



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.07.2012 Bulletin 2012/30

(51) Int Cl.:
G05G 1/12 (2006.01)

(21) Application number: **12152210.6**

(22) Date of filing: **24.01.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(30) Priority: **24.01.2011 IT TO20110048**

(54) **Adjustment lever, particularly for automotive HVAC applications, with clearance recovery**

(57) An adjustment device (1), comprising a support (3) through which a through bore (5) is formed; a shaft (11) mounted through the through bore and having a shoulder portion (17) suitable to axially engage the support; and a handgrip (19) snap-fitted on the shaft in such a way as to axially lock the shaft relative to the support, by co-operating with the shoulder portion. A collar (31) concentric with the bore and having a conical surface

(33) on the free end thereof is disposed on the support. A plurality of elastically deformable elements (191) is disposed on the handgrip, which are arranged circumferentially along said handgrip, wherein each of the elastically deformable elements is adapted to engage the conical surface in such a way as to produce a reaction force acting on the handgrip, this reaction force having an axial component directed away from the support and a centripetal radial component.

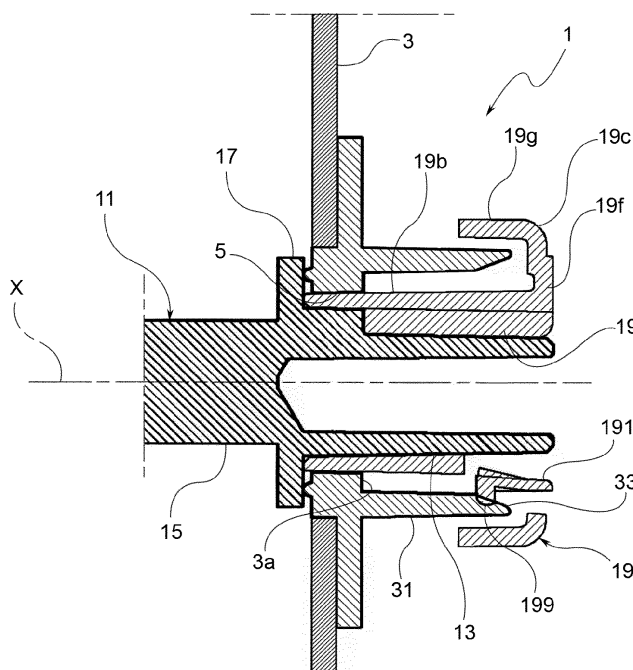


FIG. 7a

Description

[0001] The present invention relates to an adjustment device, comprising

a support through which a through bore is formed;
a shaft mounted through the through bore and having a driving part and a driven part arranged on opposite sides with respect to said support, wherein said shaft is provided with a shoulder portion at its driven part for axially engaging said support; and
a handgrip snap-fitted on the shaft at the driving part thereof, in such a way as to axially lock the shaft with respect to said support by cooperating with said shoulder portion.

[0002] Adjustment devices of this type, such as knobs or levers, are commonly used in various industrial fields, and particularly in air conditioning and heating applications (HVAC) in the automotive field. Generally, these devices are for driving mobile members which are operatively connected to the shaft of the adjustment device, such as for example a plug of an air inlet duct.

[0003] Generally, known devices do not provide for an accurate rotation of the shaft/handgrip assembly, because of the axial and radial clearances that are present, which are due to the manufacturing process and the design tolerances. This drawback can cause the handgrip to idly rotate by a certain angle during operation which angle is determined by the above-mentioned clearances, or the assembly results to be noisy when it is subjected to a vibratory movement.

[0004] An object of the present invention is thus to provide an adjustment device which is built such as to allow the clearances that are inevitably present to be recovered.

[0005] This object is achieved according to the invention by a device of the type as defined herein in the preamble, wherein a collar concentric with the bore and extending on the driving part side of the shaft is disposed on said support, said collar having a conical surface on the free end thereof; and wherein

a plurality of elastically deformable elements is provided on said handgrip, which elements are circumferentially arranged along said handgrip, wherein each of said elastically deformable elements is suitable to engage said conical surface in such a way as to produce a reaction force acting on the handgrip, said reaction force having an axial component directed away from support and a centripetal radial component.

[0006] In a device according to this solution concept, due to the elasticity of the deformable elements the handgrip is biased against the shaft in the radial and axial directions, thereby providing a perfect assembly relative to the theoretical axis of rotation of the system. This perfect assembly further allows to completely eliminate the noises within the system, which are normally associated with the clearances of the components.

[0007] Preferred embodiments of the invention are defined in the dependent claims, which are to be intended

as an integral part of the present description.

[0008] Further characteristics and advantages of the device according to the invention will be clearer with the following detailed description of an embodiment of the invention, which has been provided with reference to the annexed drawings, which are provided by way of illustrative and non-limiting example, wherein:

- Figure 1 is a perspective view of an adjustment device according to the invention;
- Figure 2 is a front view of the device in Figure 1;
- Figures 3 and 4 are front and rear views of a component of the device in Figure 1, respectively;
- Figure 5 is a side elevational view of the component in Figures 3 and 4;
- Figure 6 is a sectional view of the component in Figures 3 and 4, taken along the line VI-VI in Figure 3;
- Figure 7a is a sectional view of the device in Figure 1, taken along the line VII-VII in Figure 2;
- Figure 7b is a simplified view of a detail of the device in Figure 1; and
- Figures 8 and 9 are sectional views of the device in Figure 1, which are taken along the lines VIII-VIII and IX-IX in Figure 2, respectively.

[0009] For simplicity of illustration, only those parts that are intersected by the sectional planes are drawn in the sectional views.

[0010] With reference to the figures, an adjustment device generally designated with 1 is illustrated.

[0011] This device comprises a support 3 through which a through bore 5 is provided. In the example illustrated herein, the support 3 consists of a box wall, as can be seen in Figure 1.

[0012] The device 1 further comprises a shaft 11 mounted through the through bore 5 and having a driving part 13 and a driven part 15 which are arranged on opposite sides relative to the support 3. In the present description, the terms "driving part" and "driven part" mean those parts of the shaft that are on that side of the support on which the elements allowing the driving of the shaft are positioned, and on the side of the support on which those elements that are driven by the shaft are positioned.

[0013] The shaft 11 at the driven part 15 thereof is provided with a shoulder portion 17 which is suitable to axially engage the support 3. In the drawings, the rotation axis of the shaft 11 is designated with x. In the present description, the terms "axial", "radial", "centripetal" and "centrifuge" are related to this rotation axis.

[0014] The shaft 11 is operatively connected to a mobile member (not illustrated) which is suitable to be actuated by means of the device 1, such as a plug of an air inlet duct of a HVAC system. Therefore, the mobile member can be either integral with the shaft 11, or receive the motion therefrom by means of driving means such as gears.

[0015] The driving part 13 of the shaft 11 has a tubular

shape, and is provided at the free end thereof with a pair of retaining formations 13a, which can be seen in Figure 9.

[0016] In order to control the device 1 a handgrip 19 is provided, such as a knob or lever (separately illustrated in Figures 3 to 6), which is snap-fitted to the shaft 11 at the driving part 13 thereof, such as to axially lock the shaft 11 relative to the support 3, by co-operating with the shoulder portion 17 of the shaft 11. The snap fitting of the handgrip 19 on the shaft 11 occurs due to the pair of retaining formations 13a, each one having an inclined surface facing the free end of the shaft 11, and a small step on the opposite side of the inclined surface facing the support 3. In the assembled condition, the handgrip 19 is locked between a portion 3a of the support 3 around the bore 5 (due to an abutment projection 19a suitable to engage said portion about the bore; see Figure 8) and the retaining teeth 13a of the shaft 11, by holding, in turn, this shaft relative to the support 3. In order to center the system, a portion of the handgrip 19 protrudes inwards of the bore 5 between the shaft 11 and the bore 5, until it reaches the shoulder surface 17 of the shaft 11.

[0017] In the example illustrated herein, the handgrip 19 is mushroom-shaped, comprising a stem 19b and a head 19c, through which the cavity 19d is provided in order to allow the handgrip 19 to be mounted to the shaft 11. On the wall of this cavity an alignment projection is provided 19e, which radially projects inwards of this cavity and is suitable to engage a corresponding recess provided along the driving part 13 of the shaft 11. The head 19c of the handgrip, which is shaped to allow the grip thereof by a user, has a top portion 19f joined to the stem 19b and a side portion 19g joined to the top portion 19f, which is arranged such as to surround at least one portion of the stem 19b.

[0018] On the support 3, a collar 31 is provided which is concentric with the bore 5 and extends on the side of the driving part 13 of the shaft 11. This collar can be either fixed to the support 3 or provided as a single piece therewith, and has a conical surface 33 on the free end thereof. The conical surface 33 has a symmetry axis that matches the rotation axis x of the device 1, and is arranged on the radially inner side of the collar 31, thereby tapering as it approaches the support 3.

[0019] On the handgrip 19, a plurality of elastically deformable elements 191 is provided which are circumferentially arranged along the handgrip 19. Each of the elastically deformable elements 191 is suitable to engage the conical surface 33 of the collar 31 such as to generate a reaction force acting on the handgrip 19, which has an axial component directed away from the support 3 as well as a centripetal radial component.

[0020] As can be seen particularly in Figures 7a and 7b, this elastically deformable elements 191 preferably consist of bending tabs extending in the axial direction from the top portion 19f of the head 19c.

[0021] In Figure 7b, one of these tabs is shown according to a front view. As can be seen, the tab 191 is provided

in the wall of the stem 19b of the handgrip, being surrounded on three sides thereof by an aperture 193 separating it from this wall. The top part 19f of the head 19c further has an aperture 195 arranged at the base of each tab 191, in front of the latter in the direction of observation of Figure 7b, and a cavity is also provided behind the tab. As a result, each tab 191 is connected to the body of the handgrip 19 only by means of a bridge 197 provided in the top portion 19f of the head 19c. This measure allows, during operation, to increase the travel span of the tab 191, due to the elastic torsion of the bridge 197 thereof.

[0022] The free end of each tab 191 is provided with a nose 199 radially projecting in the centrifugal direction, by means of which the tab can engage the conical surface 33. In Figure 7b this conical surface is represented by a band defined by a pair of dotted lines. Figure 7a shows the deformation of a tab 191 resulting from the engagement thereof with the conical surface 33.

[0023] Preferably, the tabs 191 are in a number of three or higher. Particularly, these tabs are in a number of five.

[0024] Any radial and axial clearances between the shaft 11, the bore 5 and the handgrip 19 are compensated due to the elasticity of the tabs 191 in engagement with the conical surface 33, whereby the handgrip 19 is biased in the centripetal direction against the shaft 11, and in the axial direction against the retaining forms 13a of the shaft 11, thus dragging the shoulder portion 17 of the shaft 11 against the support 3. A perfect assembly is thus achieved relative to the theoretical axis of rotation of the system. This perfect assembly further allows to completely eliminate the noise that would be normally associated with the tolerances of the components.

Claims

1. An adjustment device (1) comprising
 - a support (3) through which a through bore (5) is formed;
 - a shaft (11) mounted through the through bore and having a driving part (13) and a driven part (15) arranged on opposite sides with respect to said support, wherein said shaft is provided with a shoulder portion (17) at its driven part for axially engaging said support; and
 - a handgrip (19) snap-fitted on the shaft at the driving part thereof, in such a way as to axially lock the shaft with respect to said support by cooperating with said shoulder portion;
- characterized in that**
- a collar (31) concentric with the bore and extending on the driving part side of the shaft is disposed on said support, said collar having a conical surface (33) on its free end; and **in that**
 - a plurality of elastically deformable elements (191) is disposed on said handgrip, said elastically deformable elements being arranged circumferentially along said handgrip, wherein each of said elastically

deformable elements is adapted to engage said conical surface in such a way as to produce a reaction force acting on the handgrip, said reaction force having an axial component directed away from support and a centripetal radial component.

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2. A device according to claim 1, wherein said conical surface has an axis of symmetry coinciding with the rotation axis (x) of said shaft, and is disposed on the radially inner side of the collar (31) and tapering toward the support (3). 10
3. A device according to claim 1 or 2, wherein said elastically deformable elements consist of bending tabs extending in axial direction from a top portion (19f) of the handgrip. 15
4. A device according to claim 3, wherein each of said tabs (191) is formed on the wall of a stem (19b) of the handgrip and is surrounded on three sides by an aperture (193) separating it from said wall. 20
5. A device according to claim 4, wherein each tab is connected to the body of the handgrip (19) only by means of a bridge (197) formed on the top portion (19f) of the handgrip. 25
6. A device according to any of claims 3 to 5, wherein the free end of each tab is provided with a nose (199) radially projecting in centrifugal direction, by means of which the tab is capable to engage the conical surface (33) of the collar (31). 30
7. A device according to any of the preceding claims, wherein said elastically deformable elements are three or more in number. 35
8. A device according to claim 7, wherein said elastically deformable elements are five in number. 40

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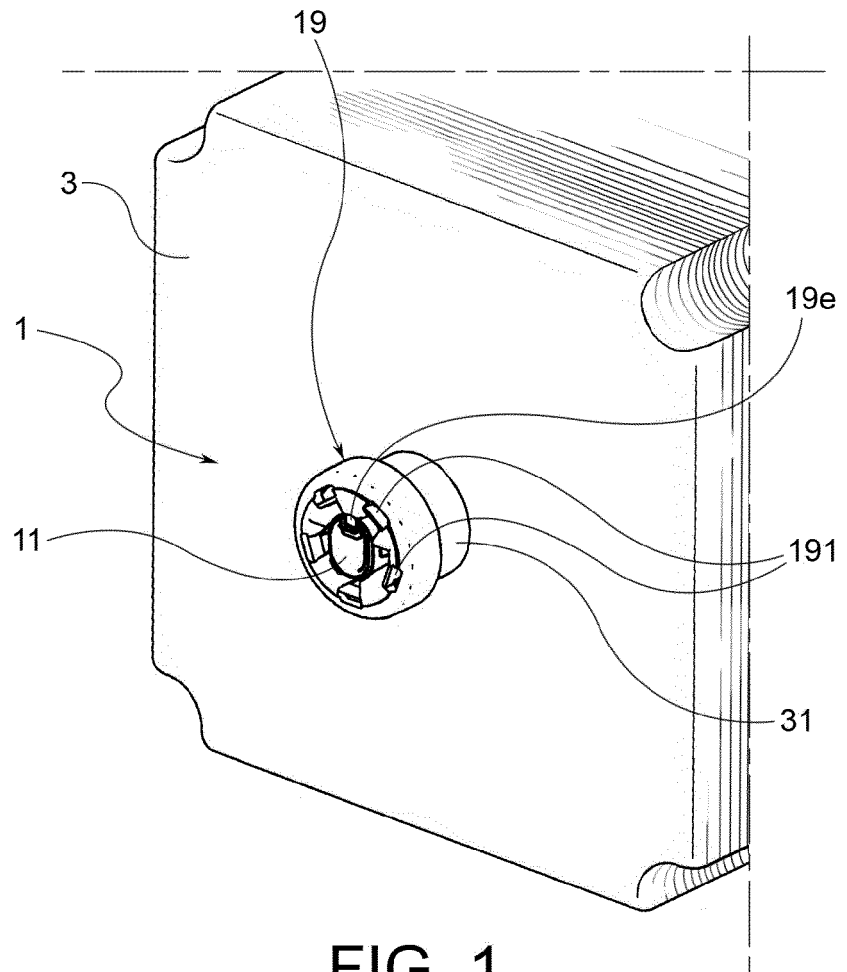


FIG. 1

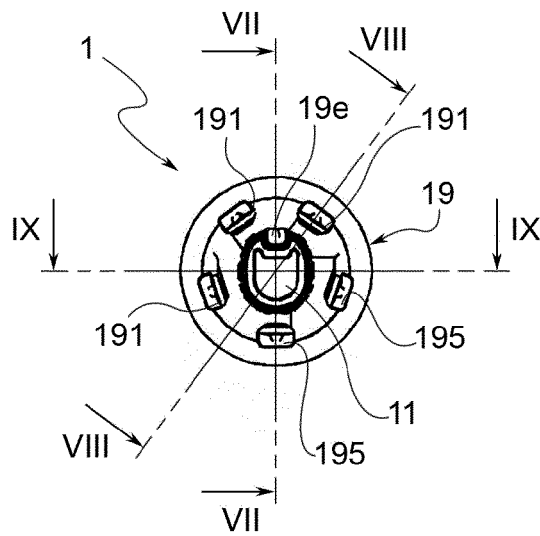
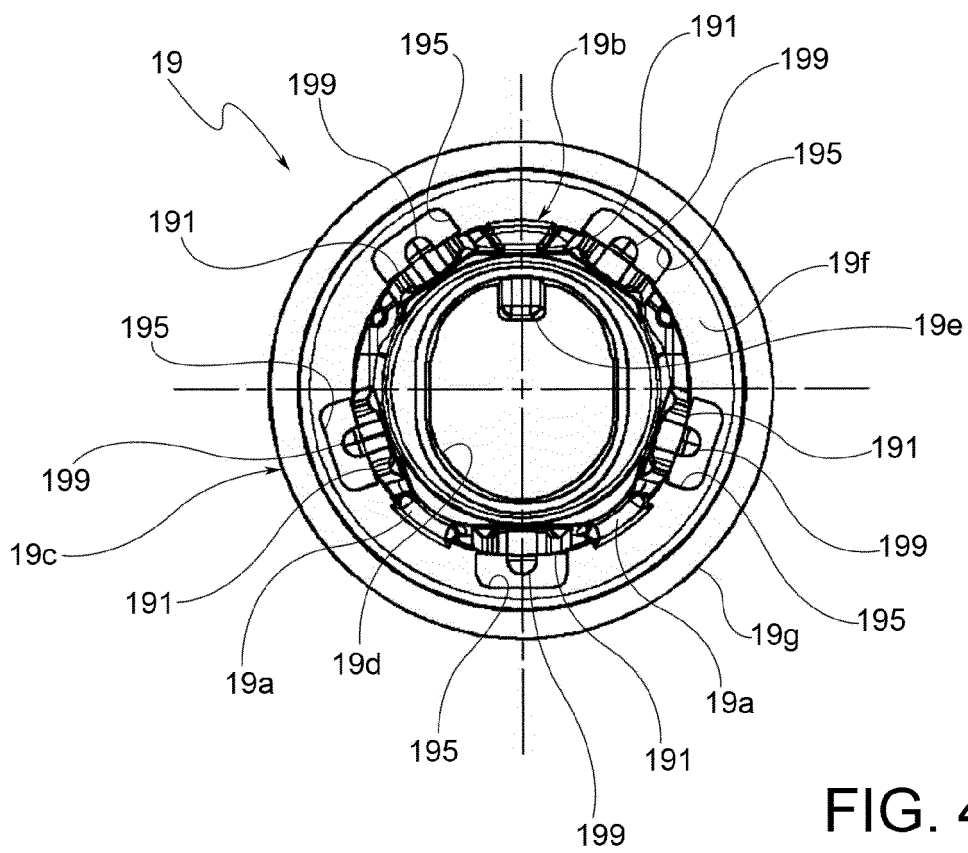
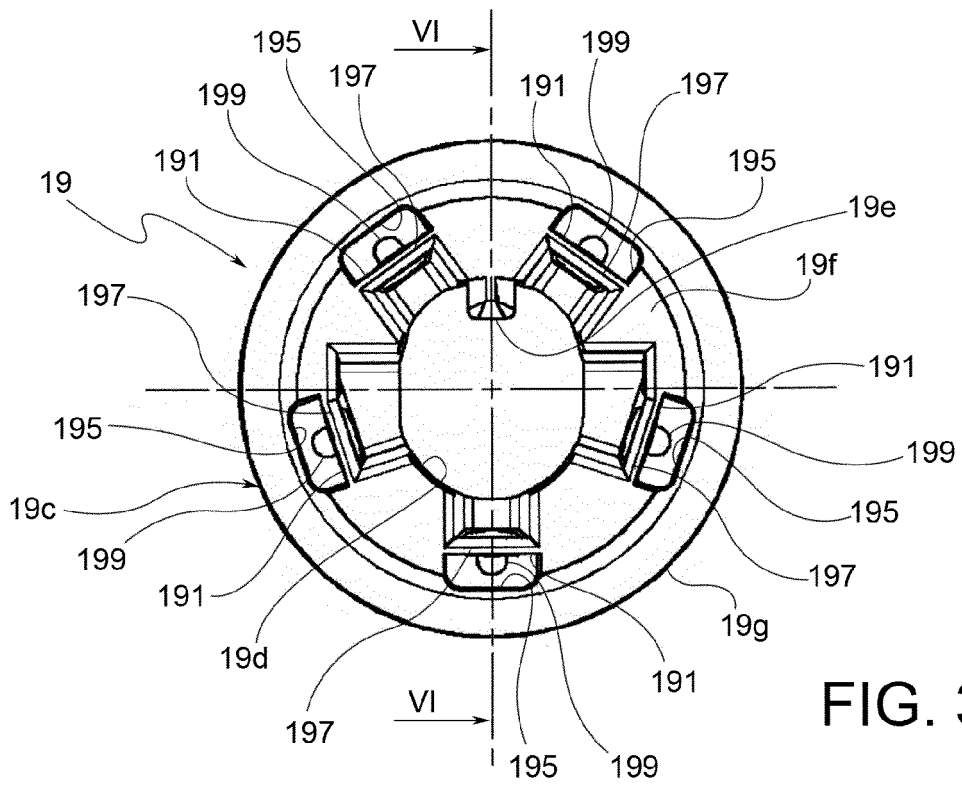
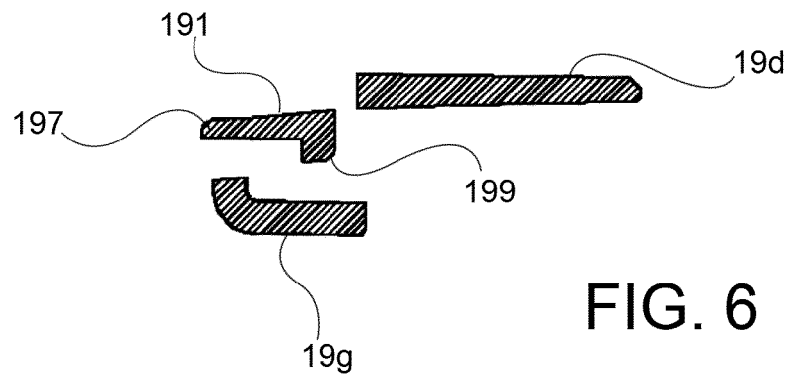
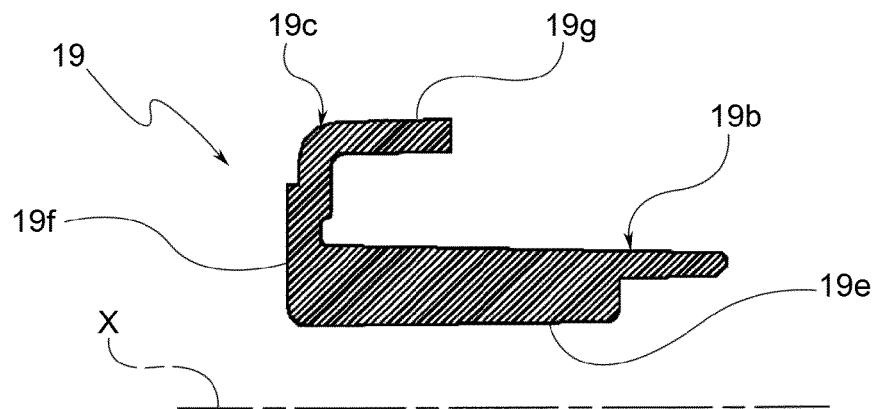
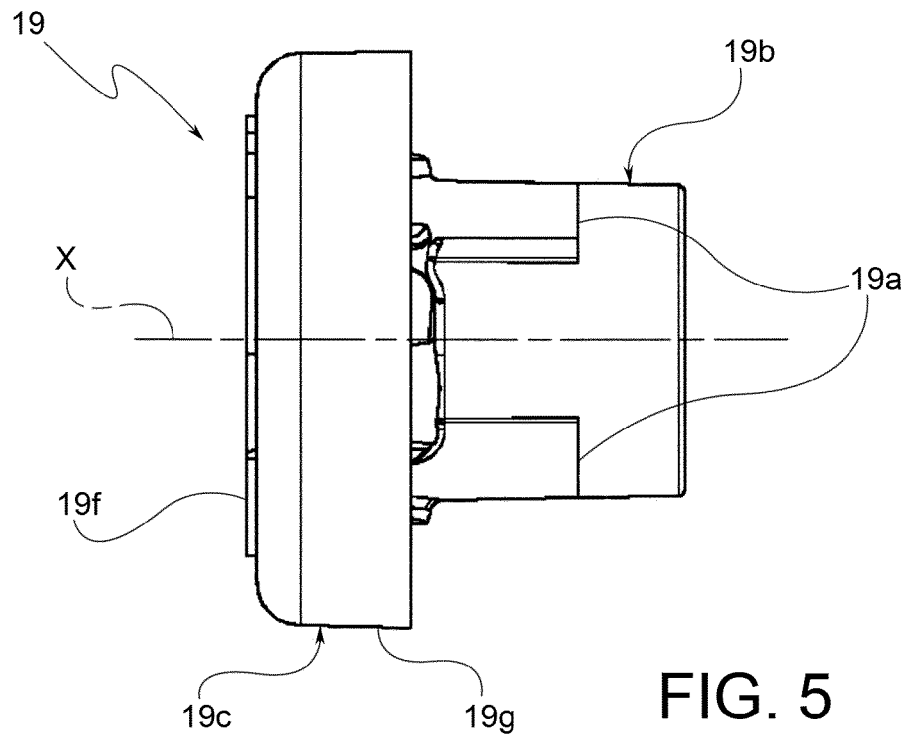


FIG. 2





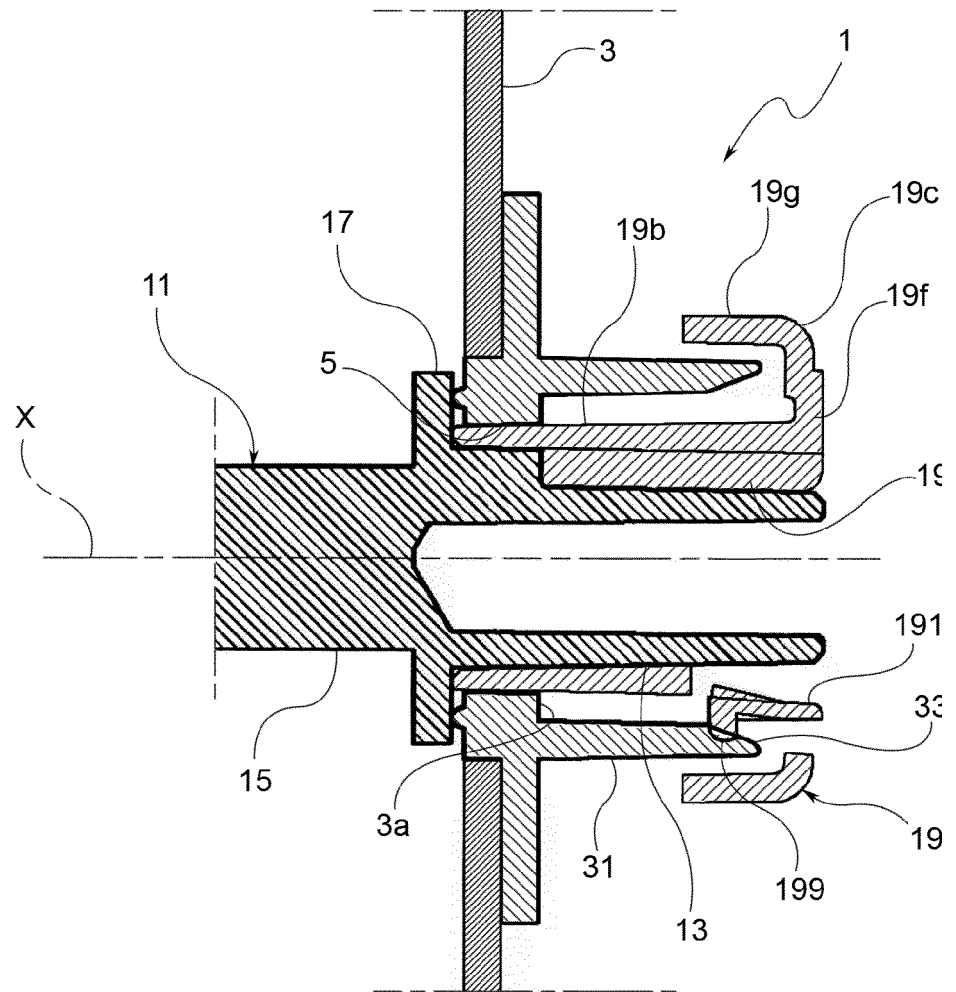


FIG. 7a

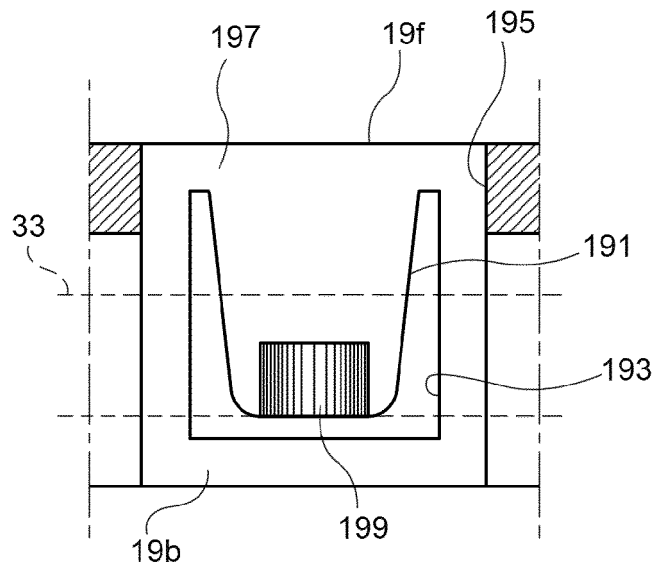


FIG. 7b

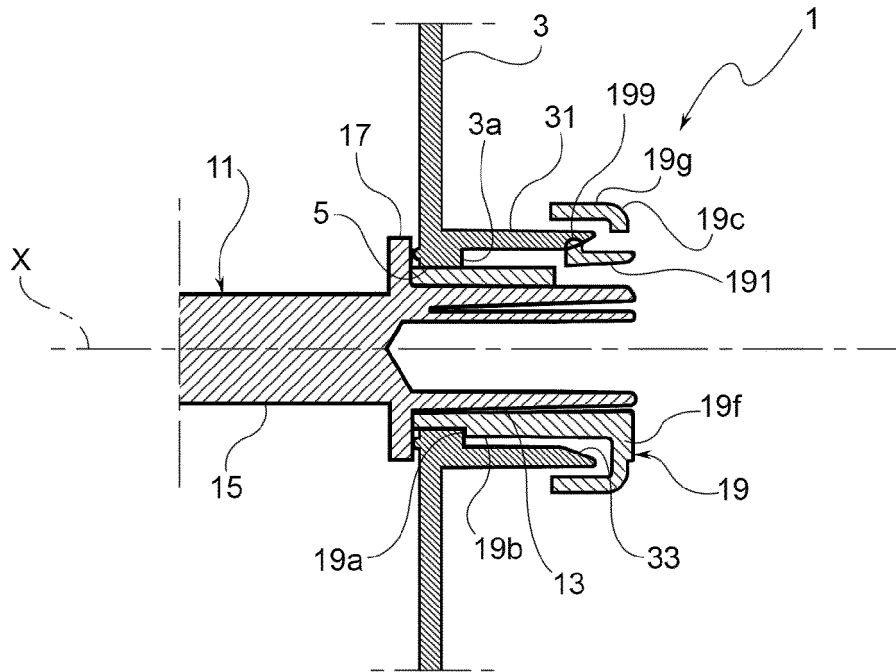


FIG. 8

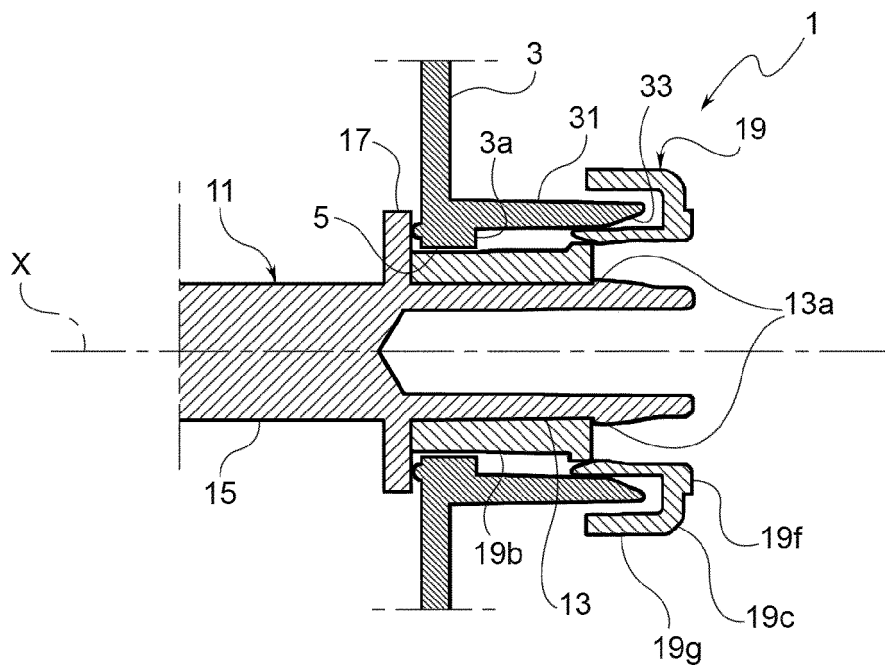


FIG. 9



EUROPEAN SEARCH REPORT

Application Number
EP 12 15 2210

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 February 2012	Examiner Kamara, Amadou
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 15 2210

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03-02-2012

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