier element 22 which is in a mounted state rigidly attached to the basic structure 10. For this purpose, each carrier element 22 comprises mounting pins 23 adapted for being

inserted in the mounting holes 18. Further, each carrier element 22 comprises two sliding plates 24 and an indention 25 for holding part of a spring element 39.

Each steering-wheel-body-side positioning feature 20 further comprises the afore mentioned spring element 39 and a carried element 30. In the assembled state, the spring element, which serves as a first resilient element, connects the carrier element 22 and the carried element 30. The spring element is a basically V-shaped part of a conductive metal, for example steel. A carried element 30 is now described in detail in view of Figures 2 and 3:

This carried element 30 has a main body 32, a movable pin 40, a spring 42, a securing element 44 and two electrical contacts 46a, 46b. The main body 32 comprises a through hole extending from the rear of the basic body to its front, so that it extends through a front wall 32a of the basic body 32. The front wall forms a step, such that the front end of the through hole has a smaller diameter than a section of the through hole extending from the front wall to the rear. The pin 40 has shoulder 40a and pin and shoulder are such dimensioned that the front end of the pin has a slightly smaller diameter than the front end of the through hole, whereas the shoulder has a larger diameter, as can easily be seen from Figure 2. The spring 42 presses against this shoulder and is biased by means of a securing element 44 held inside the through hole, for example (as shown) by means of a bayonet-type coupling. So, the pin 40 can be moved inwardly into the basic body in direction R1 against the force of the spring 42 which forms a second resilient element.

The two electrical contacts 46a and 46b are held in recesses of the main body 32 in such a way that the upper ends of the horn contacts 46a, 46b extend over the upper end of the main body, as will also be seen later in view of Figure 10a. Further, the main body comprises a horizontally extending indention 38 for the lower end 39b of the spring element 39.

Finally, two lateral grooves 36 arranged to cooperate with the sliding plates 24 are provided.

Next, the assembly of the airbag module is shown in view of Figures 5, 6 and 7. Figure 6 shows the housing 52, the retention wire 55 and the damper elements 70 with the retention wire 55 and the damper elements 70 being mounted to the housing 52. As can especially be seen from Figure 5, each damper element 70 has a first angular groove 72 such that the outer diameter of the damper element 70 corresponds basically to the inner diameter of the openings 57 for the damper element in this region. So, each damper element 70 is safely held at the housing sidewall 56. Each damper element 70 is made of an elastic material that can for example be rubber-like. Usually each elastic damper element 70 is a one-pieced injection-molded part made of an elastic plastic material, for example a silicon-based material with shore hardness of 60.

In the final assembly step of the airbag module, the cover is pushed onto the housing. The outcome of this process is shown in Figures 7 and (in more detail) Figure 8. After this assembly step the damper elements 70 extend through the openings 67 in the cover sidewall 62. As in the case of the housing sidewall, the damper elements 70 show an angular groove for this, namely the second angular groove 74.

In the assembled state, each retention protrusion 58 extends through a retention opening 68 in such a way that the retention protrusions 58 are not in mechanical contact to the cover 60. So, the cover 60 is connected to the housing 52 exclusively via the elastic damper elements 70.

Now, the assembly of the steering wheel body 5 is explained. This step comprises the mounting of the carrier elements 22 to the basic structure 10 of the steering wheel body, and the mounting of the spring elements 39 and the carried elements 32 to the carrier elements 22. It will often be preferred to first completely assemble

the steering wheel-body-side positioning features 20 being comprised of the carrier elements 22, the spring elements 39 and the carried elements 30, but this is not mandatory. Then mounting the carried 30 elements to the carrier elements 22, first the basic body 32 of the carried element 20 is sled onto the sliding plates 24 and then the spring element 39 is attached to both, the carrier element 22 and the main body 32 of the carried element 30.

Figure 10 shows most of a steering wheel-body-side positioning feature in a detailed perspective view. One can see, that the sliding plates 24 extend into the lateral grooves 36 of the main body 32 of the carried element 30, and that this main body 32 is held at the carrier element 22 by means of the spring element 39 whose upper end 39a is held in the indention 25 in the carrier element 22 and whose lower end 39b is held in the respective indention 38 in the basic body 32 of the carried element 30. The spring element 39 is biased such that the carried element 30 is pulled to an upper end position by this spring element 39. In this upper end position the upper ends of the electrical contacts 46a, 46b are in mechanical (and thus electrical) contact with the upper end 39a of the spring element 39 as can best be seen from Figure 10a which is the sectional view through Figure 10 along the plane of the sliding plates 24. If a force is applied to the carried element 30 downwardly the carried element can slide downwardly against the force of the spring element 39. In this case the two electrical contacts 46a and 46b lose their mechanical and electrical contact to the spring element 39, such that an electrical circuit is opened. This can be used for actuating the vehicle horn.

In an alternative which is not shown in the drawings, one of the electrical contacts 46a could only extend to the lower end 39b of the spring element 39, whereas the other extends to the upper end 39a of the spring element as shown in the drawings. In such configuration, the one of the electrical contacts 46a extending to the lower end 39b of the spring element 39 stays in electric contact with the spring element 39 in all situations. This geometry ensures that even in the case of tolerances in the position of the upper ends of the electrical contacts 46a, 46b, both

electrical contacts 46a, 46b are in electrical contact to the spring element 39 as long as the module is not pressed down. When the module is pressed down, the electrical contact that initially extends to the upper end 39a of the spring element loses its mechanical and electric contact to the spring element 39 (as described above) and the circuit is opened.

In another embodiment (not shown in the Figures), it would also be possible to use the spring element 39 as an electrical contact, so that one would need only one of the electrical contacts 46a, 46b.

Figure 11 shows the completely assembled state of the steering wheel. During the final assembly step the airbag module 50 is pushed into the recess of the steering wheel body 5 in a linear motion. During this pushing motion, the retention wire 55 snaps over the hooks 16 and then the pins 40 - that form snap-in elements - of the steering-wheel-body-side positioning feature snap into the hutches 66 of the cover-side-positioning features. As one can see in Figure 11, in the final assembled state the retention wire 55 is remote from the hooks 16 such that the first retention system is without function in the normal operating state.

The position of the airbag module relative to the steering wheel body 5 is completely defined by the steering-wheel-body-side positioning features and the cover-side positioning features. It is preferred that the geometry is chosen such that the pins 40 are slightly pushed outwardly against the force of the springs 42 by the cover-side positioning features 63 such that the module is centered due to the force of the springs 42. The whole module can be pressed down against the force of the spring elements 39 in order to actuate a horn. When pressing down the whole module at least one of the spring elements 39 loses its contacts to the electric contacts such that a circuit is opened. This opening of a circuit is used for activating the horn.

If the inflator is triggered due to an accident and the airbag deploys, is it very likely that the first positioning system being comprised of the cover-side positioning features and the steering-wheel-side positioning features fails, for example because of a de-snapping of the pins from the cover-side positioning features. In this case the housing is held to the steering wheel body (namely to its basic structure) by means of the first retention system being comprised of the hooks 16, the retention wire 55 and the holding elements 54 for the retention wire 55.

In such a scenario it is also likely that the damper elements 70 also de-snap from their respective openings such that the cover could uncouple from the housing. But this is prevented by means of the second retention system being formed by the retention protrusions 58 and the retention openings 68.

In normal state of operation the sub-assembly being formed of the housing 52 of the airbag module, the inflator 82 and the airbag 18 is coupled to the cover (and thus indirectly to the steering wheel body) exclusively via the elastic damper elements 70 such that this sub-assembly can swing relatively to the steering wheel body and can thus serve as a damper mass of the vibration reducing system.

Figure 13 shows the housing of a second embodiment. In this embodiment, only one damper element is present, namely the annular damper element 170 which extends around the housing sidewall 56. This annular damper element is a ring which is positioned on the housing sidewall by means of an annular groove in the outer surface the housing sidewall 56. As can be seen from Figure 14, the inner surface of the cover sidewall 62 also comprises an annular groove into which the annular damper element 170 extends such that the cover 60 is precisely positioned relative to the housing 52. The housing 52 can swing relative to the cover 60 under deformation of the elastic element 170, as described above. The retention features are also as described in the first embodiment. Alternative to providing the annular damper 170 element as a separate ring, it would also be possible to mold this annular damper element to either the housing sidewall or the cover sidewall.

Alternatively or additionally, an annular damper element – referred to as annular end damper element 172 - can be pushed onto the lower ends of the cover sidewall 62 and the housing sidewall 56 after the cover 60 has been mounted to the housing 52 (Figure 15). In this case, both, the cover sidewall 62 and the housing sidewall 56 should comprise a blade-shaped lower end. Further, both lower ends should comprise at least one positioning/ retention feature, for example in form of a groove such that annular end damper element 172 is positioned in a determined way.

Figures 16 to 18 show a third embodiment which differs from the first and second embodiment by the fact that the it does not show a second retention system but uses the features of the second retention system of the first and second embodiment for the elastic connection of between the housing 52 and the cover 60. For this reason, the retention openings of the first embodiment are now called connection openings 268 and the retention protrusions of the first embodiment are called connection protrusions 258. The elastic damper elements act between the connection openings 268 and the connection protrusions 258 and so, for each connection opening 268 one damper element 270 is provided (only one is shown in Figure 16). In the embodiment shown, this damper element 270 is a separate element (Figure 16a) which is clipped into the connection opening 268 (Figures 17 and 17a), but it would also be possible that the damper element 270 is molded onto the cover sidewall 62 around the connection opening 268. Figure 18 shows the assembled state. The connection protrusion 258 extending from the housing sidewall 56 is held by the damper element 270 such that the housing 52 can swing relative to the cover 60 as in the other embodiments. Since there is no risk of an un-snapping of the cover during deployment, a separate second retention system is not necessary in this embodiment, but can of course be provided for additional safety.

Figure 19 shows a fourth embodiment which is similar to the third embodiment: Here, the damper element 370 is located between the connection protrusion 358

and the housing sidewall 56. In this case it will in most cases be preferred that the damper element is overmolded over the housing sidewall 56 and the connection protrusion 368.

5

List of reference numbers

5	steering wheel body
10	basic structure of steering wheel body
12	skeleton
14	foam (cladding)
15	recess in hub area
16	hook (steering-wheel-body-side feature of retention system)
18	mounting holes
20	steering-wheel-body-side positioning feature
22	carrier element rigidly attached to basic structure
23	mounting pin
24	sliding plate
25	indention for spring element
30	carried element
32	main body of carried element
32a	front wall
34	through hole through housing
36	lateral grooves
38	indention for spring element
39	spring element
39a	upper end
39b	lower end
40	pin
40a	shoulder
42	spring
44	securing element
46a,b	electrical contacts
50	airbag module
52	housing
53	housing floor

54	holding element for retention wire
55	retention wire
56	housing sidewall
57	opening for damper element
58	retention protrusion
60	cover
60m	main body
60r	reinforcement element
61	roof of cover
61a	central area of the roof
62	cover sidewall
63	cover-side positioning feature
64	U-shaped surrounding
65	ramp
66	hutch
67	opening for damper element
68	retention opening
70	damper element
72	first annular groove
74	second annular groove
80	airbag
81	wrapper
82	inflator
170	annular damper element
172	annular damper element at lower edge
258	connection protrusion
268	connection opening
270	damper element in connection opening
358	connection protrusion
368	connection opening
370	damper element between housing sidewall and connection protrusion

Claims

1. Steering wheel comprising:
a steering wheel body (5)
a housing (52) being located in the hub area of the steering wheel body,
an airbag (80) being located inside the housing,
an inflator (82) being attached to the housing (52), and
a cover (60), said cover having a roof (61), wherein at least a central area (61a) of the roof (61) spans over the housing (52),
characterized in that
the housing (52) can move relative to the cover (60) under deformation of at least one elastic damper element (70, 170, 172, 270, 370).

2. Steering wheel according to claim 1,
characterized in that
the cover (60) and the housing (52) are connected to one another via the at least one elastic damper element (70, 170, 172, 270, 370) such that cover (60) and housing are parts of an airbag module (50).

3. Steering wheel according to claim 1 or claim 2, characterized in that the cover (60) comprises a cover sidewall (62) and the housing (52) comprises a housing sidewall (56).

4. Steering wheel according to claim 3, characterized in that the at least one elastic damper (70, 170, 172) element extends between the housing sidewall (56) and the cover sidewall (62) basically perpendicular to the axial direction (A) of the steering wheel.

5. Steering wheel according to claim 4, characterized in that the at least one damper element (170) is annular-shaped and extends around the housing sidewall.

6. Steering wheel according to claim 3, characterized in that the at least one damper element (370) is connected to the housing sidewall (56) and that a connection protrusion (358) extends from the damper element (370) towards the cover sidewall (62) and is connected with the cover sidewall (62).

7. Steering wheel according to claim 3, characterized in that the at least one damper element (270) is connected to the cover sidewall (62) and that a connection protrusion (258) that extends from the housing sidewall (56) is held by the damper element (270).

8. Steering wheel according to any one of claims 3 to 7, characterized in that the at least one damper element is molded to either the housing sidewall (56) or the cover sidewall (62).

9. Steering wheel according to claim 3, characterized in that the at least one damper element (172) is annular-shaped and connects the lower ends of the housing sidewall (56) and the cover sidewall (62).

10. Steering wheel according to claim 3, characterized in that the at least one damper element (70) is clipped into the housing sidewall (56) as well as into the cover sidewall (62), wherein the elastic damper element (70) preferably comprises two annular grooves (72, 74), wherein the at least one damper element is preferably pin-shaped.

11. Steering wheel according to one of the claims 1 to 10, characterized in that the cover (60) comprises a cover main body (60m) and a reinforcement element (60r), wherein the at least one elastic damper element (70) is connected to the reinforcement element (60r).

12. Steering wheel according to one of the claims 1 to 11, characterized in that a gap is provided between the cover (60) and the housing (52).

13. Steering wheel according to any one of the claims 1 to 12, characterized in that a wrapper (81) enclosing the airbag (80) at least partially is provided such that the airbag (80) and the wrapper (81) form an airbag package, wherein it is preferred that the wrapper (81) compresses the airbag (80).

14. Steering wheel according to claim 13, characterized in that the airbag package (82) is not in mechanical contact to the cover (60).

15. Steering wheel according to any of the claims 1 to 14, characterized in that the cover (60) is positioned at the steering wheel body (5) via a positioning system comprising at least one steering-wheel-body-side positioning feature (20) and at least one cover-side positioning feature (63) co-operating with said steering-wheel-side poisoning feature (20),
wherein the airbag module (50) is positioned at the steering wheel body (5) exclusively via said positioning system, as long as the positioning system is intact.

16. Steering wheel according to claim 15 as long as referring to claim 11, wherein the at least one cover-side positioning feature is a part of the reinforcement element.

17. Steering wheel according to claim 15 or claim 16, characterized in that the steering wheel further comprises
a first retention system to restrain the airbag module (50) to the steering wheel body (5) when the inflator (82) is triggered and the positioning system fails, said first retention system being separate from the positioning system and being without function as long as the positioning system is intact.

18. Steering wheel according to claim 17, characterized in that
the first retention system is acting between the housing (52) and the steering wheel body (5) and
a second retention system is provided, said second retention system acting between the housing (52) and the cover (60) and being without function as long as the at least one elastic damper element (70) is intact.

19. Steering wheel according to at least one of the claims 15 to 18, characterized in that the steering-wheel-body-side positioning feature (20) allows an essentially axial movement of the airbag module (50) towards the steering wheel body (5) against the force of at least one first resilient element (39).

20. Steering wheel according to claim 19, characterized in that a horn sensor is integrated in the steering-wheel-body-side positioning feature (20).

21. Airbag module for use as a part of a steering wheel according to one of the claims 1 to 20.

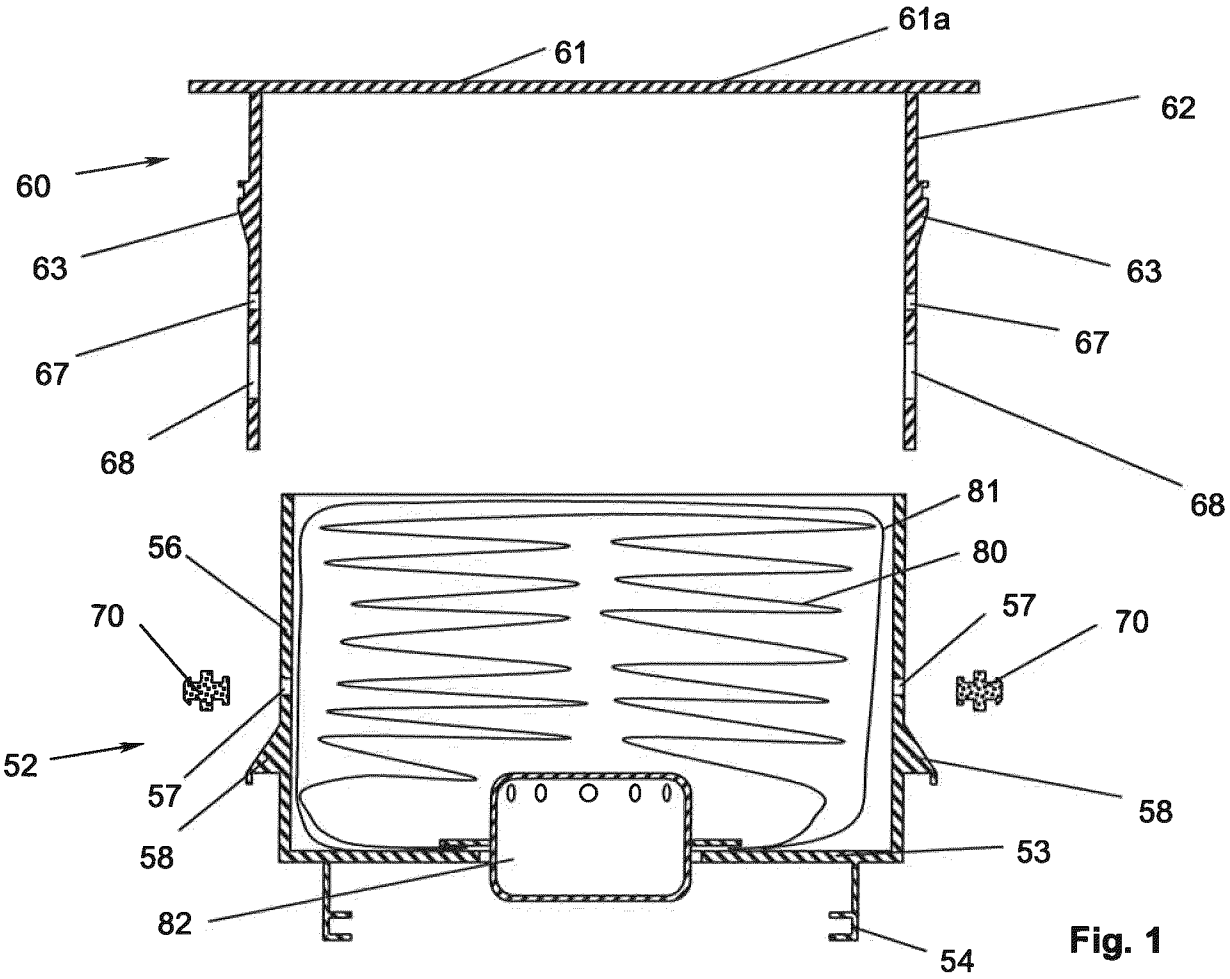
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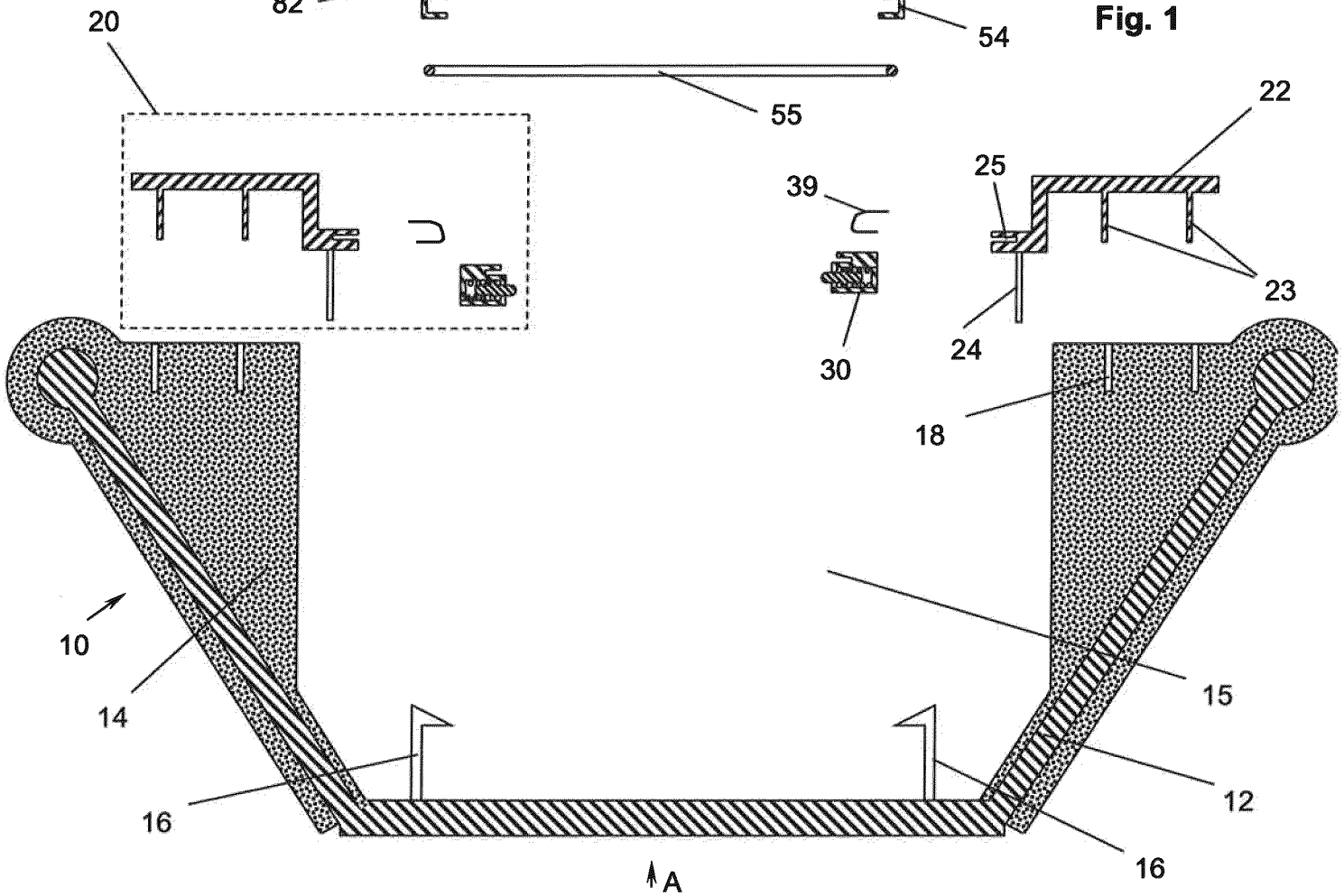
Fig. 1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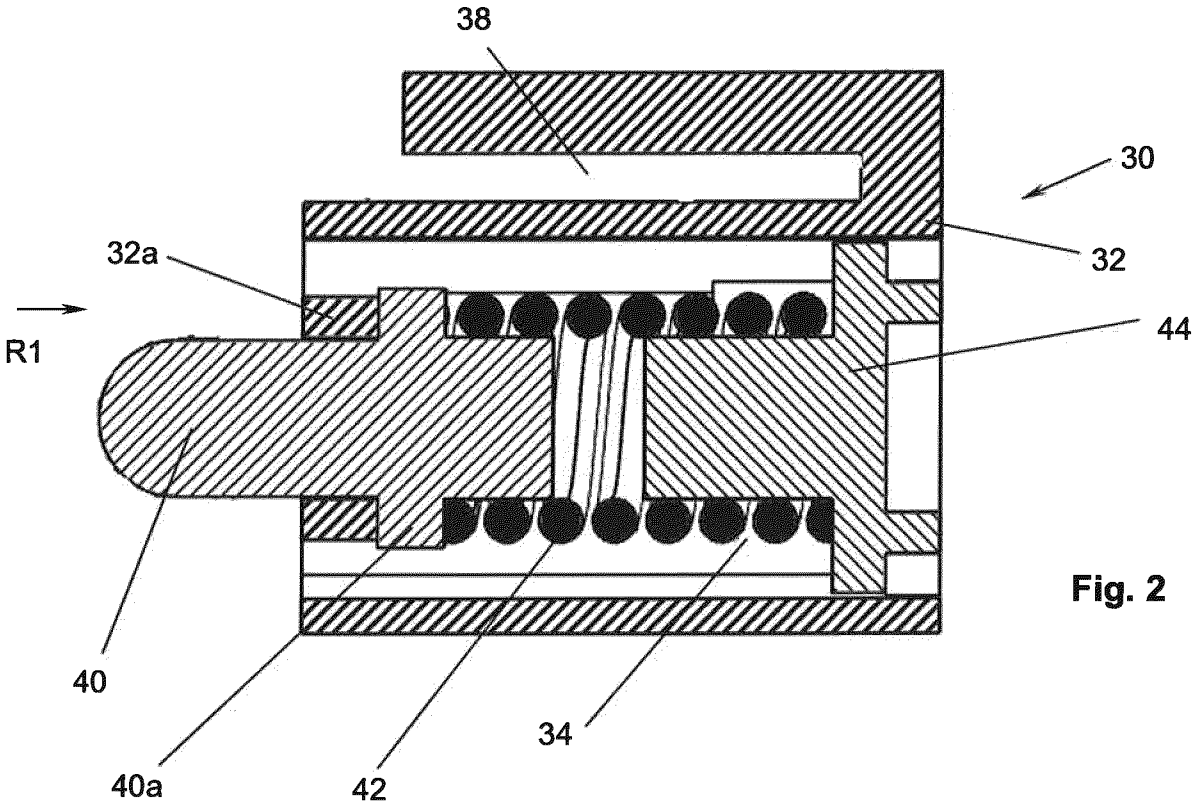
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40a
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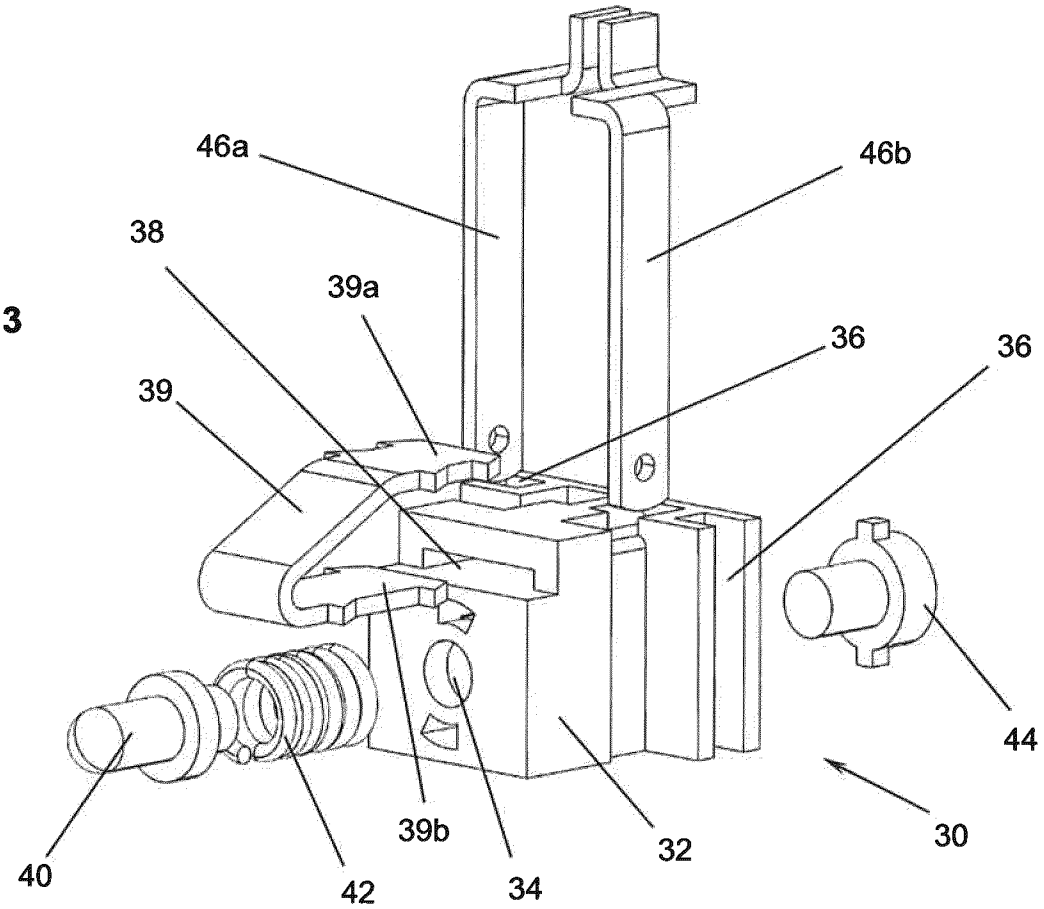
Fig. 2

Fig. 3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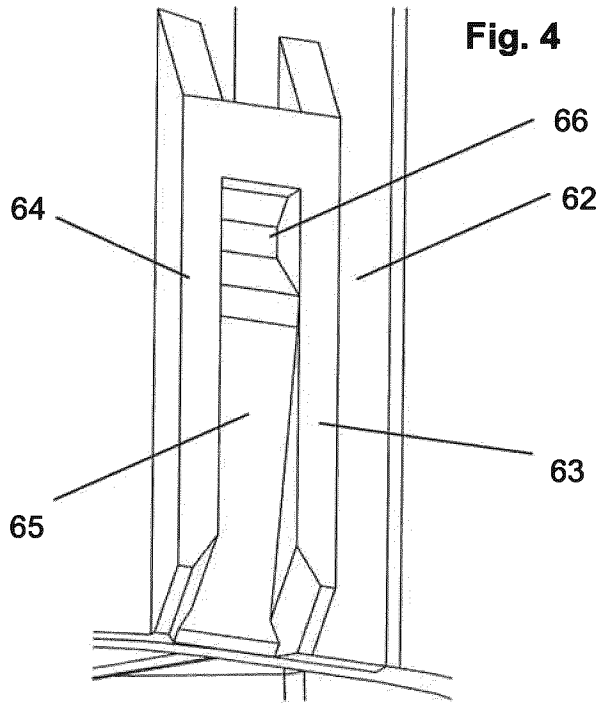

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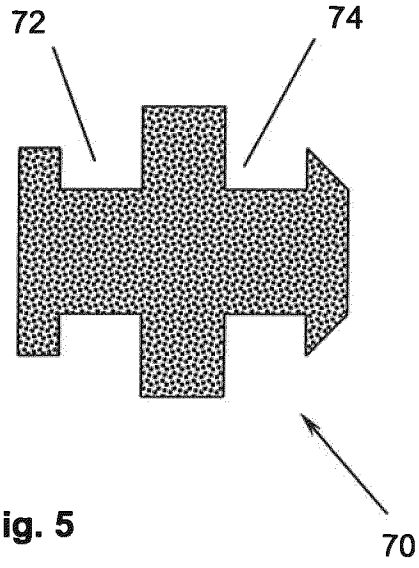


Fig. 5

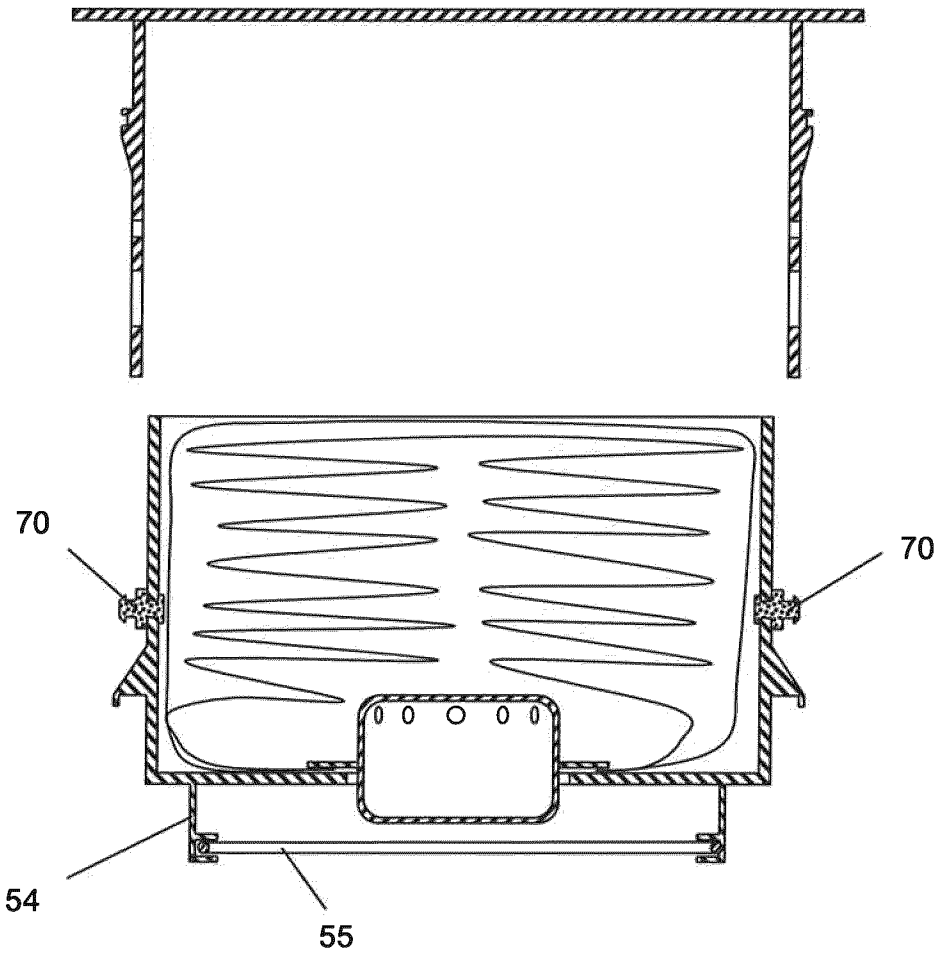


Fig. 6

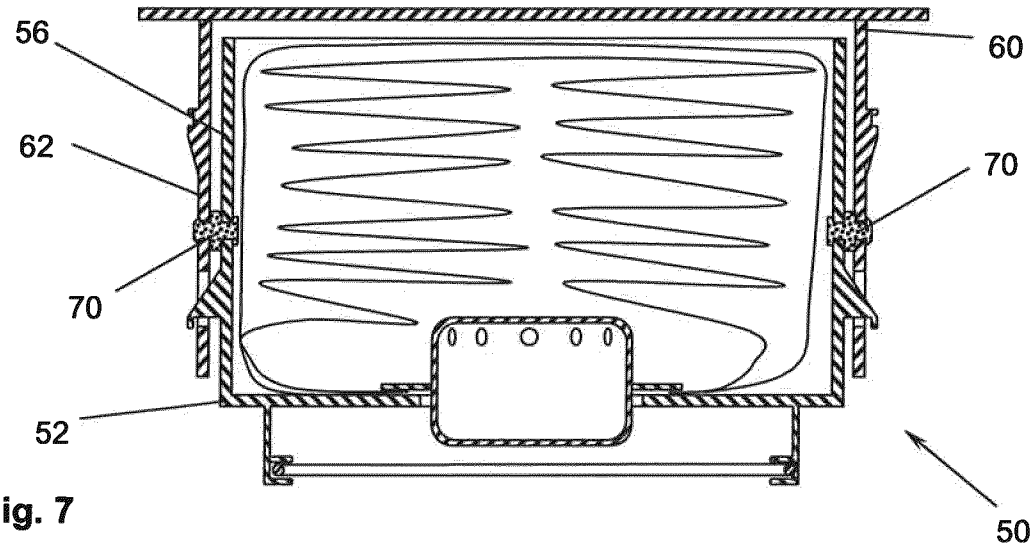


Fig. 7

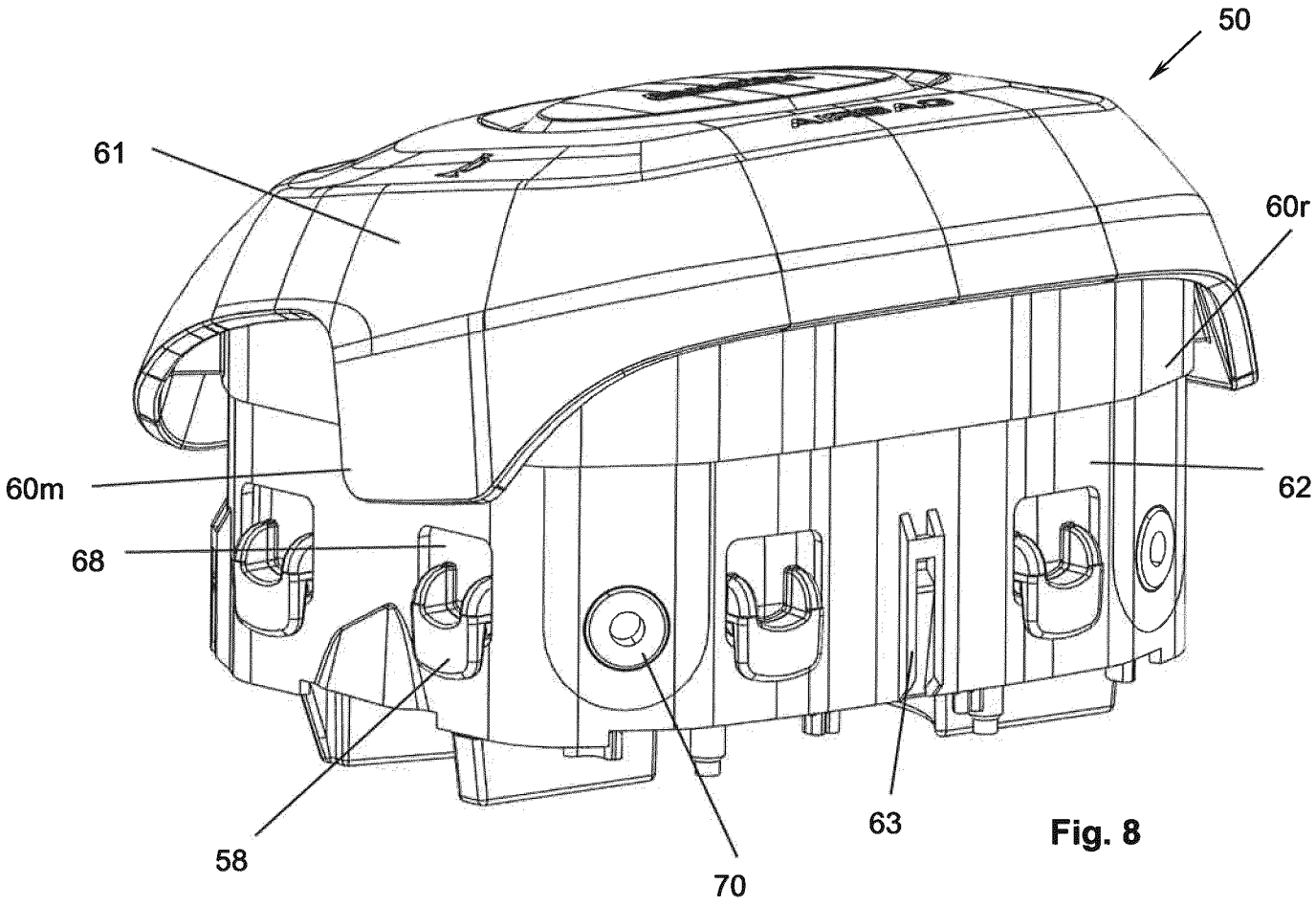


Fig. 8

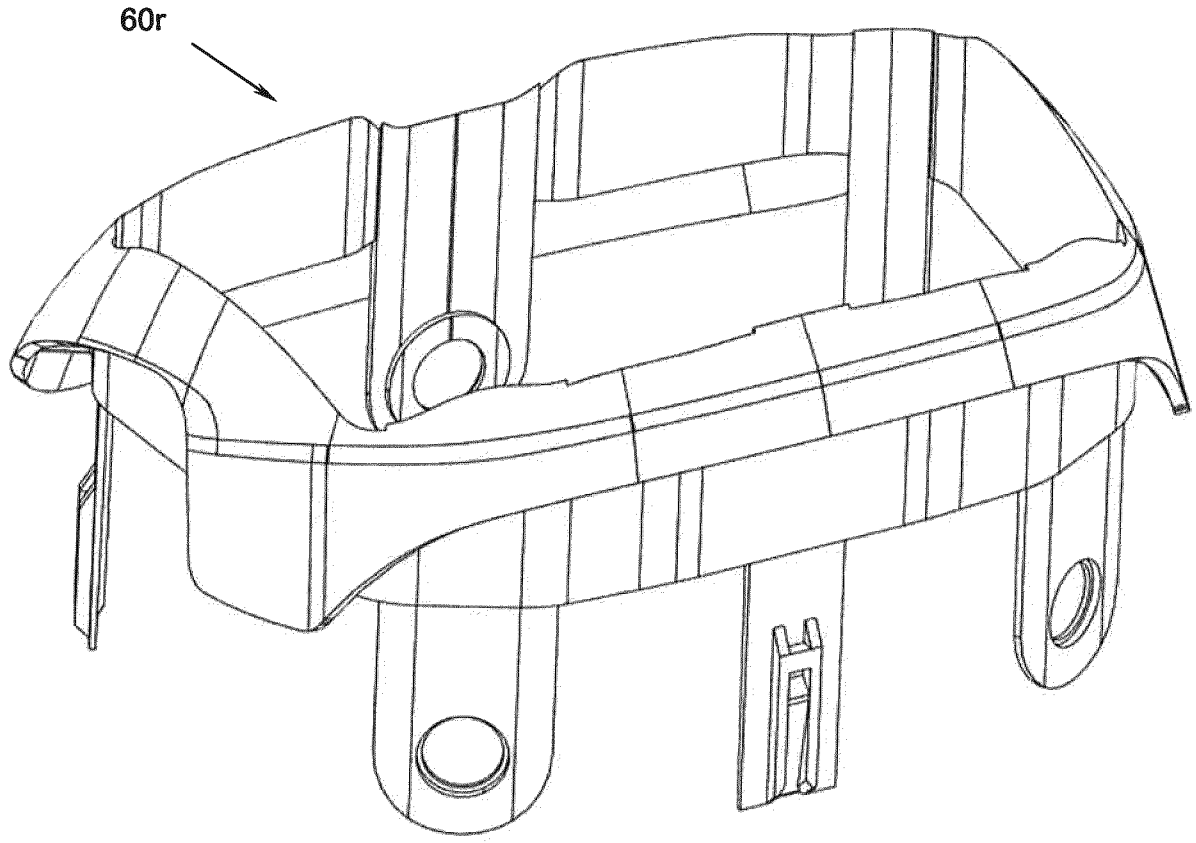
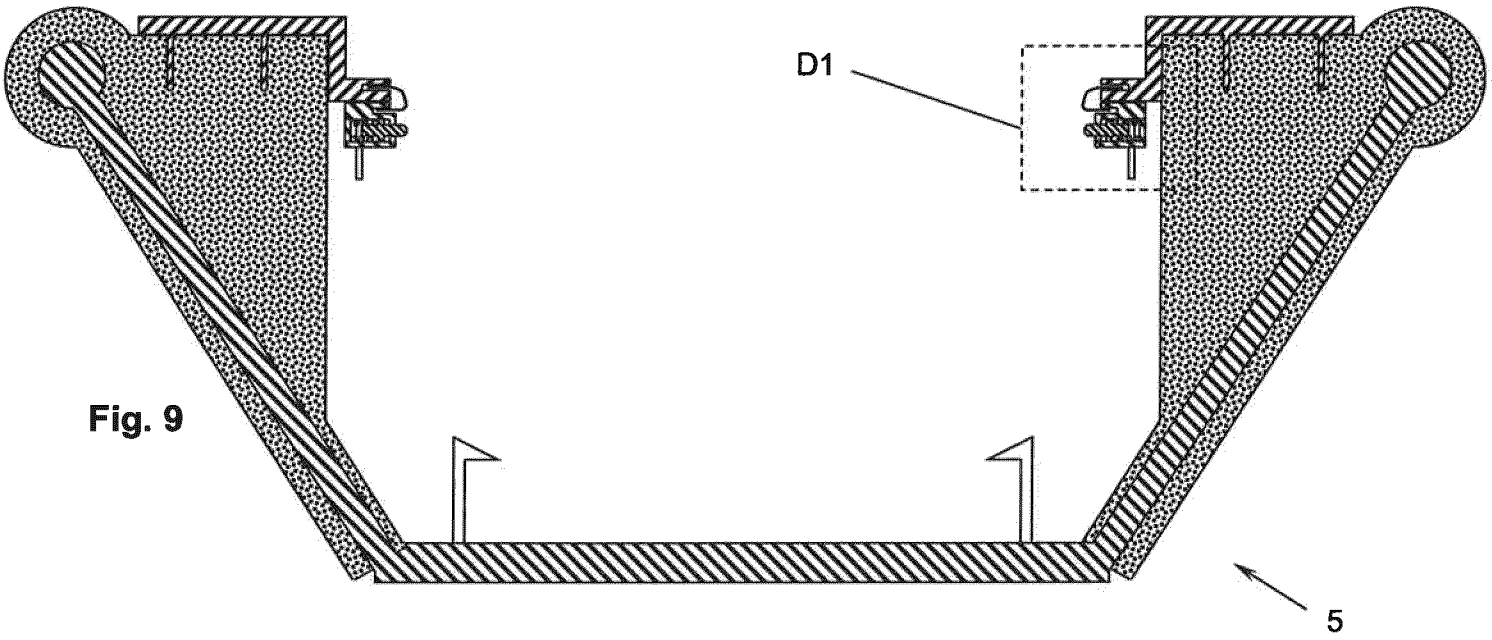


Fig. 8a



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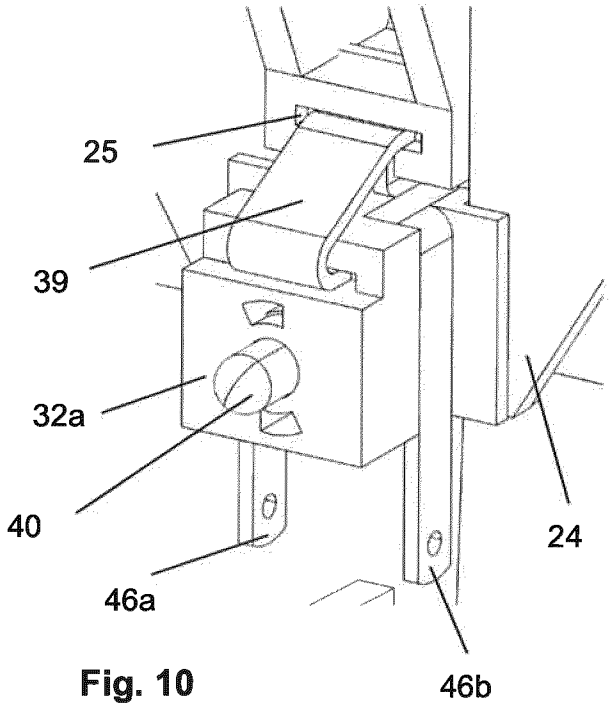


Fig. 10

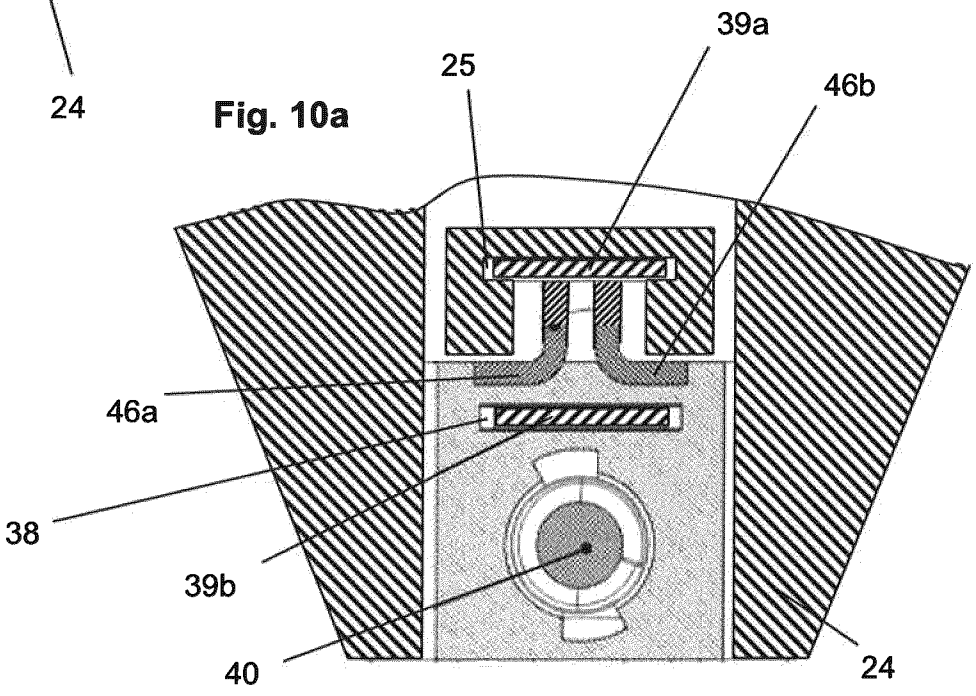


Fig. 10a

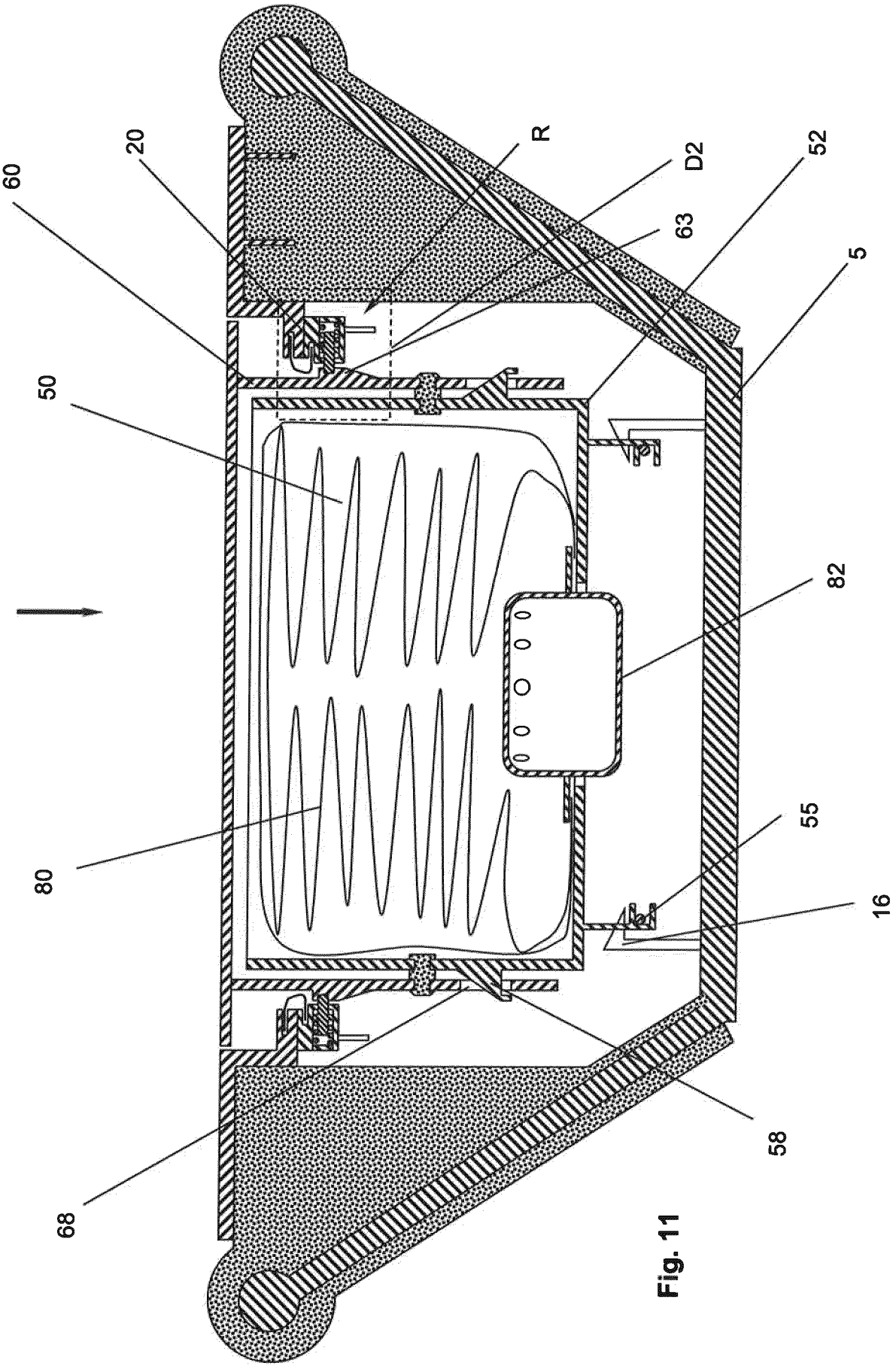


Fig. 11

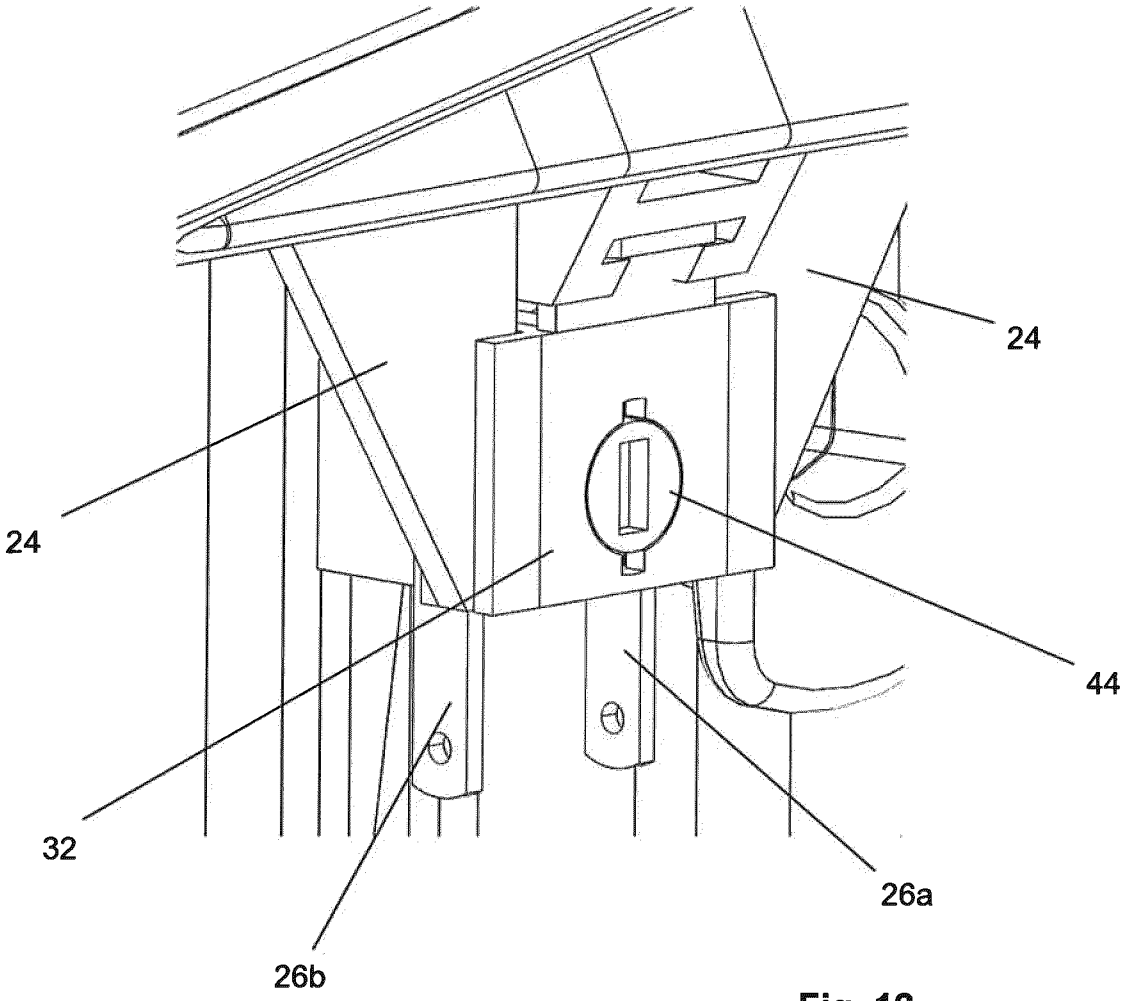


Fig. 12

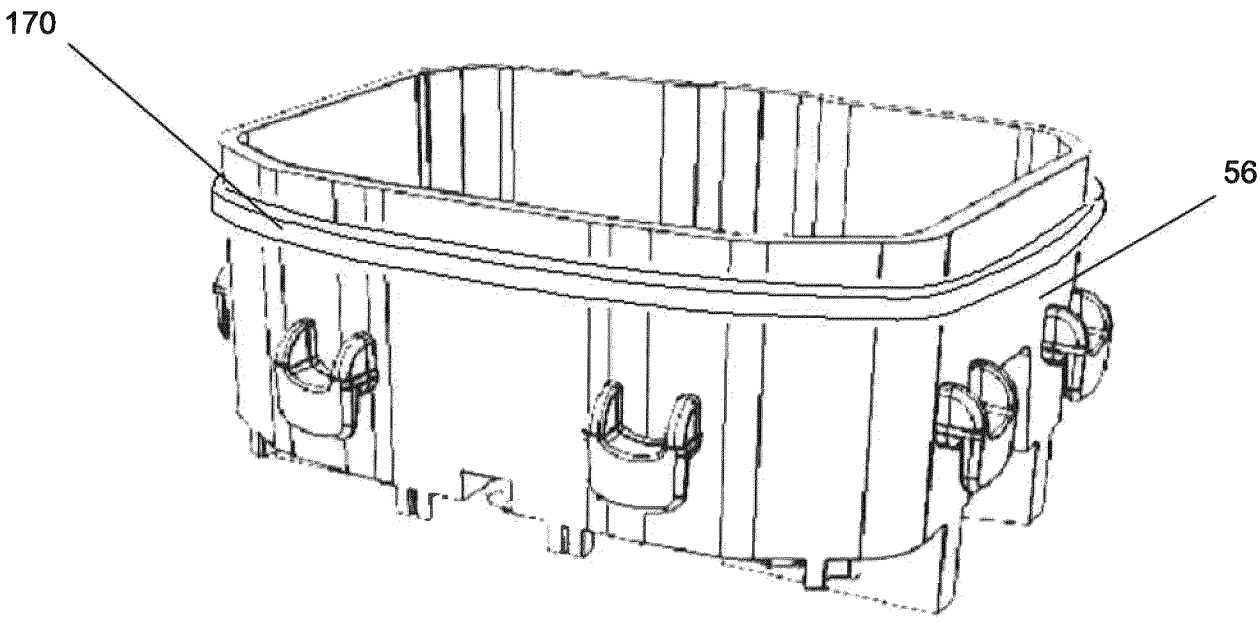


Fig. 13

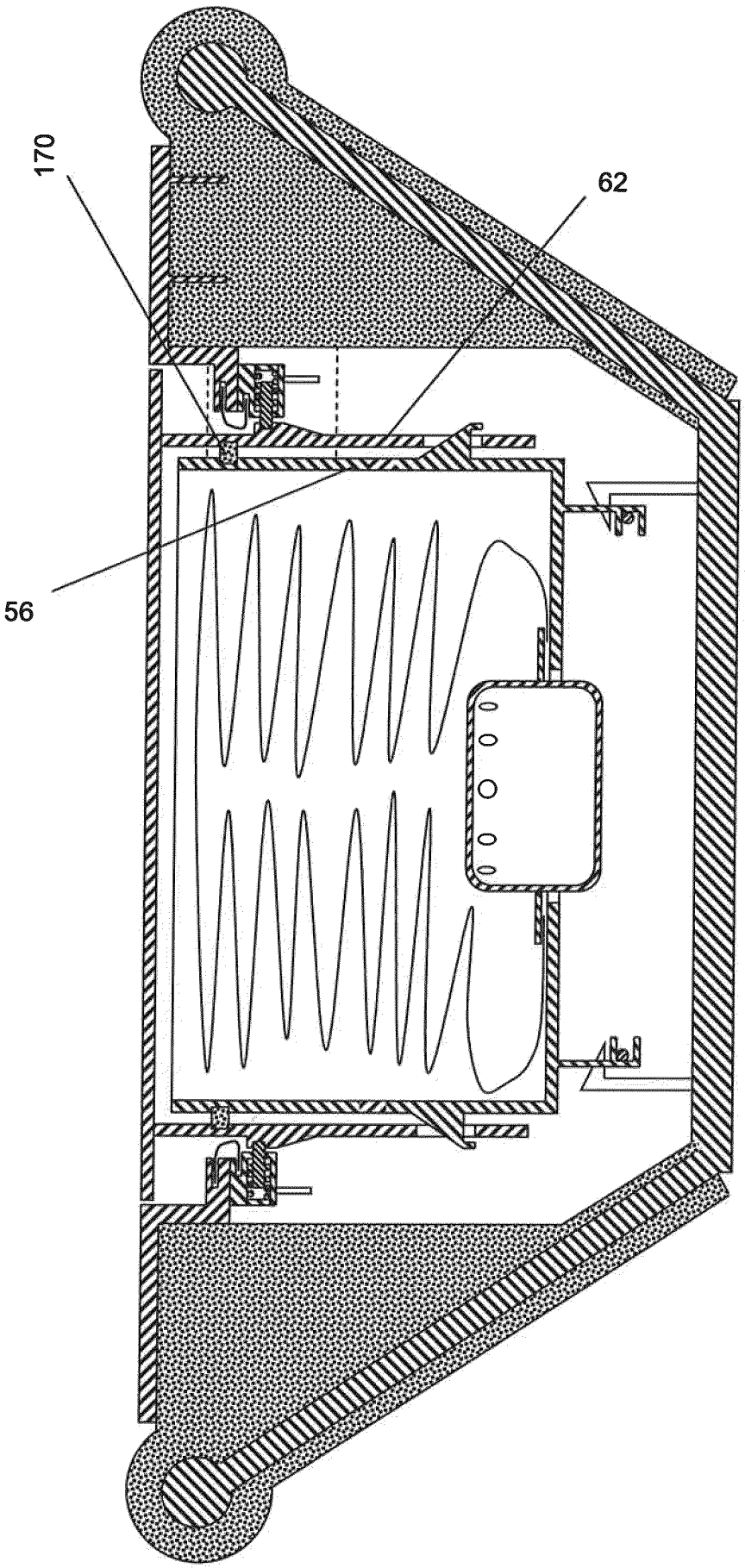


Fig. 14

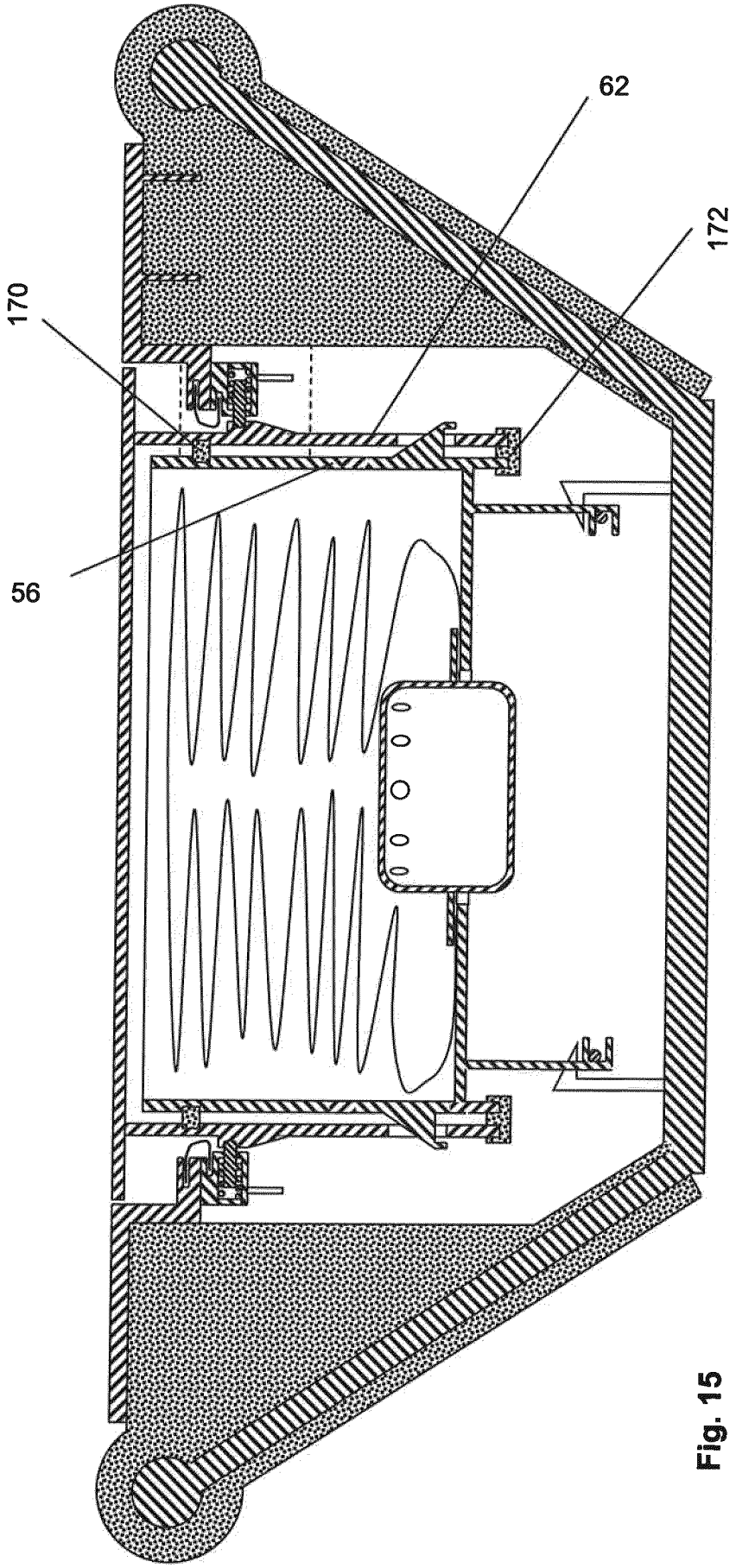


Fig. 15

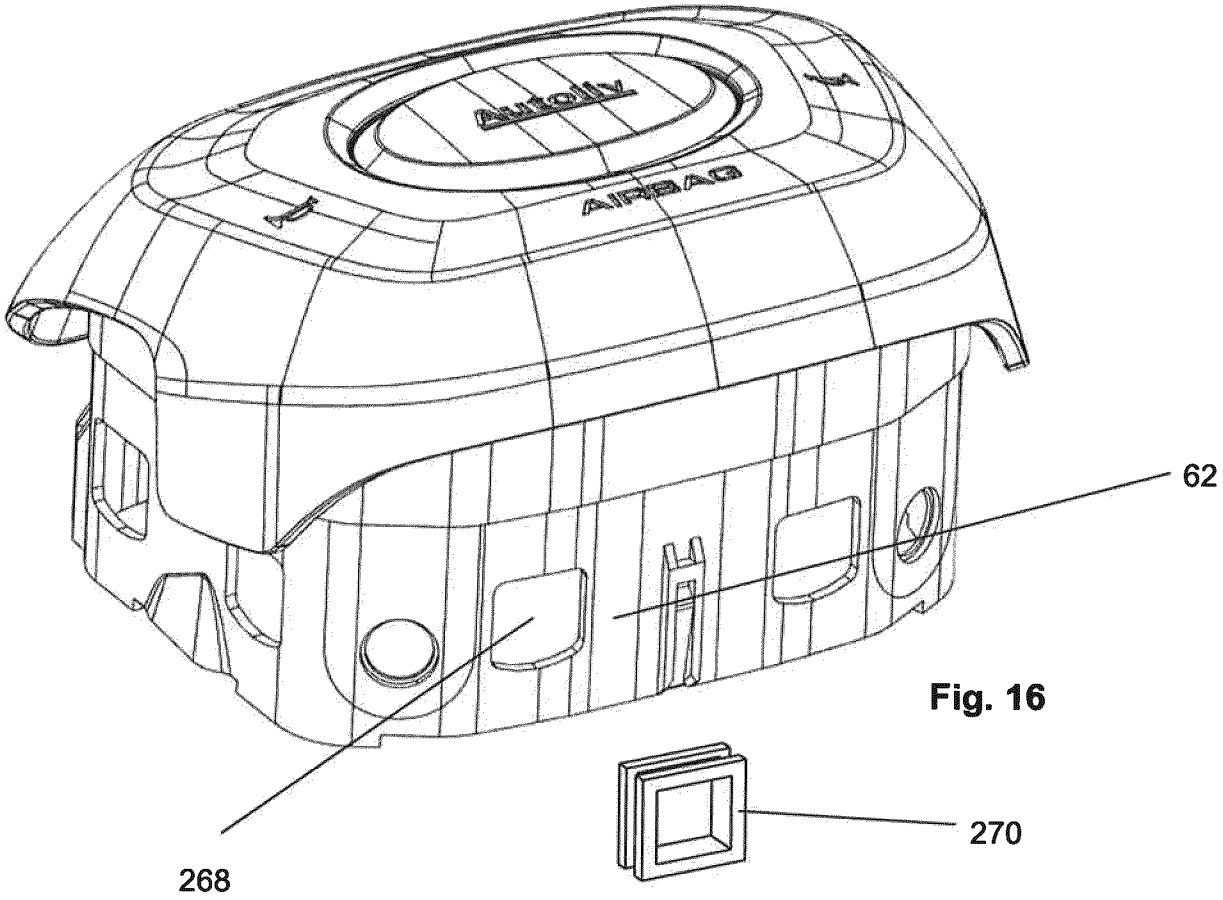


Fig. 16

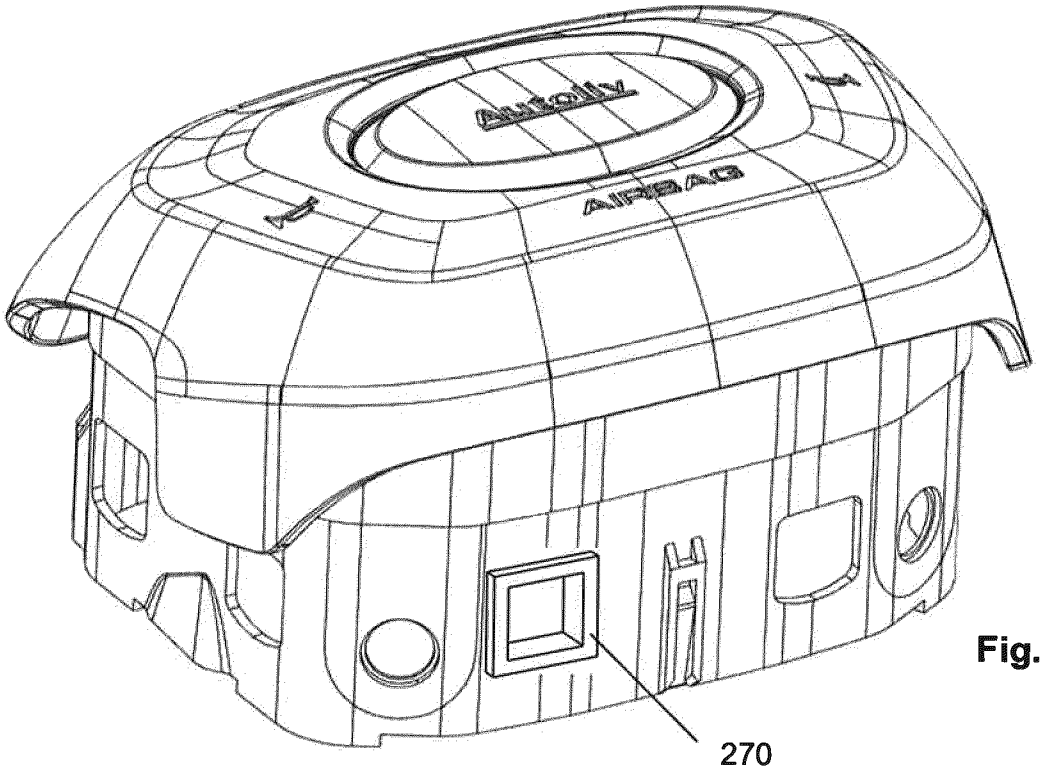


Fig. 17

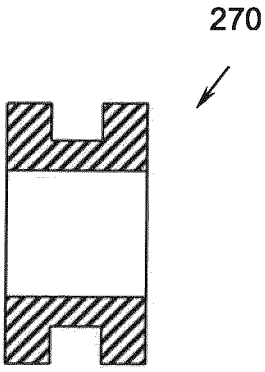


Fig. 16a

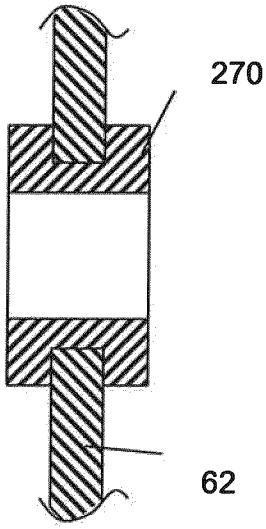
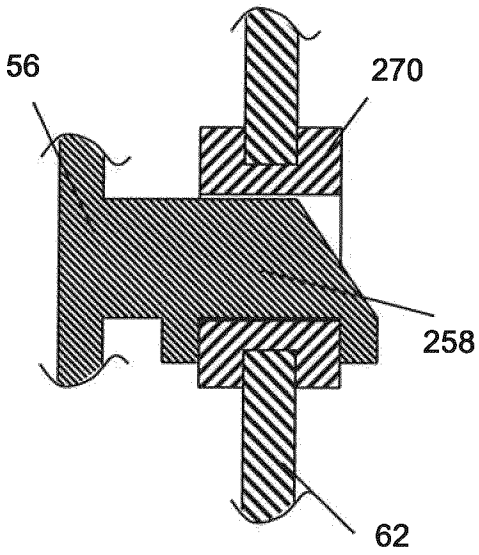


Fig. 17a



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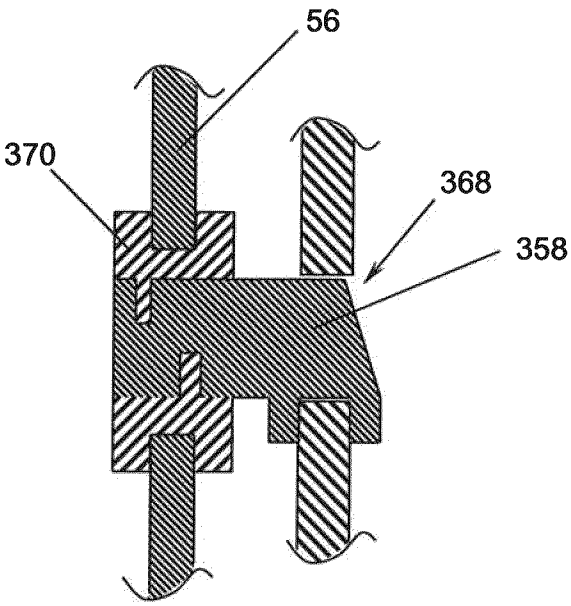

Fig. 19

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/064193

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R21/203
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 A	US 2020/130630 A1 (SCHMEIER KNUT [DE] ET AL) 30 April 2020 (2020-04-30) paragraphs [0022] - [0029]; figures 2,5	1,3, 12-14,21 15,16

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 August 2021	25/08/2021

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Petersson, Magnus

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2021/064193

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2020130630 A1	30-04-2020	NONE	