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(54) **CAMERA ASSEMBLY COMPRISING A ROTATION BLOCKING PIN**

KAMERAANORDNUNG MIT EINEM DREHSICHERUNGSSTIFT

ENSEMBLE CAMÉRA COMPRENANT UNE BROCHE À BLOCAGE ANTI-ROTATION

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a camera assembly. In particular, the camera assembly comprises a camera housing and a printed circuit board carrying an optical sensor. The printed circuit board is attached to the camera housing. A lens barrel is axially surrounded by the camera housing and mounted in the camera housing such that a defined airgap between the lens barrel and the optical sensor is set.

[0002] Furthermore, the invention relates to a method for assembling a camera assembly. In particular, the camera assembly comprises a camera housing with an attached printed circuit board which carries an optical sensor. A lens barrel is mounted such that a defined airgap between the lens barrel and the optical sensor is set.

DESCRIPTION OF THE BACKGROUND ART

[0003] European patent application EP 3 410 687 A1 discloses a camera module for a motor vehicle. The camera comprises at least one printed circuit board and a shield for enclosing said printed circuit board. The shield comprises at least a first shielding part and a second shielding part. The first shielding part encloses the second shielding part. The second shielding part comprises a hole allowing light to enter the camera module and allowing the lens objective to extend through the hole.

[0004] German patent application DE 10 2018 004 978 A1 discloses a camera comprising a housing, a circuit board, an image sensor attached to the circuit board, an optical device, and two positioning pins for aligning the image sensor with the optical device. The two positioning pins are aligned in a predetermined position relative to the housing. A positioning element in addition to the circuit board being aligned in a predetermined position relative to the two positioning pins and the image sensor is aligned in a predetermined position to the positioning element.

[0005] International patent application WO 2018/219951 A1 relates to a camera module for a motor vehicle. The camera module is used for driver monitoring in the passenger compartment. The camera module has at least one printed circuit board and a shield for enclosing said printed circuit board.

[0006] U.S. patent application US 2019/208091 A1 discloses a camera module for a vehicular vision system. The camera module includes a metal front housing, a lens holder and a metal rear housing. The front housing houses a printed circuit board having an imager disposed thereat. The lens holder is attached at a front portion of the housing so that a lens assembly is optically aligned with the imager.

[0007] German patent application DE10 2018 001 552 A1 discloses a camera with a housing, a circuit board, an image sensor attached to the circuit board, an optical device, and a positioning element for aligning the image sensor with the optical device. The image sensor is aligned with the positioning element by means of balls in a gap due to the diameter of the balls in the predetermined position in that the balls are arranged between the image sensor and the positioning element in the gap.

[0008] German patent application DE10 2016 124 668 A1 relates to a device for orientation of an optical unit of a camera. The device includes adjustment means, the actuating part of which is operatively connected to a supporting part of the optical unit. The actuating part is arranged outside the housing and the supporting part is arranged inside the housing. The actuating part and the supporting part each comprise a diametrically magnetized magnet at least on their mutually facing sides.

[0009] German patent application DE10 2016 007 627 A1 relates a camera with a housing and a first printed circuit board and image sensor attached to the printed circuit board. A second circuit board defines a second carrier for at least one electronic component. A cooling wall is connected to the at least one electronic component in a thermally conductive manner for dissipation of waste heat from the at least one electronic component into the environment.

[0010] German patent application DE 10 2014 008 452 A1 discloses a camera with a camera housing which has a housing middle part, which is closed at open end faces of the housing middle part opposite to each other by means of covering parts. One of the covering parts has an objective retainer for an objective of the camera. An image-recording sensor assembly is arranged behind the objective retainer in an interior of the camera housing, wherein at least one of the covering parts has at least one fastening projection, which extends through the housing middle part or past the housing middle part to a fastening receptacle of the other covering part. The at least one fastening projection is connected to the covering part having the fastening receptacle by means of fasteners in a tension-resistant manner with respect to a longitudinal axis of the camera housing extending between the end faces of the housing middle part.

US 2017/0307841 A1 discloses a bore in the camera housing which communicates with the lens barrel in a radial way. Consequently, a locking screw contacts the lens barrel in a radial manner in order to block further rotation of fix the position of the lens barrel.

CN110351469 A discloses a camera module with a camera housing which receives a lens barrel. The camera housing has two bore holes close to the opening of the camera housing, which receives the lens barrel. The lens barrel is fixed in position by screws, wherein the screws are screwed into the bore holes.

[0011] In general, vision cameras are more and more present in vehicles. An important feature, in prior art camera assemblies, is the adjustment of an airgap between the lens barrel and optical sensor. The lens barrel is lowered towards the optical sensor until the optimal distance is reached. This is necessary because the relative posi-

tion of the lens barrel and the optical sensor is subject to a variation that occurs after the assembly step. Any variation (deviation) greater than what is acceptable for optical purposes makes a camera assembly unsuitable for use.

[0012] The problems with the current prior art reside in the fact that a tension provided by an O-ring is not constant from camera to camera, since due to variable adjustments, the tension provided by the O-ring is not constant over time on one camera, which is in turn due to material aging. Moreover, the installation of the O-ring inside the camera housing is difficult and the correct position of the O-ring inside the camera housing after installation cannot be checked visually.

SUMMARY OF THE INVENTION

[0013] It is an object of the present invention to provide a camera assembly, which is robust against changes of the optical set-up over time, allows inspection after installation, is easy to mount and demount, and even allows easy correction of improper installation at any given time after initial manufacturing of the camera assembly.

[0014] The above object is achieved by a camera assembly, which comprises the features of claim 1.

[0015] It is a further object of the invention to provide a method for assembling a camera assembly, which allows easy mounting and demounting, allows inspection after installation, is more robust against changes of the optical set-up over time and even allows easy correction of improper installation at any given time after initial manufacturing of the camera assembly.

[0016] The above object is achieved by a method for assembling a camera assembly with a camera housing which comprises the features of claim8.

[0017] According to an embodiment of the invention, a camera assembly is composed of a camera housing and a printed circuit board attached to the camera housing. The printed circuit board carries an optical sensor. A lens barrel is axially surrounded by the camera housing and mounted in the camera housing such that a defined airgap between the lens barrel and the optical sensor is set. In order to keep the optimal set between the lens barrel and the optical sensor, at least one bore is formed in the camera housing. The bore defines a window to the lens barrel. A rotation-blocking pin is inserted in the at least one bore. Through the window, the rotation-blocking pin is in at least a force-fitting contact with a side portion of the lens barrel.

[0018] Preferably, at least the fins of the rotation-blocking pin are made from a soft, elastic material. The advantage of the camera assembly is that with the introduction of the soft, elastic rotation-blocking pin, the rotation-blocking pin takes up the functions of the removed O-ring in the prior art camera assemblies. Therefore, the camera assembly of the present invention is more robust and hence less prone to important changes by aging with respect to the airgap between the lens barrel and the optical sensor. An inspection after installation is possible. A further advantage of the inventive camera assembly is, that even an easy correction of improper installation at any given time after initial manufacturing of the camera assembly is possible. The correction is possible without consequences like destruction and replacement of any component. Depending on the material used for the rotation-blocking pin, the rotation-blocking pin's blocking force preventing rotation of the lens barrel can be selected.

[0019] According to an embodiment of the invention the at least one bore defines a first end and a second end. Through the first end, the rotation-blocking pin is inserted. The bore hole may be closed with a bottom at the second end. The bore hole may be a blind bore. On the other hand, the bore may be, with the first end and the second end, a through-hole.

[0020] According to an embodiment, at least one spreading wedge is formed inside a wall of the bore. Preferably, the spreading wedge is formed at or close to the second end of the bore.

[0021] The special embodiment has the advantage that when the rotation-blocking pin is reaching the end of its insertion travel, the wedges spread the shaft of the rotation-blocking pin. Thus, the at least on wedge serves for an initial easy insertion. At the end of the travel, the insertion force rises steeply so that the rotation-blocking pin is secured into position.

[0022] According to an embodiment of the rotation-blocking pin, the rotation-blocking pin has a solid shaft and a plurality of flexible fins. The flexible fins are arranged axially along the shaft. Each flexible fin defines an inner airgap in the unassembled stance of the rotation-blocking pin with the camera housing. In the mounted stance of the rotation-blocking pin with the camera housing, the flexible fins exert a radial blocking force against the lens barrel and against the camera housing.

[0023] According to a further embodiment of the rotation-blocking pin, the rotation-blocking pin is formed as a split shaft. The split shaft has at least two lobes and a plurality of flexible fins. The flexible fins are arranged axially above the lobes of the split shaft and each flexible fin defines an inner airgap and each lobe defines a lobe air gap in the unassembled stance of the rotation-blocking pin with the camera housing. In the mounted stance of the rotation-blocking pin with the camera housing, the flexible fins exert a radial blocking force against the lens barrel and against the camera housing. According to an embodiment, the bore has at its second end at least one wedge for spreading the lobes of the shaft apart when the rotation-blocking pin is fully inserted in the bore.

[0024] The advantage of the wedge is that as the rotation-blocking pin is reaching the end of the insertion travel, the lobes of the shaft are spread apart by the at least one special wedge inside the walls of the bore. This specific construction serves for an initial easy insertion of the rotation-blocking pin into the bore of the camera housing. At the end of the travel of the rotation-blocking

pin, the insertion force rises steeply so that the rotation-blocking pin is secured into position. If at least one fin is positioned in the bore over the window towards the lens barrel, the assembly is as well tight from below.

[0025] In an embodiment, the rotation-blocking pin is manufactured from a plastic or silicone material.

[0026] According to an embodiment of the method of the invention for assembling a camera assembly, the camera assembly is composed at least of a camera housing and a printed circuit board. The printed circuit board carries an optical sensor. The printed circuit board is attached to the camera housing. A lens barrel is axially surrounded by the camera housing and mounted in the camera housing such that a defined airgap between the lens barrel and the optical sensor is set. The steps comprise:

screwing the lens barrel into the camera housing and thereby best positioning the lens barrel in relation to the optical sensor; and

inserting a rotation-blocking pin into at least one bore formed in the camera housing, wherein the bore defines a window to the lens barrel, and wherein the fully inserted rotation-blocking pin is at least in a force-fitting contact with a side portion of the lens barrel.

[0027] The advantage of the inventive solution is that the rotation-blocking pin, in relaxed stance, gets into interference with the lens barrel. The airgaps inside the rotation-blocking pin are closing, while a radial blocking force is exerted, pushing the lens barrel tight against the camera housing.

[0028] For balancing the radial force exerted on the lens barrel, two rotation-blocking pins (or more) can be used, which are disposed in a radial pattern around the lens barrel. The radial force necessary for moving the rotation-blocking pin can be easily tuned by tweaking the material of rotation-blocking pin. The tuning parameters are: the nominal size of the airgap of the flexible fins, nominal size of airgap between the lobes, the thickness of fins, the thickness of shaft or the general diameter of shaft. The blocking force can be easily established at 2 or 3 times above minimal requirement, so that material aging cannot affect the safe fixation position. In an embodiment where the blocking pin is made of a soft material, the housing and lens barrel are made of a stiff material like common metals. The need of at least one counter pin as balancing element for radial force is reduced or even annulled.

[0029] The use of the inventive camera assembly in a driver monitoring system is one example and should not be regarded as a limitation of the present invention. There are many possible uses of the inventive camera assembly in any type of vehicle in various application or even in any industry applications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The numerous advantages of the disclosure may be better understood by those skilled in the art by reference to the accompanying figures in which:

Figure 1 is a schematic representation of the placement of a driver monitoring system camera according to an embodiment of the prior art;

Figure 2 is a perspective view of a prior art camera assembly;

Figure 3 is a cross-section view in axial direction through the centre of the camera assembly shown in Figure 2;

Figure 4 is an off-center sliced view of the camera assembly according to the present invention;

Figure 5 is a perspective side view of the housing of the camera assembly according to the present invention;

Figure 6 is a perspective front view of the housing of the camera assembly according to the present invention;

Figure 7 is a side view of the inventive camera assembly, wherein a rotation-blocking pin is not inserted;

Figure 8 is a side view of the inventive camera assembly, wherein the rotation-blocking pin is inserted;

Figure 9 is a perspective view of an embodiment of the rotation-blocking pin;

Figure 10 is a perspective view of a further embodiment of the rotation-blocking pin;

Figure 11 is a sectional view of the final assembly of the camera assembly, wherein the rotation-blocking pin is in contact with the lens barrel;

Figure 12 is a sectional view of the final assembly of the camera assembly, wherein the flexible fins are in contact with the lens barrel;

Figure 13 is an off-center sliced view of the camera assembly, wherein the rotation-blocking pin is inserted in a through-hole;

Figure 14 is an enlarged view of the rotation-blocking pin the through-hole of Figure 13;

Figure 15 is a sectional view of the camera assembly, wherein spreading wedges interact with the ro-

tation-blocking pin;

Figure 16 is a side view of the camera assembly, showing the first and the second end of the through-hole for the rotation-blocking pin; and

Figure 17 is an enlarged perspective view of the camera assembly showing the second end of the through-hole for the rotation-blocking pin.

DETAILED DESCRIPTION

[0031] In the ensuing description, numerous specific details are provided to enable maximum understanding of the embodiments that are provided by way of example. The embodiments may be implemented with or without specific details, or else with other methods, components, materials, etc.. In other circumstances, well-known structures, materials, or operations are not illustrated or described in detail so that various aspects of the embodiments will not be obscured. Reference in the course of the present description to "an embodiment" or "one embodiment" means that a particular structure, peculiarity, or characteristic described in connection with its implementation is comprised in at least one embodiment. Hence, phrases such as "in an embodiment" or "in one embodiment" that may recur in various points of the present description do not necessarily refer to one and the same embodiment. Furthermore, the particular structures, peculiarities, or characteristics may be combined in any convenient way in one or more embodiments.

[0032] Same reference numerals refer to same elements or elements of similar function throughout the various figures. Furthermore, only reference numerals necessary for the description of the respective figure are shown in the figures. The shown embodiments represent only examples of how the invention can be carried out. This should not be construed as a limitation of the invention.

[0033] **Figure 1** shows a schematic representation of an arrangement of a driver monitoring system 1 inside a motor vehicle 2 according to an embodiment of the prior art. The driver monitoring system 1 is mounted, for example, at or close to a windshield 3 of the motor vehicle 2, so that at least one camera assembly 10 (see Figure 2) of driver monitoring system 1 is looking at a driver 5 of the motor vehicle 2. In particular, a lens 4 of camera assembly 10 is pointing at the driver 5.

[0034] **Figure 2** is a perspective view of a prior art camera assembly 10. A camera housing 11 surrounds a lens barrel 12 axially. It is noted that the exterior shape of camera housing 11 (presented in the accompanied figures) shows one possible example. A printed circuit board 13, which carries an optical sensor 14 (see Figure 3), is mounted to the camera housing 11. A data cable 15 connects the printed circuit board 13 with an evaluation and control unit (not shown).

[0035] **Figure 3** is a cross-section view in axial direction through the center of the prior art camera assembly 10 shown in Figure 2. The camera housing 11 surrounds the lens barrel 12. The printed circuit board 13, carrying the optical sensor 14, is attached to the camera housing 11. In the embodiment shown, printed circuit board 13 carries further electronic components 18. The lens barrel 12 defines an optical axis 19 which is, in the mounted stage of the lens barrel 12, perpendicular to the optical sensor 14. In order to provide a proper imaging by optical sensor 14, an airgap 20 between lens barrel 12 and optical sensor 14 needs to be adjusted. In order to achieve the required airgap 20, lens barrel 12 and camera housing 11 feature a thread 16 which allows travel of the lens barrel 12 towards or away from the optical sensor 14 until the optimal and required airgap 20 is reached. An O-ring 17 is sitting on a radial rim 21 and is exposed to a certain tension once lens barrel 12 has reached, due to a rotational movement of lens barrel 12, an optimal and required airgap 20 with the optical sensor 14. The axial tension (along the optical axis 19) of O-ring 17 should stabilize the airgap 20 between lens barrel 12 and optical sensor 14 and thus prevent accidental rotation of the lens barrel 12 relative to the camera housing 11. A secondary function of the O-ring 17 is to ensure tightness between the optical sensor 14 on the printed circuit 13 and the outside of camera assembly 10.

[0036] There are some problems of current prior art camera assemblies 10 mentioned above. The tension provided by O-ring 17 is not constant from camera to camera which results in a variable adjustment and mounting of camera assembly 10. Additionally, the tension provided by O-ring 17 on lens barrel 12 is not constant over time due to material aging. Moreover, the installation of O-ring 17 inside camera housing 10 is difficult and the correct position of O-ring 17 inside camera housing 11 after installation cannot be checked visually.

[0037] **Figure 4** is an off-center sliced view of the camera assembly 10 according to an embodiment of the present invention. A bore 23 is formed in camera housing 11. In the embodiment shown here, bore 23 is a through-hole which defines a first open end 23_1 and a second open end 23_2 in camera housing 11. The bore 23 can receive a rotation-blocking pin 25. In the embodiment of Figure 4, rotation-blocking pin 25 is inserted in bore 23 and in contact with a side portion 22 of lens barrel 12. The placement of bore 23 is such that a window 24, shown as a dashed line in Figure 4, is formed, through which the side portion 22 of lens barrel 12 can be reached by rotation-blocking pin 25. The contact between rotation-blocking pin 25 and lens barrel 12 block a rotation of lens barrel 12. Thus, the rotation-blocking pin 25 is able to stabilize the airgap 20 between lens barrel 12 and optical sensor 14 and thus prevents accidental rotation of lens barrel 12 relative to camera housing 11. According to a preferred embodiment, rotation-blocking pin 25 is soft and elastic, for example made from a polymer material.

[0038] **Figure 5** is a perspective side view of the cam-

era housing 11 for the camera assembly 10 according to an embodiment of the present invention. The camera housing 11 has, as mentioned in the description of Figure 4, a bore 23 formed, which is generally parallel to optical axis 19 (see Figure 3) of lens barrel 12. In the embodiment shown here, bore 23 is a through-hole with a first open end 23_1 and a second open end 23_2. Furthermore, in the embodiment shown here, bore 23 has at least one wedge 27 formed in camera housing 11, which at least one wedge 27 can cooperate with the rotation-blocking pin 25 (not shown here). **Figure 6** is a perspective front view of camera housing 11 of Figure 5. Bore 23, as also shown in Figure 4, has a window 24 (shown here as a solid line) which communicates with thread 16 for lens barrel 12 (not shown here) to be mounted in camera housing 11. Through the window 24, the side portion 22 of lens barrel 12 can be reached by rotation-blocking pin 25 (see Figure 4). Window 24 partially intersects the cylindrical thread 16 that is housing lens barrel 12. Through this construction principle, it is possible to inspect the correct insertion of rotation-blocking pin 25 and camera housing 11 serves not only to accommodate lens barrel 12, but also to accommodate rotation-blocking pin 25.

[0039] **Figure 7** is a side view of the inventive camera assembly 10, wherein the rotation-blocking pin 25 is not inserted in bore 23. Printed circuit board 13 is mounted to camera housing 11. Trough bore 23, viewing from the first end 23_1, one can see thread 16 of camera housing 11. In the embodiment shown here, bore 23 is not a through-hole. Instead, bore 23 is closed by a bottom 26 and features the two wedges 27.

[0040] **Figure 8** is a side view of inventive camera assembly 10, wherein rotation-blocking pin 25 is inserted in bore 23. The rotation-blocking pin 25 is inserted from the first open end 23_1.

[0041] **Figure 9** is a perspective view of an embodiment of the rotation-blocking pin 25. Rotation-blocking pin 25 defines a first end 25_1 and a second end 25_2. In the embodiment shown here, a shaft 30 of the rotation-blocking pin 25 is split in at least two lobes 34. Each lobe 34 has stacked a plurality of flexible fins 36. At first end 25_1, the shaft 30 carries a stopper cap 32. When compressed radially, the fins 36 are enclosing the shaft 30, virtually until an inner air gap 38 between the respective flexible fin 36 and shaft 30 becomes zero. The shaft 30 with two lobes 34 is particularly flexible when compressed in a radial direction which is due to a lobe air gap 39 between the respective lobe 34 and shaft 30.

[0042] **Figure 10** is a perspective view of a further embodiment of the rotation-blocking pin 25. For the sake of simplicity, shaft 30 is manufactured without lobes (solid shaft). Such a solution ensures a better seal against the penetration of vapours into camera housing 11, which accommodates sensitive elements such as the optical sensor 14. Here as well, when compressed radially, the fins 36 are enclosing the shaft 30, virtually until the inner air gap 38 becomes zero. The rotation-blocking pins 25, as described above, may be manufactured from a wide range of plastic and silicone materials by conventional methods.

[0043] **Figure 11** is a sectional view of the final assembly of camera assembly 10, wherein the rotation-blocking pin 25 is in contact with the lens barrel 12. **Figure 12** is a sectional view of the final assembly of camera assembly 10, wherein the flexible fins 36 of rotation-blocking pin 25 are in contact with the lens barrel 12.

[0044] Camera housing 11 is fixed together with the printed circuit board 13 carrying the optical sensor 14 (see Figure 4). Lens barrel 12 is inserted, for example screwed, into camera housing 11, wherein this step includes an angular turning for best positioning the lens barrel 12 in relation to the optical sensor 14 (see Figure 4). Rotation-blocking pin 25 is then inserted inside bore 23 of camera housing 11, starting from the first end 23_1 of bore 23 of camera housing 11. In Figures 11 and 12, bore 23 is closed at its second end 23_2 with a bottom 26. This is the best solution for tightness (seal). The insertion is exerted by pushing force 40 (see Figure 12) exerted on the rotation-blocking pin 25. The insertion may continue until the stopper cap 32 reaches the bottom 26 of bore 23.

[0045] As can be seen from the final assembly of camera assembly 11 in Figure 11 and Figure 12, the flexible fins 36 of the rotation-blocking pin 25 help to maintain the position of lens barrel 12 in camera housing 11. The rotation-blocking pin 25 shown here has a solid shaft 30 (no lobes 34).

[0046] Figure 11 shows the situation when the rotation-blocking pin 25 is in a relaxed stance and the flexible fins 36 get into interference with lens barrel 12. The relaxed stance is defined by the opened inner airgaps 38 (see Figure 10) of the flexible fins 36 of rotation-blocking pin 25.

[0047] Figure 12 shows the situation when rotation-blocking pin 25 is inserted in bore 23 and maintains the folded flexible fins 36 inside bore 23. This is the best solution for tightness. The inner airgaps 38 (see Figure 10) of the flexible fins 36 are closed and the flexible fins 36 exert a radial blocking force 42 which pushes the lens barrel 12 tight against the camera housing 11. According to a further embodiment, for balancing the radial blocking force 42 exerted on the lens barrel 12, two or more rotation-blocking pins 25 may be used. The rotation-blocking pins 25 can be disposed in a radial pattern around lens barrel 12.

[0048] **Figure 13** is an off-center sliced view of camera assembly 10, wherein the at least one rotation-blocking pin 25 is inserted in bore 23, which is configured as a through-hole. **Figure 14** is an enlarged view of the rotation-blocking pin 25 in the bore 23 of Figure 13. Normally, the force for extracting the rotation-blocking pin 25 is considerably higher than the force for insertion. In a normal use case, however, there is no need to disassemble. If necessary, demounting, can also be ensured by pushing from the second end 23_2 (opposite direction) of the bore 23. The movement of the rotation-blocking pin 25 in the

bore 23 is limited by a radial rim 33, which gets into contact with a stopper cap 32 of the rotation-blocking pin 25. Here, some of the flexible fins 36 are in force-fitting contact with lens barrel 12 mounted in camera housing 11. Lens barrel 12 is maintained by the flexible fins 36 of rotation-blocking pin 25 in the adjusted position in relation to the optical sensor 14.

[0049] **Figure 15** is sectional view of the camera assembly 10, wherein spreading wedges 27 interact with the rotation-blocking pin 25. In the embodiment shown here, as the rotation-blocking pin 25 is reaching the end of its insertion travel into the bore 23, the flexible fins 36 of shaft 30 are spread apart by wedges 27 formed inside the wall 28 of bore 23. At the end of the travel of the rotation-blocking pin 25 in the bore 23, the insertion force rises steeply so that the rotation-blocking pin 25 is secured into position.

[0050] **Figure 16** is a side view of the embodiment of the camera assembly 10 shown in Figure 15, wherein the printed circuit board 13 together with the optical sensor 14 (see also Figure 13) are mounted to camera housing 11. The bore 23, for insertion of rotation-blocking pin 25, showing the first end 23_1 and the second end 23_2 of bore 23, is a through-hole in this embodiment. Rotation-blocking pin 25 is inserted in bore 23. The two lobes 34 of rotation-blocking pin 25 are not seen at the second end 23_2 of bore 23, because the rotation-blocking pin 25 is designed such that a fully inserted rotation-blocking pin 25, including the lobes 34, does not disturb the spherical topology of camera housing 11.

[0051] **Figure 17** is an enlarged perspective view of the camera assembly 10 showing the second end 23_2 of the bore 23 (through-hole) for the rotation-blocking pin 25. The lobes 34 of the shaft 30 are spread apart by wedges 27 being close to the second end 23_2 of bore 23 (through-hole). Figure 16 and 17 clearly show that the bore 23 is formed such in the camera housing 11, that the spherical topology of the camera housing 11 is not disturbed.

[0052] It is believed that the present disclosure and many of its attendant advantages will be understood by the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the components without departing from the disclosed subject matter or without sacrificing all of its material advantages. The form described is merely explanatory, and it is the intention of the following claims to encompass and include such changes. Accordingly, the scope of the invention should be limited only by the claims appended hereto.

LIST OF REFERENCE NUMERALS

[0053]

1	Driver monitoring system
2	Vehicle
3	Windshield
4	Lens
5	Driver
10	Camera assembly
11	Camera housing
12	Lens barrel
13	Printed circuit board
14	Optical sensor
15	Data cable
16	Thread
17	O-Ring
18	Electronic components
19	Optical axis
20	Airgap
21	Radial rim
22	Side portion of lense barrel
23	Bore
23_1	First end
23_2	Second end
24	Window
25	Rotation-blocking pin
25_1	First end
25_2	Second end
26	Bottom
27	Wedge
28	Wall
30	Shaft
32	Stopper cap
33	Radial rim
34	Lobe
36	Flexible fin
38	Inner air gap
39	Lobe air gap
40	Pushing force
42	Radial blocking force

Claims

1. A camera assembly (10) comprising:

a camera housing (11),
a printed circuit board (13), carrying an optical sensor (14) attached to the camera housing (11);
a lens barrel (12) axially surrounded by the camera housing (11) and mounted in the camera housing (11) such that a defined airgap (20) between the lens barrel (12) and the optical sensor (14) is set,
characterized by
a bore (23), formed tangentially to the lens barrel (12), in the camera housing (11) and thereby defining a window (24) to the lens barrel (12); and
a rotation-blocking pin (25) with a plurality of stacked flexible fins (36) inserted in the bore (23) wherein the flexible fins (36) of rotation-blocking pin (25) are at least in a force-fitting contact

though the window with a side portion (22) of the lens barrel (12).

2. The camera assembly (10) as claimed in claim 1, wherein the bore (23) in the camera housing (11) defines a first end (23_1) and a second end (23_2), wherein the second end (23_2) of the bore (23) is closed with a bottom (26) or the bore (23) in the camera housing (11), with the first end (23_1) and the second end (23_2) is a through-hole.

3. The camera assembly (10) as claimed in claim 2, wherein at least one spreading wedge (27) is formed inside a wall (28) of the bore (23).

4. The camera assembly (10) as claimed in any of the preceding claims, wherein the rotation-blocking pin (25) has a solid shaft (30) and the plurality of flexible fins (36), wherein the flexible fins (36) are arranged axially along the shaft (30) and each flexible fin (36) defines an inner airgap (38) in the unassembled stance of the rotation-blocking pin (25) with the camera housing (11), whereas in the mounted stance of the rotation-blocking pin (25) with the camera housing (11), the flexible fins (36) exert a radial blocking force (42) against the lens barrel (12) and against the camera housing (11).

5. The camera assembly (10) as claimed in any of the claims 1 to 3, wherein the rotation-blocking pin (25) is formed as a split shaft (30) with at least two lobes (34) and the plurality of flexible fins (36), wherein the flexible fins (36) are arranged axially along the lobes (34) of the split shaft (30) and each flexible fin (36) defines an inner airgap (38) and each lobe (34) defines a lobe air gap (39) in the unassembled stance of the rotation-blocking pin (25) with the camera housing (11), and in the mounted stance of the rotation-blocking pin (25) with the camera housing (11), the flexible fins (36) exert a radial blocking force (42) against the lens barrel (12) and against the camera housing (11).

6. The camera assembly (10) as claimed in claim 5, wherein the bore (23) has at its second end (23_2) at least one wedge (27) for spreading the lobes (34) of the shaft (30) apart when the rotation-blocking pin (25) is fully inserted in the bore (23).

7. The camera assembly (10) as claimed in any of the preceding claims, wherein the rotation-blocking pin (25) is manufactured from a plastic or silicone material.

8. A method for assembling a camera assembly (10) with a camera housing (11) and a printed circuit board (13), carrying an optical sensor (14) and being attached to the camera housing (11), a lens barrel (12) is axially surrounded by the camera housing (11) and mounted in the camera housing (11) such that a defined airgap (20) between the lens barrel (12) and the optical sensor (14) is set;
comprising the steps of:

screwing the lens barrel (12) into the camera housing (11) and thereby best positioning the lens barrel (12) in relation to the optical sensor (14); and
inserting a rotation-blocking pin (25), having plurality of stacked flexible fins (36) into at least one bore (23) formed in the camera housing (11), wherein the bore (23) defines a window (24) to the lens barrel (12), and wherein the flexible fins (36) of the fully inserted rotation-blocking pin (25) are at least in a force-fitting contact through the window (24) with a side portion (22) of the lens barrel (12).

9. The method as claimed in claim 8, wherein the insertion of the rotation-blocking pin (25) starts from a first end (23_1) of the bore (23) and ends when a stopper cap (32) of the rotation-blocking pin (25) is in contact with a radial rim (21) inside the bore (23).

10. The method as claimed in any of the preceding claims 8 to 9, wherein the rotation-blocking pin (25) has a solid shaft (30) and the plurality of flexible fins (36) each defining an inner airgap (38), wherein the inner airgaps (38) of the flexible fins (36) of the fully inserted rotation-blocking pin (25) are compressed and thereby a radial blocking force (42) is exerted against the lens barrel (12) and against the camera housing (11).

11. The method as claimed in any of the preceding claims 8 to 9, wherein the rotation-blocking pin (25) is formed as a split shaft (30) with at least two lobes (34) and a plurality of flexible fins (36), wherein the flexible fins (36) are arranged axially above the lobes (34) of the split shaft (30), wherein an inner airgap (38) of each of the flexible fins (36) is compressed and a wedge (27) for spreading the flexible fins (36) and the lobes (34) of the shaft (30) apart, when the rotation-blocking pin (25) is fully inserted in the bore (23) and thereby exerts a radial blocking force (42) against the lens barrel (12) and against the camera housing (11).

Patentansprüche

1. Eine Kameraanordnung (10) umfassend:

ein Kameragehäuse (11),
eine gedruckte Leiterplatte (13), die einen optischen Sensor (14) trägt, der an dem Kamera-

gehäuse (11) befestigt ist;
einen Linsentubus (12), der axial von dem Kameragehäuse (11) umgeben und in dem Kameragehäuse (11) so montiert ist, dass ein definierter Luftspalt (20) zwischen dem Linsentubus (12) und dem optischen Sensor (14) eingestellt ist,
gekennzeichnet durch
eine Bohrung (23), die tangential zum Linsentubus (12) im Kameragehäuse (11) ausgebildet ist und dadurch ein Fenster (24) für den Linsentubus (12) definiert; und
einen Drehsicherungsstift (25) mit einer Vielzahl von gestapelten flexiblen Rippen (36), die in die Bohrung (23) eingesetzt sind, wobei die flexiblen Rippen (36) des Drehsicherungsstifts (25) zumindest in einem kraftschlüssigen Kontakt durch das Fenster mit einem Seitenabschnitt (22) des Linsentubus (12) stehen.

2. Die Kameraanordnung (10) nach Anspruch 1, wobei die Bohrung (23) im Kameragehäuse (11) ein erstes Ende (23_1) und ein zweites Ende (23_2) definiert, wobei das zweite Ende (23_2) der Bohrung (23) mit einem Boden (26) oder der Bohrung (23) im Kameragehäuse (11) verschlossen ist, wobei das erste Ende (23_1) und das zweite Ende (23_2) ein Durchgangsloch ist.

3. Die Kameraanordnung (10) nach Anspruch 2, wobei mindestens ein Spreizkeil (27) innerhalb einer Wand (28) der Bohrung (23) ausgebildet ist.

4. Die Kameraanordnung (10) nach einem der vorhergehenden Ansprüche, wobei der Drehsicherungsstift (25) einen massiven Schaft (30) und die Vielzahl von flexiblen Rippen (36) aufweist, wobei die flexiblen Rippen (36) axial entlang des Schaftes (30) angeordnet sind und jede flexible Rippe (36) in der unmontierten Stellung des Drehsicherungsstiftes (25) mit dem Kameragehäuse (11) einen inneren Luftspalt (38) definiert, während die flexiblen Rippen (36) in der montierten Stellung des Drehsicherungsstifts (25) mit dem Kameragehäuse (11) eine radiale Sperrkraft (42) gegen den Linsentubus (12) und gegen das Kameragehäuse (11) ausüben.

5. Die Kameraanordnung (10) nach einem der Ansprüche 1 bis 3, wobei der Drehsicherungsstift (25) als eine geteilte Welle (30) mit mindestens zwei Lappen (34) und der Vielzahl von flexiblen Rippen (36) ausgebildet ist, wobei die flexiblen Rippen (36) axial entlang der Lappen (34) der geteilten Welle (30) angeordnet sind, und jede flexible Rippe (36) einen inneren Luftspalt (38) und jeder Lappen (34) einen Lappenluftspalt (39) in der unmontierten Stellung des Drehsicherungsstifts (25) mit dem Kameragehäuse (11) definiert, und in der montierten Stellung des Drehsicherungsstifts (25) mit dem Kameragehäuse (11) die flexiblen Rippen (36) eine radiale Sperrkraft (42) gegen den Linsentubus (12) und gegen das Kameragehäuse (11) ausüben.

6. Die Kameraanordnung (10) nach Anspruch 5, wobei die Bohrung (23) an ihrem zweiten Ende (23_2) mindestens einen Keil (27) zum Auseinanderspreizen der Lappen (34) der Welle (30) aufweist, wenn der Drehsicherungsstift (25) vollständig in die Bohrung (23) eingesetzt ist.

7. Die Kameraanordnung (10) nach einem der vorhergehenden Ansprüche, wobei der Drehsicherungsstift (25) aus einem Kunststoff- oder Silikonmaterial hergestellt ist.

8. Ein Verfahren zum Zusammenbau einer Kameraanordnung (10) mit einem Kameragehäuse (11) und einer gedruckten Leiterplatte (13), die einen optischen Sensor (14) trägt und an dem Kameragehäuse (11) befestigt ist, wobei ein Linsentubus (12) axial von dem Kameragehäuse (11) umgeben und in dem Kameragehäuse (11) so montiert wird, dass ein definierter Luftspalt (20) zwischen dem Linsentubus (12) und dem optischen Sensor (14) eingestellt wird; mit den folgenden Schritten:

Einschrauben des Linsentubus (12) in das Kameragehäuse (11) und dadurch optimale Positionierung des Linsentubus (12) in Bezug auf den optischen Sensor (14); und
Einsetzen eines Drehsicherungsstifts (25) mit einer Vielzahl von gestapelten flexiblen Rippen (36) in mindestens eine im Kameragehäuse (11) ausgebildete Bohrung (23), wobei die Bohrung (23) ein Fenster (24) zum Linsentubus (12) definiert, und wobei die flexiblen Rippen (36) des vollständig eingesetzten Drehsicherungsstifts (25) mindestens in einem kraftschlüssigen Kontakt durch das Fenster (24) mit einem Seitenabschnitt (22) des Linsentubus (12) stehen.

9. Das Verfahren nach Anspruch 8, wobei das Einsetzen des Drehsicherungsstifts (25) von einem ersten Ende (23_1) der Bohrung (23) ausgeht und endet, wenn eine Anschlagkappe (32) des Drehsicherungsstifts (25) in Kontakt mit einem radialen Rand (21) innerhalb der Bohrung (23) ist.

10. Das Verfahren nach einem der vorhergehenden Ansprüche 8 bis 9, wobei der Drehsicherungsstift (25) einen massiven Schaft (30) aufweist und die Vielzahl von flexiblen Rippen (36) jeweils einen inneren Luftspalt (38) definieren, wobei die inneren Luftspalte (38) der flexiblen Rippen (36) des vollständig eingesetzten Drehsicherungsstifts (25) zusammengedrückt werden und dadurch eine radiale Sperrkraft

(42) gegen den Linsentubus (12) und gegen das Kameragehäuse (11) ausgeübt wird.

11. Das Verfahren nach einem der vorhergehenden Ansprüche 8 bis 9, wobei der Drehsicherungsstift (25) als eine geteilte Welle (30) mit mindestens zwei Lappen (34) und einer Vielzahl von flexiblen Rippen (36) ausgebildet ist, wobei die flexiblen Rippen (36) axial über den Lappen (34) der geteilten Welle (30) angeordnet sind, wobei ein innerer Luftspalt (38) jeder der flexiblen Rippen (36) zusammengedrückt wird und ein Keil (27) die flexiblen Rippen (36) und den Lappen (34) der Welle (30) auseinanderspreizt, wenn der Drehsicherungsstift (25) vollständig in die Bohrung (23) eingesetzt ist und dadurch eine radiale Sperrkraft (42) gegen den Linsentubus (12) und gegen das Kameragehäuse (11) ausübt.

Revendications

1. Un ensemble caméra (10) comprenant :

un boîtier de caméra (11),
une carte de circuit imprimé (13), portant un capteur optique (14) fixé au boîtier de caméra (11) ;
un barillet de lentille (12) entouré axialement par le boîtier de caméra (11) et monté dans le boîtier de caméra (11) de telle sorte qu'un entrefer défini (20) entre le barillet de lentille (12) et le capteur optique (14) soit réglé,
caractérisé par
un alésage (23), formé tangentiellement au barillet de lentille (12), dans le boîtier de caméra (11) et définissant ainsi une fenêtre (24) au barillet de lentille (12) ; et
une broche à blocage anti-rotation (25) avec une pluralité d'ailettes flexibles empilées (36) inséré dans l'alésage (23) dans lequel les ailettes flexibles (36) de la broche à blocage anti-rotation (25) sont au moins en contact par force à travers la fenêtre avec une partie latérale (22) du barillet de lentille (12).

2. L'ensemble caméra (10) selon la revendication 1, dans lequel l'alésage (23) dans le boîtier de caméra (11) définit une première extrémité (23_1) et une deuxième extrémité (23_2), dans lequel la deuxième extrémité (23_2) de l'alésage (23) est fermée par un fond (26) ou l'alésage (23) dans le boîtier de caméra (11), avec la première extrémité (23_1) et la deuxième extrémité (23_2) est un trou traversant.

3. L'ensemble caméra (10) selon la revendication 2, dans lequel au moins une cale d'écartement (27) est formée à l'intérieur d'une paroi (28) de l'alésage (23).

4. L'ensemble caméra (10) selon l'une quelconque des revendications précédentes, dans lequel la broche à blocage anti-rotation (25) comporte un arbre solide (30) et la pluralité d'ailettes flexibles (36), dans lequel les ailettes flexibles (36) sont disposées axialement le long de l'arbre (30) et chaque ailette flexible (36) définit un entrefer intérieur (38) dans la position non assemblée de la broche à blocage anti-rotation (25) avec le boîtier de caméra (11), tandis qu'en position montée de la broche à blocage anti-rotation (25) avec le boîtier de caméra (11), les ailettes flexibles (36) exercent une force de blocage radiale (42) contre le barillet de lentille (12) et contre le boîtier de caméra (11).

5. L'ensemble caméra (10) selon l'une des revendications 1 à 3, dans lequel la broche à blocage anti-rotation (25) est formée d'un arbre divisé (30) avec au moins deux lobes (34) et la pluralité d'ailettes flexibles (36), dans lequel les ailettes flexibles (36) sont disposées axialement le long des lobes (34) de l'arbre divisé (30) et chaque ailette flexible (36) définit un entrefer intérieur (38) et chaque lobe (34) définit un entrefer de lobe (39) dans la position non assemblée de la broche à blocage anti-rotation (25) avec le boîtier de caméra (11), et dans la position montée de la broche à blocage anti-rotation (25) avec le boîtier de caméra (11), les ailettes flexibles (36) exercent une force de blocage radiale (42) contre le barillet de lentille (12) et contre le boîtier de caméra (11).

6. L'ensemble caméra (10) selon la revendication 5, dans lequel l'alésage (23) comporte à sa deuxième extrémité (23_2) au moins une cale (27) pour écarter les lobes (34) de l'arbre (30) lorsque la broche à blocage anti-rotation (25) est entièrement insérée dans l'alésage (23).

7. L'ensemble caméra (10) selon l'une des revendications précédentes, dans lequel la broche à blocage anti-rotation (25) est fabriquée à partir d'un matériau en plastique ou en silicone.

8. Un procédé d'assemblage d'une caméra (10) avec un boîtier de caméra (11) et une carte de circuit imprimé (13), portant un capteur optique (14) et fixé au boîtier de caméra (11), un barillet de lentille (12) est entouré axialement par le boîtier de caméra (11) et monté dans le boîtier de caméra (11) de telle sorte qu'un entrefer défini (20) entre le barillet de lentille (12) et le capteur optique (14) est réglé ;

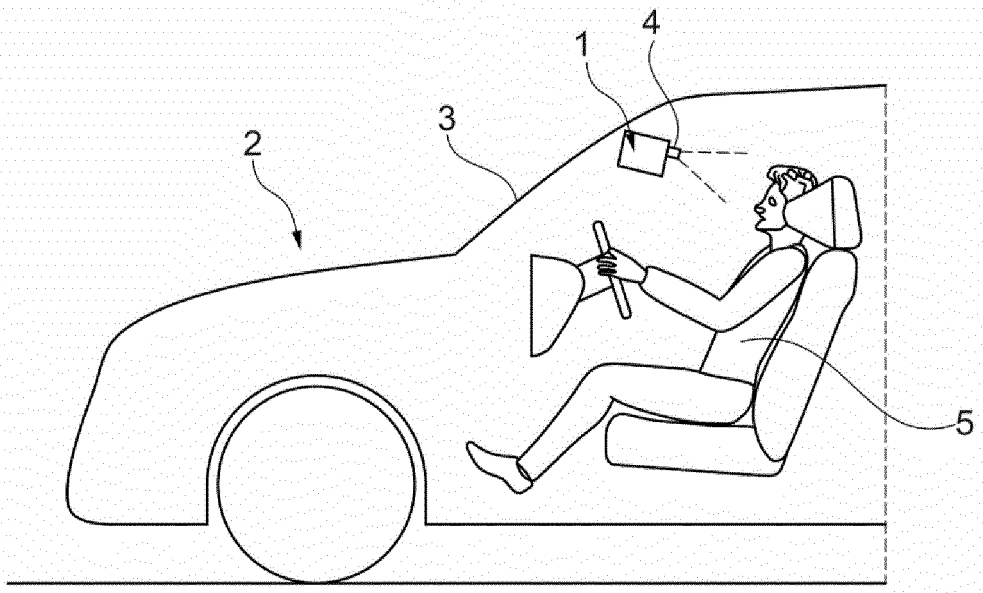
comprenant les étapes suivantes
visser le barillet de lentille (12) dans le boîtier de caméra (11) et ainsi positionner au mieux le barillet de lentille (12) par rapport au capteur optique (14) ; et
insérer une broche à blocage anti-rotation (25),

comportant une pluralité d'ailettes flexibles empilées (36), dans au moins un alésage (23) formé dans le boîtier de caméra (11), dans lequel l'alésage (23) définit une fenêtre (24) vers le barillet de lentille (12), et dans lequel les ailettes flexibles (36) de la broche à blocage anti-rotation entièrement insérée (25) sont au moins en contact par force à travers la fenêtre (24) avec une partie latérale (22) du barillet de lentille (12).

9. Le procédé selon la revendication 8, dans lequel l'insertion de la broche à blocage anti-rotation (25) commence à une première extrémité (23_1) de l'alésage (23) et se termine lorsqu'un bouchon (32) de la broche à blocage anti-rotation (25) est en contact avec un bord radial (21) à l'intérieur de l'alésage (23).

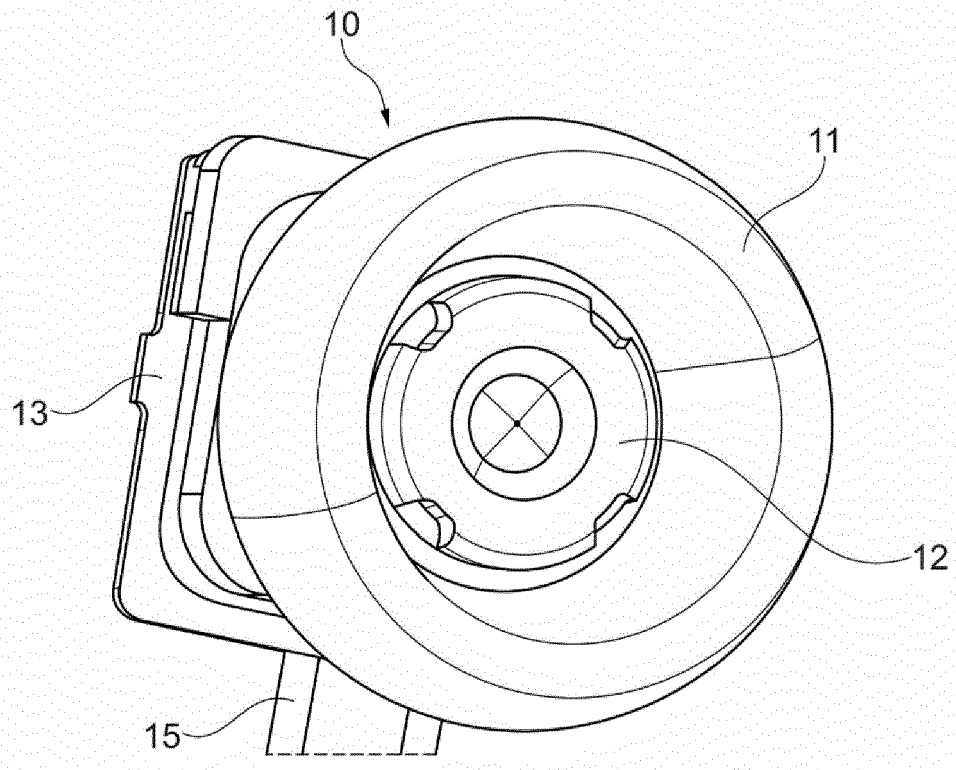
10. Le procédé selon l'une quelconque des revendications précédentes 8 à 9, dans lequel la broche à blocage anti-rotation (25) a un arbre solide (30) et la pluralité d'ailettes flexibles (36) définissant chacune un entrefer intérieur (38), dans lequel les entrefers intérieurs (38) des ailettes flexibles (36) de la broche à blocage anti-rotation entièrement insérée (25) sont comprimés et une force de blocage radiale (42) est ainsi exercée contre le barillet de lentille (12) et contre le boîtier de caméra (11).

11. Le procédé selon l'une quelconque des revendications précédentes 8 à 9, dans lequel la broche à blocage anti-rotation (25) est formée d'un arbre fendu (30) avec au moins deux lobes (34) et une pluralité d'ailettes flexibles (36), dans lequel les ailettes flexibles (36) sont disposées axialement au-dessus des lobes (34) de l'arbre fendu (30), dans lequel un entrefer intérieur (38) de chacune des ailettes flexibles (36) est comprimé et une cale (27) pour écarter les ailettes flexibles (36) et les lobes (34) de l'arbre (30), lorsque la broche à blocage anti-rotation (25) est entièrement insérée dans l'alésage (23) et exerce ainsi une force de blocage radiale (42) contre le barillet de lentille (12) et contre le boîtier de caméra (11).



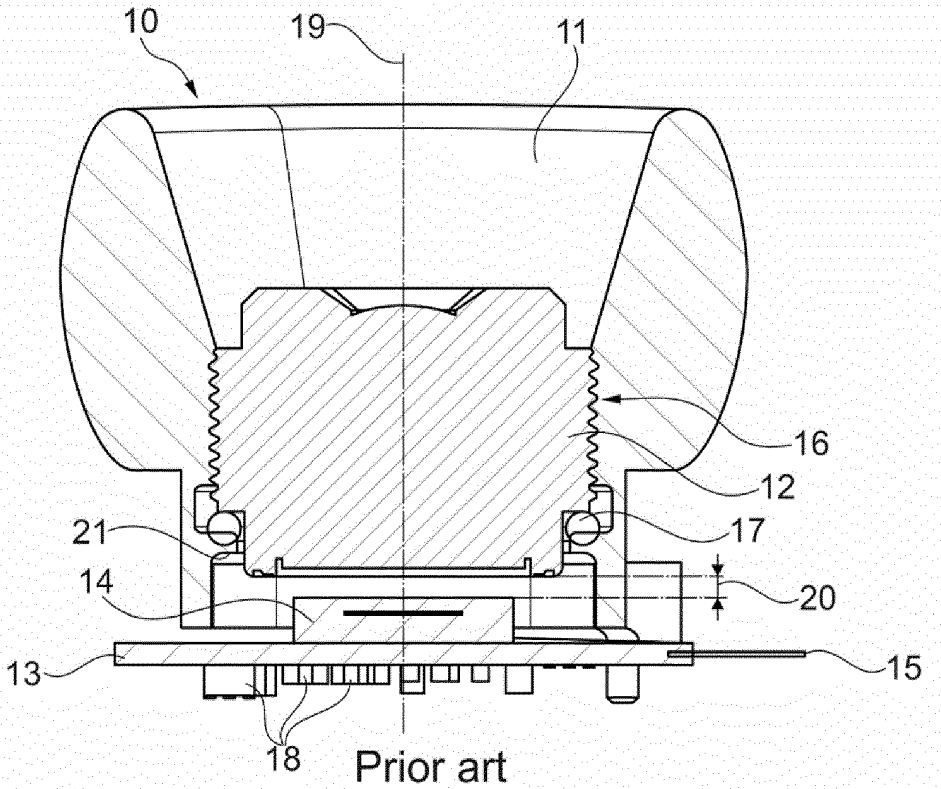
Prior art

Fig. 1



Prior art

Fig. 2



Prior art

Fig. 3

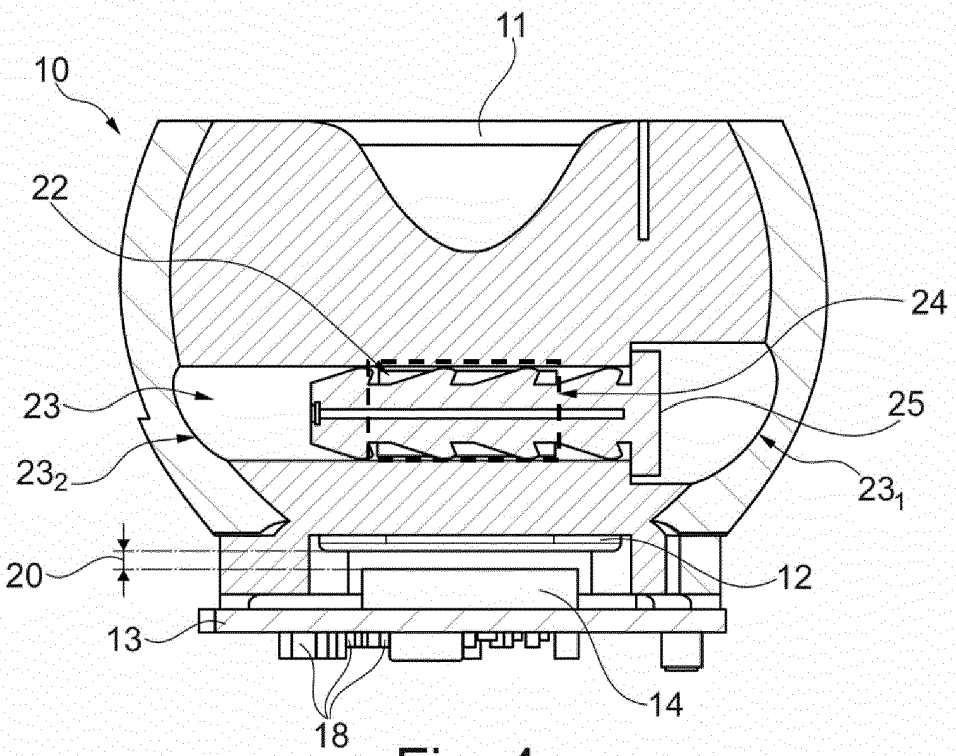


Fig. 4

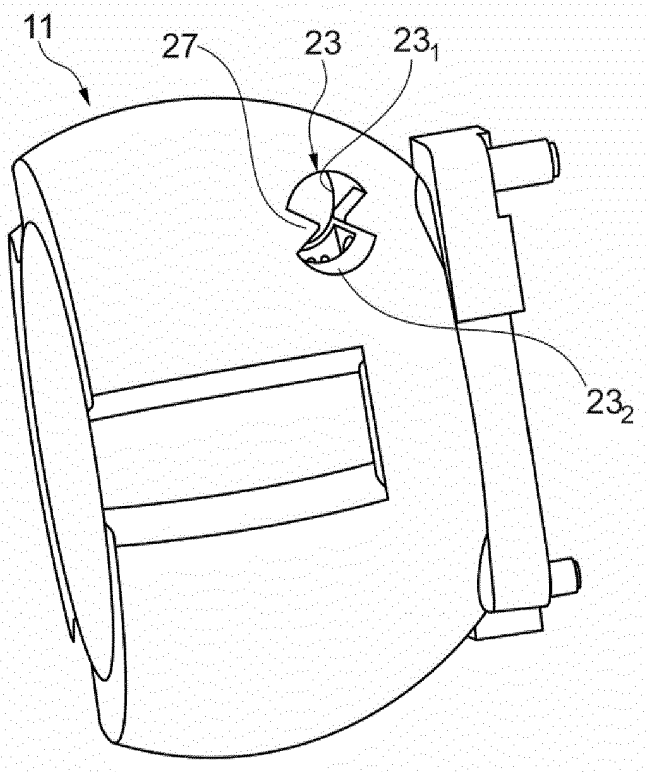


Fig. 5

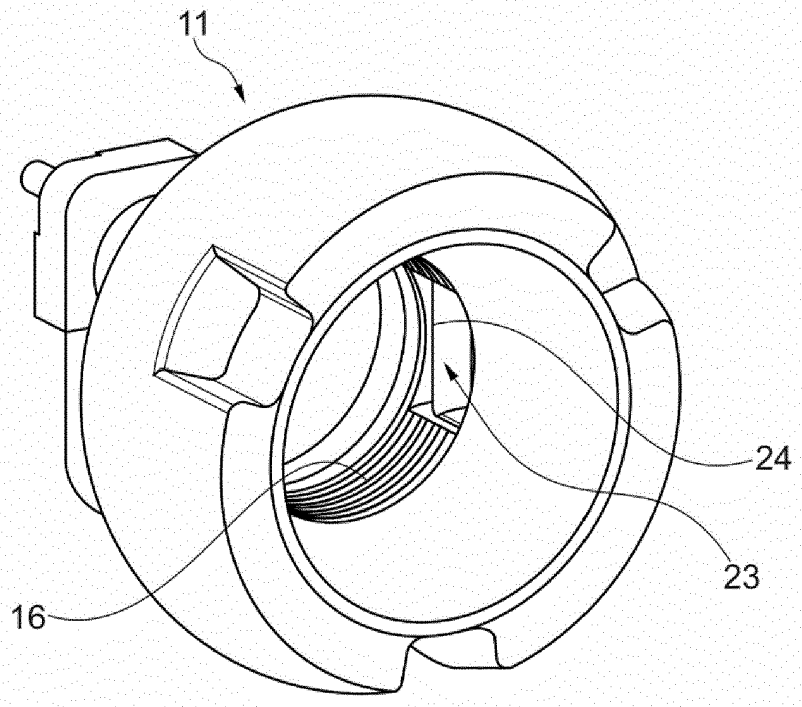


Fig. 6

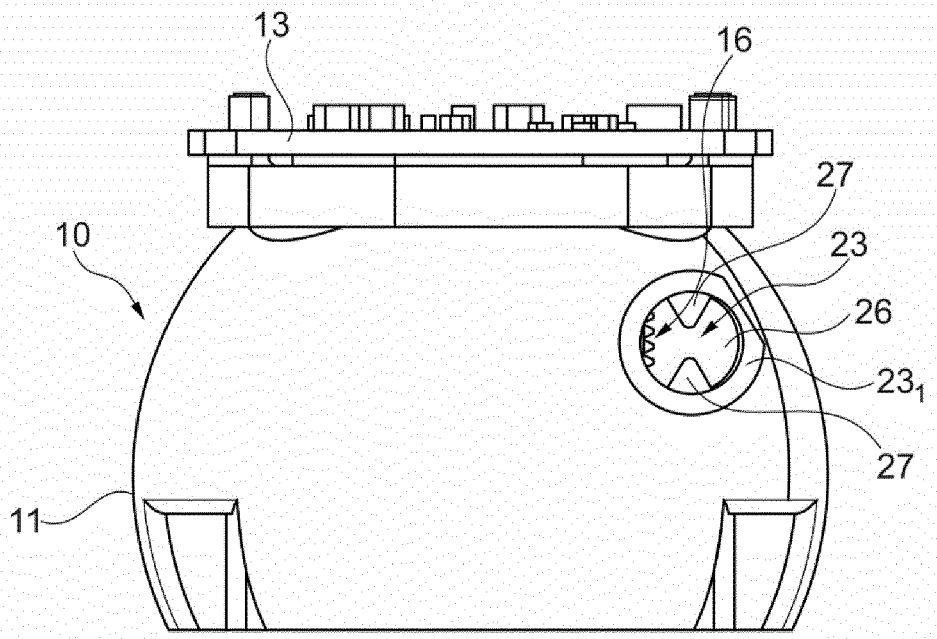


Fig. 7

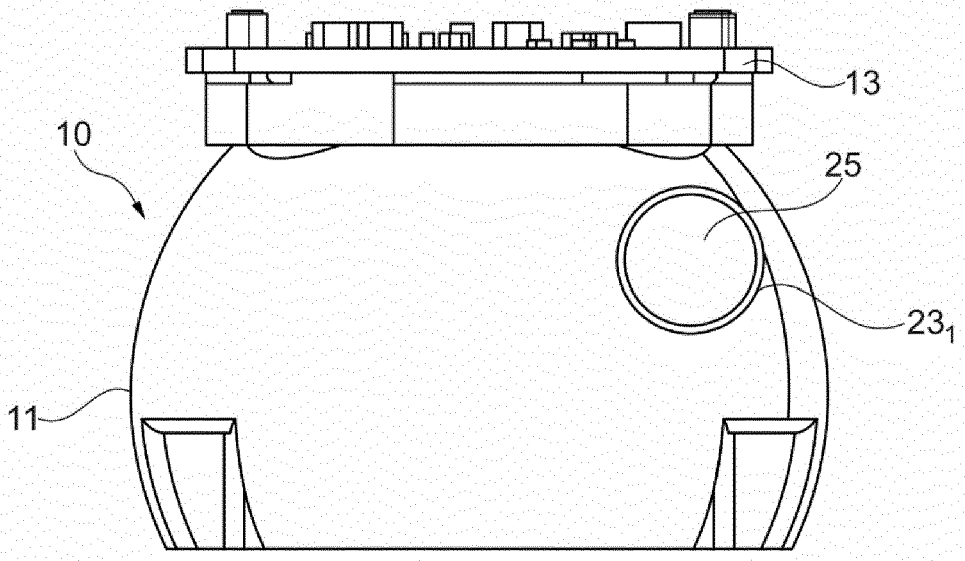
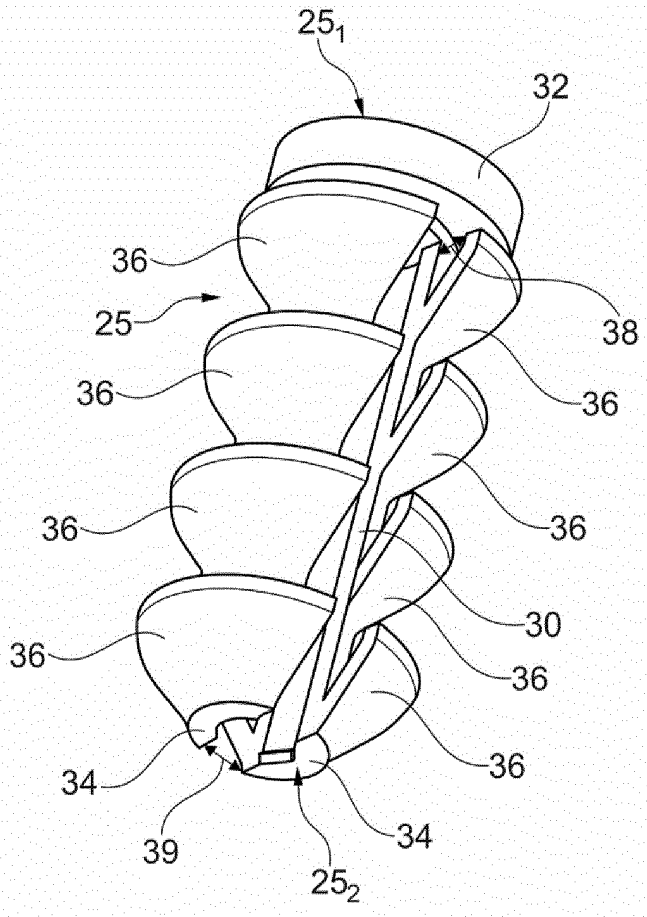


Fig. 8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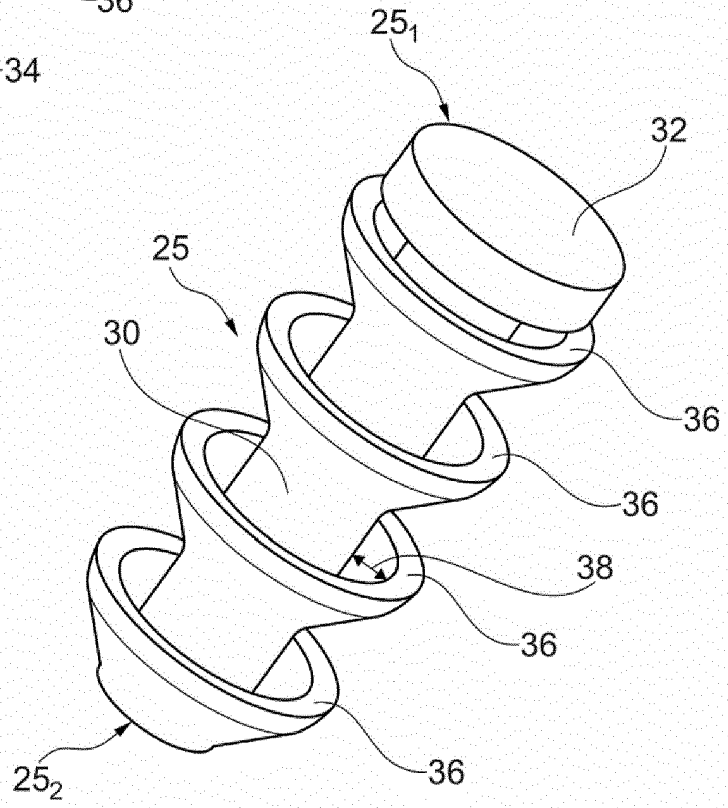
25₂

Fig. 9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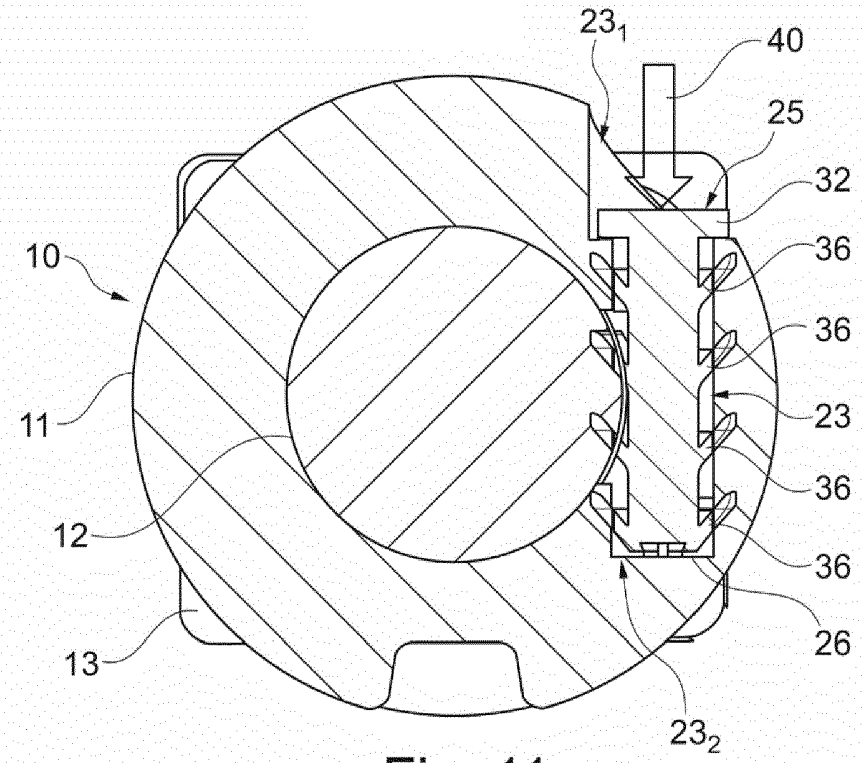
36
25₂

Fig. 10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23_2

Fig. 11

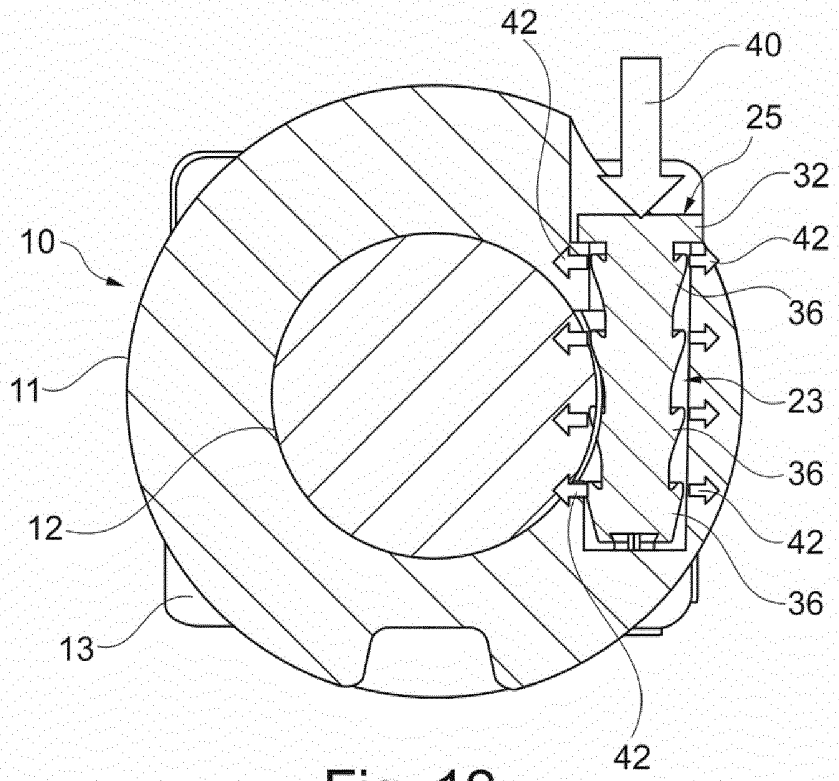
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Fig. 12

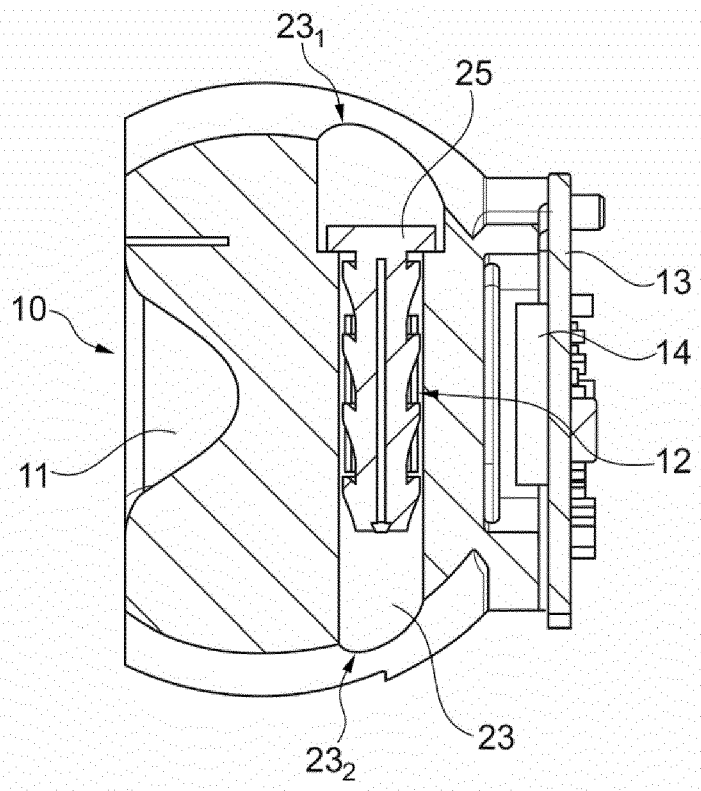

Fig. 13

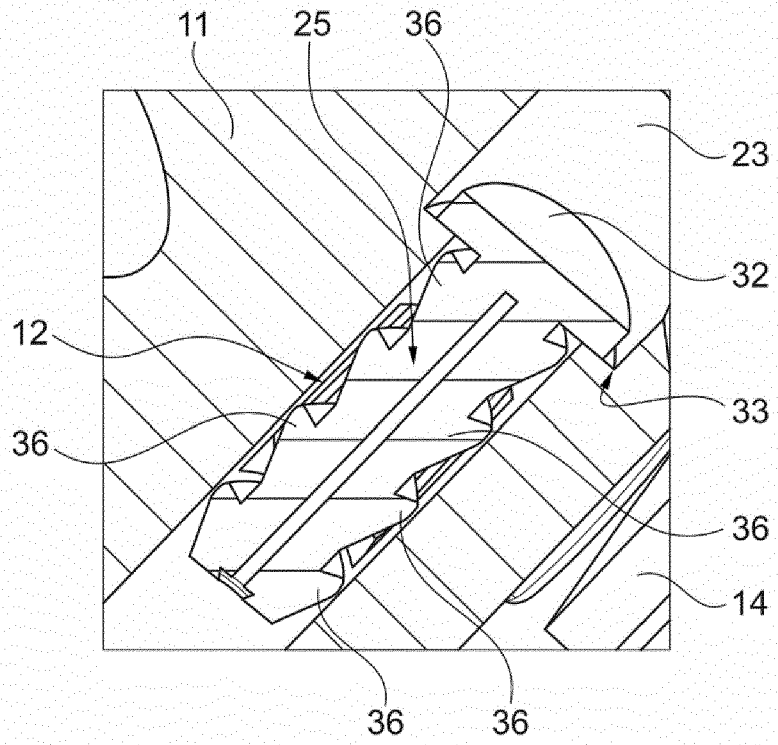

Fig. 14

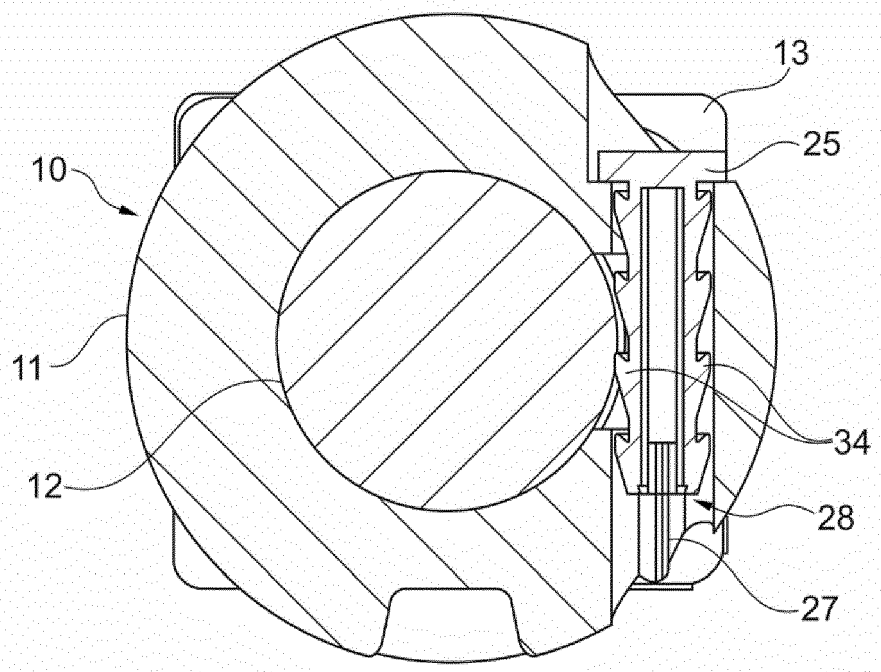

Fig. 15

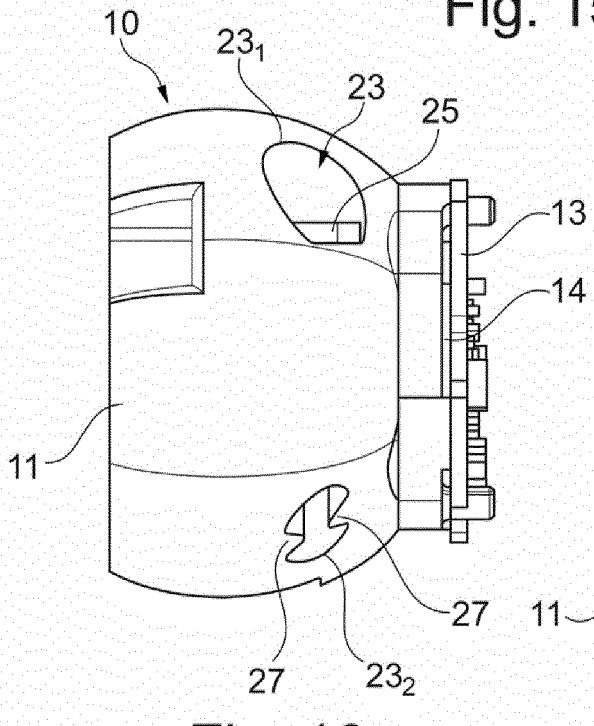

Fig. 16

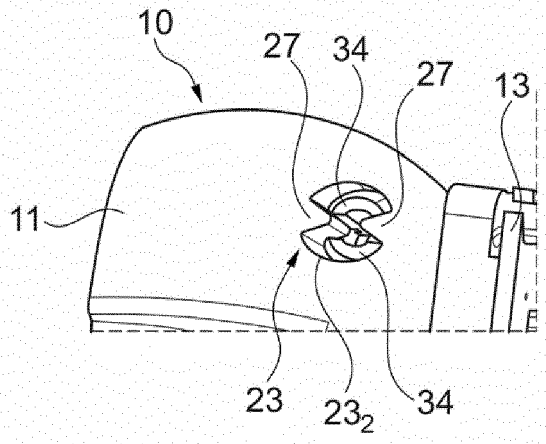

Fig. 17

REFERENCES CITED IN THE DESCRIPTION

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