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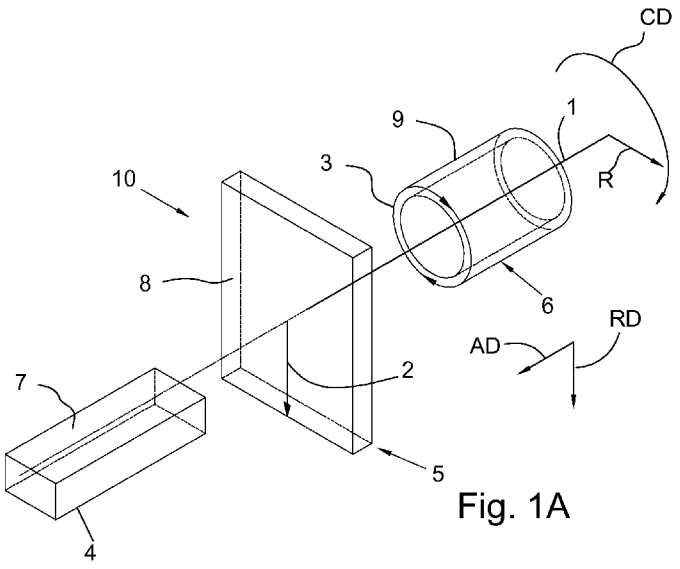


Fig. 1A

(57) **Abstract**: A clutch assembly for transferring torque between a flywheel of an engine and a transmission, the clutch assembly comprising a. housing, a pressure plate fixedly secured to the housing, the pressure plate operatively arranged to cause a friction clutch disc to rotate the flywheel, wherein the pressure plate is arranged for rotation about an axis of rotation, wherein the pressure plate is axially movable relative to the axis of rotation, and including actuation means for engaging and disengaging the clutch, an adjustment means operatively arranged to adjust travel of the pressure plate and the friction clutch disc, and a plurality of lever arms, operatively arranged to amplify force within the clutch assembly, the adjustment means comprising a clamp spring having a first end operatively arranged to prevent an uncontrolled movement of the adjustment means and a second end operatively arranged to center the adjustment means within the clutch assembly.

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CLUTCH ASSEMBLY HAVING A CLAMP SPRING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Patent Application No. 61/943,083, filed February 21, 2014, which application is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The invention relates to a clutch assembly and, more specifically, to a clamp spring of a clutch assembly.

BACKGROUND

[0003] Clutch assemblies are used in some forms of drivetrains of motor vehicles between an engine and a transmission. A motor vehicle typically includes a single clutch or a dual clutch. In a motor vehicle with a single clutch, the clutch is coupled between the crankshaft and the input shaft of the transmission, thereby transferring torque from the crankshaft to the transmission. In a motor vehicle with a dual clutch, torque is transferred to two transmission input shafts coaxially in relation to one another. Over time, the friction disc in the clutch assembly becomes increasingly worn. In order to compensate for the wear of the friction disc, some clutch assemblies include a means for adjusting the clutch assembly in relation to the amount of wear endured by the friction disc. However, prior to the installation of a clutch assembly in an automobile, an uncontrolled movement of the adjustment means can occur. In order to prevent this uncontrolled movement of the adjustment means (which includes the adjuster ring and sensor ring), a transport lock has been used.

[0004] Figure 2 is a top plan view of transport lock **200** of typical clutch assembly **100** (shown in Figure 3). In Figure 2, transport lock **200** is formed as a ring which is fixedly secured to housing **130** (shown in Figure 3) of clutch assembly **100** (shown in Figure 3). Transport lock **200** includes first set of teeth **201**, second set of teeth **202**, and third set of teeth **203**. First set of teeth **201** is fixedly connected to second set of teeth **202** by bar **204**. Second set of teeth **202** is fixedly connected to third set of teeth **203** by bar **205**. Third set of teeth **203** is fixedly connected to first set of teeth **201** by bar **206**. First set of teeth **201** includes four teeth members **208**, **209**,

210 and **211**. Second set of teeth **202** includes four teeth members **212**, **213**, **214** and **215**. Third set of teeth **203** includes four teeth members **216**, **218**, **219** and **220**. Teeth members **208**, **211**, **212**, **215**, **216** and **220** further include notches **208n**, **211n**, **212n**, **215n**, **216n** and **220n**, respectively.

[0005] Figure 3 is a fragmentary top view of the adjustment means of typical clutch assembly **100** having at least one clutch, of which the adjustment means compensates for the wear of at least one friction disc. In order to compensate for the wear of the friction disc, clutch assembly **100** comprises a preloaded adjuster ring **140** (shown in Figure 4) and a preloaded sensor ring **150** (shown in Figure 4) with ramps being provided between the clutch housing **130** and the lever plate **101**. The adjuster ring and the sensor ring are preloaded in a circumferential direction with pressure springs such that when the friction disc becomes increasingly worn, adjuster ring **140** (shown in Figure 4) and sensor ring **150** (shown in Figure 4) move in order to compensate the gap created between the pressure plate and the friction disc. The activation of the adjustment process is determined by sensor devices which measure a travel or actuating force of plurality of lever arms **102**, **103**, **104**, **105**, **106**, and **108**. The sensor devices comprise clamp spring **300** and adjustment tab **160** (shown in Figure 6). Clamp spring **300**, which is arranged to engage adjustment tab **160** (shown in Figure 6), is fixedly secured to housing **130** of clutch assembly **100** by rivets **131** and **132**, whereby rivets **131** and **132** pass through notches **211n** and **212n** (shown in Figure 2) of transport lock **200** (shown in Figure 2) and washers **221** and **222** (not shown), respectively.

[0006] To prevent an uncontrolled movement of adjuster ring **140** (shown in Figure 4) prior to the installation of clutch assembly **100** in an automobile, transport lock **200** (shown in Figure 2) prevents a complete relaxation of lever arms **102**, **103**, **104**, **105**, **106** and **108**. Transport lock **200** (shown in Figure 2) is positioned between clamp spring **300** and lever plate **101**, which is fixedly connected to lever arms **102**, **103**, **106**, and **108**. Lever arms **102**, **103**, **104**, **105**, **106** and **108** further include apertures **102a**, **103a**, **104a**, **105a**, **106a** and **108a**, respectively, which allow teeth **210**, **211**, **212** and **213** of transport lock **200** (shown in Figure 2) to protrude perpendicularly to the plane of axis of lever arms **102**, **103**, **106**, **108**, through apertures **102a**, **103a**, **106a** and **108a**, respectively. Bar **204** of transport lock **200** (shown in Figure 2) is arranged to engage lever arms **104** and **105**. Washers **221** and **222** (not shown) are positioned

between transport lock **200** (shown in Figure 2) and clamp spring **300**, and washers **221** and **222** (not shown) are positioned over notches **211n** and **212n** (shown in Figure 2) of transport lock **200** (shown in Figure 2), respectively, to create a gap between transport lock **200** (shown in Figure 2) and clamp spring **300**. It should be appreciated that washers **221** and **222** (not shown) are used to ensure the proper function of transport lock **200** (shown in Figure 2).

[0007] Figure 4 is a fragmentary cross sectional view of the adjustment means of typical clutch assembly **100**, taken generally along line **4-4** in Figure 3. In Figure 4, transport lock **200** (shown in Figure 2) places a predetermined load on lever arms **102**, **103**, **104**, **105**, **106**, and **108** (shown in Figure 3) which prevents a complete relaxation of lever arms **102**, **103**, **104**, **105**, **106**, and **108** (shown in Figure 3). Lever arms **102**, **103**, **104**, **105**, **106**, and **108** (shown in Figure 3) are oriented radially and fixedly connected to lever plate **101**. As transport lock **200** (shown in Figure 2) applies a predetermined load onto lever arms **102**, **103**, **104**, **105**, **106**, and **108** (shown in Figure 3), lever plate **101** in turn applies a load to adjuster ring **140**, thereby preventing an uncontrolled movement of adjuster ring **140**. Once clutch assembly **100** is connected to the transmission of an automobile, a load is placed on lever arms **102**, **103**, **104**, **105**, **106** and **108** (shown in Figure 3) greater than the load applied by transport lock **200** (shown in Figure 2), such that lever arms **102**, **103**, **104**, **105**, **106**, and **108** (shown in Figure 3) no longer engage transport lock **200** (shown in Figure 2), thereby allowing the actuation means necessary to engage the pressure plate with the friction disc.

[0008] Figure 5 is a perspective view of typical clamp spring **300** of clutch assembly **100** (shown in Figure 3). In Figure 5, clamp spring **300** is formed as a tripartite member fixedly secured to housing **130** (shown in Figure 3) of clutch assembly **100** (shown in Figure 3). Clamp spring **300** includes body **301**, first end **302**, second end **303** and third end **304**. First end **302** of body **301** is formed by first flat member **305**, second flat member **306** and arcuate member **308**, and the first and second flat members **305** and **306** are fixedly connected by arcuate member **308**. Second end **303** of body **301** is formed by flat member **309**. Third end **304** of body **301** is formed by first flat member **310**, second flat member **311** and arcuate member **312**, and the first and second flat members **310** and **311** are fixedly connected by arcuate member **312**. Body **301**, first end **302** and second end **303** further contain apertures **301a**, **302a** and **303a**, respectively.

[0009] Figure 6 is a fragmentary cross sectional view of the adjustment means of typical clutch assembly **100** having clamp spring **300**, taken generally along line **4-4** in Figure 3. In Figure 6, clamp spring **300** is positioned between transport lock **200** (shown in Figure 2) and housing **130** of clutch assembly **100**. First end **302** of clamp spring **300** includes first flat member **305**, second flat member **306** and arcuate member **308**, and the first and second flat members **305** and **306** are fixedly connected by arcuate member **308**. The adjustment tab **160** is fixedly secured to second flat member **306** of first end **302** of body **301** (shown in Figure 5) of clamp spring **300** by bolt **133**, which passes from adjustment tab **160** through aperture **302a** (shown in Figure 5) of second flat member **306** of first end **302**. The adjustment tab **160**, which is fixedly secured to clamp spring **300**, also engages lever plate **101**. Clamp spring **300** and adjustment tab **160** measure the travel or actuating force of lever arms **102**, **103**, **104**, **105**, **106**, and **108** and prevent an uncontrolled movement of the sensor ring (shown in Figure 3).

[0010] During the lifetime of clutch assembly **100**, the distance between the pressure plate and the friction disc should remain constant. However, as the friction disc becomes increasingly worn, the distance between the pressure plate and the friction disc increases, which in turn results in an increase of the travel necessary to engage the pressure plate with the friction disc. The adjustment tab **160**, which is fixedly secured to clamp spring **300** and places a predefined load on sensor ring **150**, senses the amount of wear or distance between the pressure plate and the friction disc. The adjustment tab **160** is further placed over the lever plate **101**, whereby an increase in the travel necessary to engage the pressure plate with the friction disc (larger than the gap between adjustment tab **160** and lever plate **101**) produces a higher axial movement of lever plate **101**, engaging adjustment tab **160**. Since adjustment tab **160** is also fixedly secured to clamp spring **300**, the axial movement of lever plate **101** causes adjustment tab **160** and clamp spring **300** to undergo a travel or distance equal to the increase in distance between the pressure plate and the worn friction disc.

[0011] To compensate for the increased travel or distance between adjustment tab **160** and sensor ring **150**, and thus an increase in the distance necessary for the pressure plate to engage with the friction disc, sensor ring **150** moves axially along the axis of rotation to reengage with adjustment tab **160**. As sensor ring **150** reengages with adjustment tab **160**, adjuster ring **140** simultaneously moves axially along the axis of rotation a distance equal to the

distance traveled by sensor ring **150**. As adjuster ring **140** moves axially, adjustment means (comprising adjuster ring **140**, sensor ring **150**, clamp spring **300**, adjustment tab **160** and lever plate **101**) is moved axially along the axis of rotation a distance equivalent to that traveled by adjuster ring **140** and sensor ring **150**, such that the distance between the pressure plate and the friction disc remains constant.

[0012] Clutch assembly **100** (shown in Figure 3) is installed in an automobile, centering pin **400** (shown in Figure 7) further prevents an uncontrolled movement of sensor ring **150** (shown in Figure 6). Figure 7 is a perspective view of typical centering pin **400** of clutch assembly **100** (shown in Figure 8). The centering pin **400** engages sensor ring **150** (shown in Figure 8) of clutch assembly **100** (shown in Figure 8) to center sensor ring **150** as sensor ring **150** moves axially within clutch assembly **100** (shown in Figure 8). The centering pin **400** is formed as an "L" shaped bracket, having first flat member **401** and second flat member **402**. First flat member **401** of centering pin **400** lies perpendicularly to the plane of axis of second flat member **402** of centering pin **400**. First flat member **401** further contains aperture **401a**.

[0013] Figure 8 is a fragmentary top view of the adjustment means of typical clutch assembly **100** having centering pin **400**. In Figure 8, clamp spring **300** and centering pin **400** are both independently operable and spatially oriented within clutch assembly **100**. With housing **130** (shown in Figure 3) removed, aperture **401a** of centering pin **400** and aperture **303a** of clamp spring **300** can be seen. Centering pin **400** and second end **303** of clamp spring **300** are fixedly secured to housing **130** (shown in Figure 3) by rivets **403** (shown in Figure 9) and **131** (shown in Figure 3), respectively, which pass through apertures **401a** and **303a**, respectively. It should be appreciated that clamp spring **300** and centering pin **400** are two distinct structures. First flat member **401** of centering pin **400** is fixedly secured to housing **130** (shown in Figure 3) by rivet **403** (shown in Figure 9). First flat member **401** of centering pin **400** lies parallel to the plane of axis of housing **130** (shown in Figure 9). Second flat member **402** of centering pin **400** lies perpendicular to the plane of axis of housing **130** (shown in Figure 9). As clutch assembly **100** rotates about an axis of rotation, second flat member **402** of centering pin **400** is engaged with sensor ring **150** to center sensor ring **150** and thereby prevent sensor ring **150** from moving within a plane perpendicular to the axis of rotation of clutch assembly **100**.

[0014] Figure 9 is a fragmentary partial cross sectional view of the adjustment means of typical clutch assembly **100** having centering pin **400**, taken generally along line **8-8** in Figure 8. In Figure 9, centering pin **400** is fixedly secured to housing **130** of clutch assembly **100** by rivet **403**. First flat member **401** of centering pin **400** lies parallel to the plane of axis of housing **130**. Second flat member **402** of centering pin **400** lies perpendicularly to the plane of axis of housing **130**. As clutch assembly **100** rotates about an axis of rotation, second flat member **402** of centering pin **400** is engaged with sensor ring **150** to center sensor ring **150** and thereby prevents sensor ring **150** from moving within a plane perpendicular to the axis of rotation of clutch assembly **100**.

[0015] Thus, there has been a long-felt need for a clamp spring for a clutch assembly which prevents an uncontrolled movement of the adjustment means within the clutch assembly.

SUMMARY

[0016] The present invention broadly comprises a clutch assembly for transferring a torque between a flywheel of an engine and a transmission in a motor vehicle, the clutch assembly comprising a housing, a pressure plate fixedly secured to the housing, the pressure plate operatively arranged to cause a friction clutch disc to rotate the flywheel, wherein the pressure plate is arranged for rotation about an axis of rotation, wherein the pressure plate is axially movable relative to the axis of rotation, and including actuation means for engaging and disengaging the clutch, an adjustment means operatively arranged to adjust travel of the pressure plate and the friction clutch disc, and a plurality of lever arms, operatively arranged to amplify force within the clutch assembly, the adjustment means comprising a clamp spring having a first end operatively arranged to prevent an uncontrolled movement of the adjustment means and a second end operatively arranged to center the adjustment means within the clutch assembly.

[0017] A general object of the invention is to provide a clamp spring that prevents an unwanted movement of the adjustment means of a clutch assembly.

[0018] Another object of the invention is to provide a clamp spring that prevents an unwanted movement of the adjuster ring of a clutch assembly.

[0019] Yet another object of the invention is to provide a clamp spring that prevents an unwanted movement of the sensor ring of a clutch assembly.

[0020] A further object of the invention is to provide a cost savings for the manufacturing and production of a transport lock for an adjustment device within a clutch assembly.

[0021] A further object of the invention is to provide a cost savings for the manufacturing and production of a centering pin for an adjustment device within a clutch assembly.

[0022] These and other objects, features and advantages of the present invention will become readily apparent upon a review of the following detailed description of the invention, in view of the drawings and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Various embodiments are disclosed, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, in which:

Figure 1A is a perspective view of a cylindrical coordinate system demonstrating spatial terminology used in the present application;

Figure 1B is a perspective view of an object in the cylindrical coordinate system of Figure 1A demonstrating spatial terminology used in the present application;

Figure 2 is a top plan view of transport lock **200** of typical clutch assembly **100**;

Figure 3 is a fragmentary top view of the adjustment means of typical clutch assembly **100**;

Figure 4 is a fragmentary cross sectional view of the adjustment means of typical clutch assembly **100** taken generally along line **4-4** in Figure 3;

Figure 5 is a perspective view of typical clamp spring **300** of typical clutch assembly **100**;

Figure 6 is a fragmentary cross sectional view of the adjustment means of typical clutch assembly **100** having clamp spring **300** taken generally along line **4-4** in Figure 3;

Figure 7 is a perspective view of typical centering pin **400** of typical clutch assembly **100**;

Figure 8 is a fragmentary top view of the adjustment means of typical clutch assembly **100** having centering pin **400**;

Figure 9 is a fragmentary partial cross sectional view of the adjustment means of typical clutch assembly **100** having centering pin **400** taken generally along line **8-8** in Figure 8;

Figure 10 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention;

Figure 11A is a perspective view of clamp spring **600** of the present invention, illustrating clamp spring **600** which includes nose **602B** and tab **603B**;

Figure 11B is a perspective view of another embodiment of clamp spring **700**, illustrating clamp spring **700** which includes nose **702B** and tab **703B**;

Figure 11C is a perspective view of another embodiment of clamp spring **800**, illustrating clamp spring **800** which includes nose **802B** and tab **803B**;

Figure 12 is a fragmentary cross sectional view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **600** which includes nose **602B** taken generally along line **12-12** in Figure 10;

Figure 13 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **600** which includes tab **603B**;

Figure 14 is a fragmentary partial cross sectional view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **600** which includes tab **603B** taken generally along line **14-14** in Figure 13;

Figure 15 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **700** which includes tab **703B**;

Figure 16 is a fragmentary partial cross sectional view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **700** which includes tab **703B** taken generally along line **16-16**;

Figure 17 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **800** which includes tab **803B**; and,

Figure 18 is a fragmentary partial cross sectional view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **800** which includes tab **803B** taken generally along line **18-18** in Figure 17.

DETAILED DESCRIPTION

[0024] At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements of the invention. It is to be understood that the invention as claimed is not limited to the disclosed aspects.

[0025] Furthermore, it is understood that this patent is not limited to the particular methodology, materials and modifications described and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the present invention as claimed.

[0026] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this invention belongs. It should be understood that any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the invention.

[0027] By "non-rotatably connected" first and second components we mean that the first component is connected to the second component so that any time the first component rotates, the second component rotates with the first component, and any time the second component rotates, the first component rotates with the second component. Axial displacement between the first and second components is possible.

[0028] Figure 1A is a perspective view of cylindrical coordinate system **10** demonstrating spatial terminology used in the present patent. The present invention is at least partially described within the context of cylindrical coordinate system **10**. System **10** has a longitudinal axis **1**, used as the reference for the directional and spatial terms that follow. Axial direction **AD** is parallel to axis **1**. Radial direction **RD** is orthogonal to axis **1**. Circumferential direction **CD** is defined by an endpoint of radius **R** (orthogonal to axis **1**) rotated about axis **1**.

[0029] To clarify the spatial terminology, objects **4**, **5**, and **6** are used. Surface **7** of object **4** forms an axial plane. For example, axis **1** is congruent with surface **7**. Surface **8** of object **5** forms a radial plane. For example, radius **2** is congruent with surface **8**. Surface **9** of object **6** forms a circumferential surface. For example, circumference **3** is congruent with surface **9**. As a further example, axial movement or disposition is parallel to axis **1**; radial movement or disposition is orthogonal to axis **2**, and circumferential movement or disposition is parallel to circumference **3**. Rotation is described herein with respect to axis **1**.

[0030] The adverbs "axially," "radially," and "circumferentially" are used with respect to an orientation parallel to axis **1**, radius **2**, or circumference **3**, respectively. The adverbs "axially," "radially," and "circumferentially" are also used regarding orientation parallel to respective planes.

[0031] Figure 1B is a perspective view of object **15** in cylindrical coordinate system **10** of Figure 1A demonstrating spatial terminology used in the present patent. Cylindrical object **15** is representative of a cylindrical object in a cylindrical coordinate system and is not intended to limit the claims of the present invention in any manner. Object **15** includes axial surface **11**, radial surface **12**, and circumferential surface **13**. Surface **11** is part of an axial plane; surface **12** is part of a radial plane, and surface **13** is part of a circumferential plane.

[0032] Figure 10 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention having at least one clutch, of which the adjustment means compensates for the wear of at least one friction disc. In order to compensate for the wear of the friction disc, clutch assembly **500** comprises a preloaded adjuster ring **540** (shown in Figure 12) and a preloaded sensor ring **550** (shown in Figure 12) with ramps being provided between clutch housing **530** and lever plate **501**. The adjuster ring **540** and sensor ring **550** are preloaded in a circumferential direction with pressure springs such that when the friction disc becomes increasingly worn, the adjuster ring **540** (shown in Figure 12) and sensor ring **550** (shown in Figure 12) move in order to compensate the gap created between the pressure plate and the friction disc.

[0033] The activation of the adjustment process is determined by sensor devices which measure a travel or actuating force of lever arms **502**, **503**, **504**, **505**, **506**, and **508**. Lever arms **502**, **503**, **504**, **505**, **506**, and **508** further include apertures **502a**, **503a**, **504a**, **505a**, **506a** and **508a**, respectively. The sensor devices comprise clamp spring **600** and adjustment tab **560** (shown in Figure 12). Clamp spring **600**, which is operably engaged with adjustment tab **560** (shown in Figure 12), is fixedly secured to housing **530** of clutch assembly **500** by rivets **531** and **532**.

[0034] Figures 11A-11C are perspective views of various embodiments of clamp spring **600**, **700** and **800**, respectively, of the present invention. It should be noted that clamp spring **600**, **700** and **800** all perform identical functions. Figure 11A is a perspective view of clamp spring **600** of the present invention, illustrating clamp spring **600** which includes nose **602B** and tab **603B**. In Figure 11A, clamp spring **600** is formed as a tripartite member fixedly secured to housing **530** (shown in Figure 10) of clutch assembly **500** (shown in Figure 10). Clamp spring **600** includes body **601**, first end **602**, second end **603** and third end **604**. First end **602** of body

601 includes first end **602A** and nose **602B**. First end **602A** is formed by first flat member **605**, second flat member **606** and arcuate member **608**, whereby the first and second flat members **605** and **606** are fixedly connected by arcuate member **608**. Nose **602B** is formed by first flat member **609**, second flat member **610** and arcuate member **611**, whereby the first and second flat members **609** and **610** are fixedly connected by arcuate member **611**. First end **602A** and nose **602B** are fixedly connected and operably arranged to engage with adjuster ring **540** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). It should be appreciated that nose **602B** of clamp spring **600** prevents an uncontrolled movement of adjuster ring **540** (shown in Figure 12) prior to installation of clutch assembly **500** (shown in Figure 12) within an automobile.

[0035] Second end **603** of body **601** includes second end **603A** and tab **603B**. Second end **603A** is formed by flat member **612**. Tab **603B** is formed by first flat member **613**, second flat member **614** and arcuate member **615**, whereby the first and second flat members **613** and **614** are fixedly connected by arcuate member **615**. Second end **603A** and nose **603B** are fixedly connected and operably arranged to engage with sensor ring **550** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). It should be appreciated that tab **603B** of clamp spring **600** prevents an uncontrolled movement of sensor ring **550** (shown in Figure 12) after installation of clutch assembly **500** (shown in Figure 12) within an automobile.

[0036] Third end **604** of body **601** is formed by first flat member **616**, second flat member **618** and arcuate member **619**, whereby the first and second flat members **616** and **618** are fixedly connected by arcuate member **619**. Body **601**, first end **602A** and second end **603A** of clamp spring **600** further include apertures **601a**, **602a** and **603a**, respectively.

[0037] Figure 11B is a perspective view of another embodiment of clamp spring **700** of the present invention, illustrating clamp spring **700** which includes nose **702B** and tab **703B**. In Figure 11B, clamp spring **700** is formed as a tripartite member fixedly secured to housing **530** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). Clamp spring **700** includes body **701**, first end **702**, second end **703** and third end **704**. First end **702** of body **701** is comprised of first end **702A** and nose **702B**. First end **702A** is formed by first flat member **705**, second flat member **706** and arcuate member **708**, whereby the first and second flat members **705** and **706** are fixedly connected by arcuate member **708**. Nose **702B** is formed by first flat member **709**, second flat member **710** and arcuate member **711**, whereby the first and second flat

members **709** and **710** are fixedly connected by arcuate member **711**. First end **702A** and nose **702B** are fixedly connected and operably arranged to engage with adjuster ring **550** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). It should be appreciated that nose **702B** of clamp spring **700** prevents an uncontrolled movement of adjuster ring **540** (shown in Figure 12) prior to installation of clutch assembly **500** (shown in Figure 12) in an automobile.

[0038] Second end **703** of body **701** includes second end **703A** and tab **703B**. Second end **703A** is formed by flat member **712**. Tab **703B** is formed by first flat member **713**, second flat member **714** and arcuate member **715**, whereby the first and second flat members **713** and **714** are fixedly connected by arcuate member **715**. Second end **703A** and tab **703B** are fixedly connected by arcuate member **716** and operably arranged to engage with sensor ring **540** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). It should be appreciated that tab **703B** of clamp spring **700** prevents an uncontrolled movement of sensor ring **550** (shown in Figure 12) after installation of clutch assembly **500** (shown in Figure 12) in an automobile.

[0039] Third end **704** of body **701** is formed by first flat member **718**, second flat member **719** and arcuate member **720**, whereby the first and second flat members **718** and **719** are fixedly connected by arcuate member **720**. Body **701**, first end **702A** and second end **703A** of clamp spring **700** further include apertures **701a**, **702a** and **703a**, respectively.

[0040] Figure 11C is a perspective view of a further embodiment of clamp spring **800**, illustrating clamp spring **800** which includes **802B** and tab **803B**. In Figure 11C, clamp spring **800** is formed as a tripartite member fixedly secured to housing **530** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). Clamp spring **800** includes body **801**, first end **802**, second end **803** and third end **804**. First end **802** of body **801** includes first end **802A** and nose **802B**. First end **802A** is formed by first flat member **805**, second flat member **806** and arcuate member **808**, whereby the first and second flat members **805** and **806** are fixedly connected by arcuate member **808**. Nose **802B** is formed by first flat member **809**, second flat member **810** and arcuate member **811**, whereby the first and second flat members **809** and **810** are fixedly connected by arcuate member **811**. First end **802A** and nose **802B** are fixedly connected and operably arranged to engage adjuster ring **550** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). It should be appreciated that nose **802B** of clamp spring **800** prevents an

uncontrolled movement of adjuster ring **540** (shown in Figure 12) prior to installation of clutch assembly **500** (shown in Figure 12) in an automobile.

[0041] Second end **803** of body **801** includes second end **803A** and tab **803B**. Second end **803A** is formed by flat member **812**. Tab **803B** is formed by flat member **813**. Second end **803A** and tab **803B** are fixedly connected and operably arranged to engage sensor ring **540** (shown in Figure 12) of clutch assembly **500** (shown in Figure 12). It should be appreciated that tab **803B** of clamp spring **800** prevents an uncontrolled movement of sensor ring **550** (shown in Figure 12) after installation of clutch assembly **500** (shown in Figure 12) in an automobile.

[0042] Third end **804** of body **801** is formed by first flat member **814**, second flat member **815** and arcuate member **816**, whereby the first and second flat members **814** and **815** are fixedly connected by arcuate member **816**. Body **801**, first end **802A** and second end **803A** of clamp spring **800** further include apertures **801a**, **802a** and **803a**, respectively.

[0043] Figure 12 is a fragmentary cross sectional view of the adjustment means of clutch assembly **500** of the present invention having clamp spring **600** (shown in Figure 11A) with nose **602B** taken along line **12-12** in Figure 10. In Figure 12, clamp spring **600** (shown in Figure 11A) which includes nose **602B** (shown in Figure 11A) prevents an uncontrolled movement of the adjustment means of clutch assembly **500** when in an uninstalled state by operatively applying a load to adjuster ring **540** and thereby preventing an axial movement of adjuster ring **540**. The nose **602B** of clamp spring **600** (shown in Figure 11A) includes first flat member **809**, second flat member **610** and arcuate member **611**, and the first and second flat members **809** and **810** are fixedly connected by arcuate member **611**. Second flat member **610** of nose **602B** of clamp spring **600** (shown in Figure 11A) engages with adjuster ring **540** of clutch assembly **500**. Clamp spring **600** (shown in Figure 11A) is positioned between lever plate **501** and housing **530** of clutch assembly **500**. Clamp spring **600** (shown in Figure 11A) is fixedly secured to housing **530** of clutch assembly **500** by rivets **531** and **532** (shown in Figure 10). It should be appreciated that nose **602B** of clamp spring **600** (shown in Figure 10) prevents an uncontrolled movement of adjuster ring **540** prior to installation of clutch assembly **500** in an automobile.

[0044] The Adjustment tab **560** is fixedly secured to second flat member **606** of first end **602A** of first end **602** (shown in Figure 11A) of body **601** (shown in Figure 11A) of clamp spring **600** (shown in Figure 11A) by bolt **533**, which passes from adjustment tab **560** through aperture

602a (shown in Figure 11A) of second flat member **606** of first end **602A**. The first end **602A** further includes first flat member **605**, second flat member **606** and arcuate member **608**, whereby the first and second flat members **605** and **606** are fixedly secured by arcuate member **608**. The adjustment tab **560**, which is fixedly secured to clamp spring **600** (shown in Figure 11A), is also engaged with lever plate **501**. Clamp spring **600** (shown in Figure 11A) and adjustment tab **560** measure the travel of lever arms **502**, **503**, **504**, **505**, **506**, and **508** (shown in Figure 10).

[0045] Throughout the lifetime of clutch assembly **500**, the distance between the pressure plate and the friction disc should remain constant. However, as the clutch disc becomes increasingly worn, the distance between the pressure plate and the friction disc increases which in turn results in an increase in the load or actuating force placed on lever arms **502**, **503**, **504**, **505**, **506** and **508** (shown in Figure 10) necessary to engage the pressure plate with the friction disc. The adjustment tab **560**, which is fixedly secured to clamp spring **600** (shown in Figure 11A) and places a predefined load on sensor ring **550**, senses the amount of wear or distance between the pressure plate and the friction disc. The adjustment tab **560** is further placed over lever plate **501**, whereby an increase in the travel necessary to engage the pressure plate with the friction disc (larger than the gap between adjustment tab **560** and lever plate **501**) produces a higher axial movement of lever plate **501**, engaging adjustment tab **560**. Since adjustment tab **560** is also fixedly secured to clamp spring **600** (shown in Figure 11A), the axial movement of lever plate **501** causes adjustment tab **560** and clamp spring **600** (shown in Figure 11A) to undergo a travel or distance equal to the increase in distance between the pressure plate and the worn friction disc.

[0046] To compensate for the increased travel or distance between adjustment tab **560** and sensor ring **550**, and thus an increase in the distance necessary for the pressure plate to engage with the friction disc, sensor ring **550** moves axially to reengage with adjustment tab **560**. As sensor ring **550** reengages with adjustment tab **560**, adjuster ring **540** simultaneously moves axially a distance equal to the distance traveled by sensor ring **550**. As adjuster ring **550** moves axially, adjustment means (comprising adjuster ring **540**, sensor ring **550**, clamp spring **600** (shown in Figure 11A), adjustment tab **560** and lever plate **501**) is moved axially a distance

equivalent to that traveled by adjuster ring **540** and sensor ring **550**, such that the distance between the pressure plate and the friction disc remains constant.

[0047] Figures 13-18 show clutch assembly **500** with various embodiments of a clamp spring **600**, **700** and **800** having tab **603B**, **703B** and **803B**, (shown in Figures 11A, 11B and 11C) respectively. Figure 13 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **600** which includes tab **603B**. It should be appreciated that clamp spring **600** and tab **603B** are a single, unified structure. In Figure 13, tab **603B** further prevents an uncontrolled movement of sensor ring **550**. With housing **530** removed, aperture **603a** of clamp spring **600** can be seen. Second end **603A** of second end **603** of clamp spring **600** is fixedly secured to housing **530** (shown in Figure 10) by rivet **531** (shown in Figure 10), which passes through aperture **603a**. Flat member **612** of second end **603A** and first flat member **613** of tab **603B** lie perpendicular to the plane of axis of second flat member **614** of tab **603B**. As clutch assembly **500** rotates about an axis of rotation, second flat member **614** of clamp spring **600** engages sensor ring **550** to center the sensor ring and prevent an uncontrolled movement within a plane perpendicular to the axis of rotation of clutch assembly **500**.

[0048] Figure 14 is a fragmentary partial cross section of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **600** (shown in Figure 13) which includes tab **603B** taken generally along line **14-14** in Figure 13. It should be appreciated that clamp spring **600** (shown in Figure 13) and tab **603B** form a single, unified structure. In Figure 14, tab **603B** of clamp spring **600** (shown in Figure 13) engages with sensor ring **550** of clutch assembly **500**. Tab **603B** engages sensor ring **550** of clutch assembly **500** to center sensor ring **550** as sensor ring **150** moves within the axis of rotation clutch assembly **500**. Tab **603B** is formed by first flat member **613**, second flat member **614** and arcuate member **615**, whereby the first and second flat members **613** and **614** are fixedly connected by arcuate member **615**. Second end **603A** (shown in Figure 11A), comprising first flat member **612** (shown in Figure 11A) and tab **603B** are fixedly connected and operably arranged to engage with sensor ring **550** of clutch assembly **500**. Flat member **612** (shown in Figure 11A) of second end **603A** (shown in Figure 11A) and first flat member **613** of tab **603B** lie perpendicular to the plane of axis of second flat member **614** of tab **603B**.

[0049] Figure 15 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **700** which includes tab **703B**. It should be appreciated that clamp spring **700** and tab **703B** are a single, unified structure. Tab **703B** further prevents an uncontrolled movement of sensor ring **550**. With housing **530** removed, aperture **703a** of clamp spring **700** can be seen. Second end **703A** of second end **703** of clamp spring **700** is fixedly secured to housing **530** (shown in Figure 10) by rivet **531** (shown in Figure 10), which passes through aperture **703a**. Flat member **712** of second end **703A** and first flat member **713** of tab **703B** lie perpendicular to the plane of axis of second flat member **714** of tab **703B**. As clutch assembly **500** rotates about an axis of rotation, second flat member **714** of clamp spring **700** engages sensor ring **550** to center the sensor ring and prevent it from moving within a plane perpendicular to the axis of rotation of clutch assembly **500**.

[0050] Figure 16 is a fragmentary partial cross section of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **700** (shown in Figure 15) which includes tab **703B** taken generally along line **16-16** in Figure 15. It should be appreciated that clamp spring **700** (shown in Figure 15) and tab **703B** are a single, unified structure. In Figure 16, tab **703B** of clamp spring **700** (shown in Figure 15) is engaged with sensor ring **550** of clutch assembly **500**. Tab **703B** engages with sensor ring **550** of clutch assembly **500** to center sensor ring **550** as sensor ring **550** moves within the axis of rotation of clutch assembly **500**. Tab **703B** is formed by first flat member **713**, second flat member **714** and first arcuate member **715**, whereby the first and second flat members **713** and **714** are fixedly connected by arcuate member **715**. Second end **703A**, comprising flat member **712** and tab **703B** are fixedly connected by arcuate member **716** and operably arranged to engage with sensor ring **550** of clutch assembly **500**. Flat member **712** of second end **703A** and first flat member **713** of tab **703B** lie perpendicular to the plane of axis of second flat member **714** of tab **703B**.

[0051] Figure 17 is a fragmentary top view of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **800** which includes tab **803B**. It should be appreciated that clamp spring **800** and tab **803B** are a single, unified structure. Tab **803B** further prevents an uncontrolled movement of sensor ring **550**. Tab **803B** engages with sensor ring **550** of clutch assembly **500** to center sensor ring **550** as sensor ring **550** moves within the axis of rotation of clutch assembly **500**. Tab **803B** is formed by flat member **813**. Second end **803A**,

comprising flat member **812**, and tab **803B** are fixedly connected and operably arranged to engage with sensor ring **550** of clutch assembly **500**.

[0052] Figure 18 is a fragmentary partial cross section of the adjustment means of clutch assembly **500** of the present invention, illustrating clamp spring **800** (shown in Figure 17) which includes tab **803B** taken generally along line **18-18** in Figure 17. It should be appreciated that clamp spring **800** (shown in Figure 17) and tab **803B** are a single, unified structure. In Figure 18, tab **803B** of clamp spring **800** is engaged with sensor ring **550** of clutch assembly **500**. Tab **803B** engages with sensor ring **550** of clutch assembly **500** to center sensor ring **550** as sensor ring **150** moves within the axis of rotation of clutch assembly **500**. Tab **803B** is formed by flat member **813**. Second end **803A**, comprising flat member **812** and tab **803B** are fixedly connected and operably arranged to engage with sensor ring **550** of clutch assembly **500**. Flat member **811** of second end **803A** and first flat member **812** of tab **803B** lie perpendicular to the plane of axis of second flat member **813** of tab **803B**.

List of reference numbers

1	longitudinal axis
2	radius
3	circumference
4	object
5	object
6	object
7	surface
8	surface
9	surface
10	system
11	surface
12	surface
13	surface
15	object
100	clutch assembly
101	lever plate
102	lever arm
102a	aperture
103	lever arm
103a	aperture
104	lever arm
104a	aperture
105	lever arm
105a	aperture
106	lever arm
106a	aperture
108	lever arm
108a	aperture
130	housing

131 rivet
132 rivet
133 bolt
140 adjuster ring
150 sensor ring
160 adjustment tab
200 transport lock
201 first set of teeth
202 second set of teeth
203 third set of teeth
204 bar
205 bar
206 bar
208 tooth
208n notch
209 tooth
210 tooth
211 tooth
211n notch
212 tooth
212n notch
213 tooth
214 tooth
215 tooth
215n notch
216 tooth
216n notch
218 tooth
219 tooth
220 tooth

220n notch
221 washer
222 washer
300 clamp spring
301 body
301a aperture
302 first end
302a aperture
303 second end
303a aperture
304 third end
305 first flat member
306 second flat member
308 arcuate member
309 flat member
310 first flat member
311 second flat member
312 arcuate member
400 centering pin
401 first flat member
401a aperture
402 second flat member
403 rivet
500 clutch assembly
501 lever plate
502 lever arm
503 lever arm
504 lever arm
505 lever arm
506 lever arm

508 lever arm
530 housing
531 rivet
532 rivet
533 bolt
540 adjuster ring
550 sensor ring
560 adjustment tab
600 clamp spring
601 body
602 first end
602A first end
602B nose
603 second end
603A second end
603B tab
603B tab
604 third end
605 first flat member
606 second flat member
608 arcuate member
609 first flat member
610 second flat member
611 arcuate member
612 flat member
613 first flat member
614 second flat member
615 arcuate member
616 first flat member
618 second flat member

619 arcuate member
700 clamp spring
701 body
701a aperture
702 first end
702a aperture
702A first end
702B nose
703 second end
703a aperture
703A second end
703B tab
704 third end
705 first flat member
706 second flat member
708 arcuate member
709 first flat member
710 second flat member
711 arcuate member
712 flat member
713 first flat member
714 second flat member
715 arcuate member
716 arcuate member
718 first flat member
719 second flat member
720 arcuate member
800 clamp spring
801 body
801a aperture

802 first end
802a aperture
802A first end
802B nose
803 second end
803a aperture
803A second end
803B tab
804 third end
805 first flat member
806 second flat member
808 arcuate member
809 first flat member
810 second flat member
811 arcuate member
812 flat member
813 flat member
814 first flat member
815 second flat member
816 arcuate member

CLAIMS

What We Claim Is:

1. A clutch assembly for transferring a torque between a flywheel of an engine and a transmission in a motor vehicle, said clutch assembly comprising a housing, a pressure plate fixedly secured to said housing, said pressure plate operatively arranged to cause a friction clutch disc to rotate said flywheel, wherein said pressure plate is arranged for rotation about an axis of rotation, wherein said pressure plate is axially movable relative to said axis of rotation, and including actuation means for engaging and disengaging said clutch, an adjustment means operatively arranged to adjust travel of said pressure plate and said friction clutch disc, and a plurality of lever arms, operatively arranged to amplify force within said clutch assembly, said adjustment means comprising a clamp spring having a first end operatively arranged to prevent an uncontrolled movement of the adjustment means and a second end operatively arranged to center the adjustment means within the clutch assembly.

2. The clutch assembly as recited in Claim 1, wherein said first end comprises a nose operatively arranged to engage said adjustment means.

3. The clutch assembly as recited in Claim 2, wherein said nose applies a load to an adjuster ring of said adjustment means.

4. The clutch assembly as recited in Claim 2, wherein said nose comprises a first flat member, a second flat member and an arcuate member, said first and second flat members fixedly connected by said arcuate member.

5. The clutch assembly as recited in Claim 1, wherein said second end comprises a tab operatively arranged to engage said adjustment means.

6. The clutch assembly as recited in Claim 5, wherein said tab is operatively engaged with a sensor ring of said adjustment means.

7. The clutch assembly as recited in Claim 5, wherein said tab comprises a first flat member, a second flat member and an arcuate member, said first and second flat members fixedly connected by arcuate member.

8. A clamp spring for a clutch assembly, comprising:

a first end operatively arranged to prevent an uncontrolled movement of an adjustment means and a second end operatively arranged to center an adjustment means within a clutch assembly.

9. The clamp spring as recited in Claim 8, wherein said first end comprises a nose operatively arranged to engage said adjustment means.

10. The clamp spring as recited in Claim 9, wherein said nose applies a load to an adjuster ring of said adjustment means.

11. The clamp spring as recited in Claim 9, wherein said nose comprises a first flat member, a second flat member and an arcuate member, said first and second flat member fixedly connected by arcuate member.

12. The clamp spring as recited in Claim 8, wherein said second end comprises a tab operatively arranged to engage said adjustment means.

13. The clamp spring as recited in Claim 12, wherein said tab is operatively engaged with a sensor ring of said adjustment means.

14. The clutch assembly as recited in Claim 12, wherein said tab comprises a first flat member, a second flat member and an arcuate member, said first and second flat members fixedly connected by arcuate member.

15. A clamp spring for a clutch assembly, comprising:
a first end operatively arranged to prevent an uncontrolled movement of an adjustment means and a second end operatively arranged to center an adjustment means within a clutch assembly.

16. The clamp spring as recited in Claim 15, wherein said first end comprises a nose operatively arranged to engage said adjustment means.

17. The clamp spring as recited in Claim 16, wherein said nose applies a load to an adjuster ring of said adjustment means.

18. The clamp spring as recited in Claim 16, wherein said nose comprises a first flat member, a second flat member and an arcuate member, said first and second flat member fixedly connected by arcuate member.

19. The clamp spring as recited in Claim 15, wherein said second end comprises a tab operatively arranged to engage said adjustment means.

20. The clamp spring as recited in Claim 19, wherein said tab is operatively engaged with a sensor ring of said adjustment means.

21. The clamp spring as recited in Claim 19, wherein said tab comprises a first flat member, a second flat member, a first arcuate member and a second arcuate member, said first and second

flat members fixedly connected by first arcuate member, said first flat member fixedly connected to said second arcuate member.

22. A clamp spring for a clutch assembly, comprising:

a first end operatively arranged to prevent an uncontrolled movement of an adjustment means and a second end operatively arranged to center an adjustment means within a clutch assembly.

23. The clamp spring as recited in Claim 22, wherein said first end comprises a nose operatively arranged to engage said adjustment means.

24. The clamp spring as recited in Claim 23, wherein said nose applies a load to an adjuster ring of said adjustment means.

25. The clamp spring as recited in Claim 23, wherein said nose comprises a first flat member, a second flat member and an arcuate member, said first and second flat member fixedly connected by arcuate member.

26. The clamp spring as recited in Claim 22, wherein said second end comprises a tab operatively arranged to engage said adjustment means.

27. The clamp spring as recited in Claim 24, wherein said tab is operatively engaged with a sensor ring of said adjustment means.

28. The clamp spring as recited in Claim 12, wherein said tab comprises a flat member

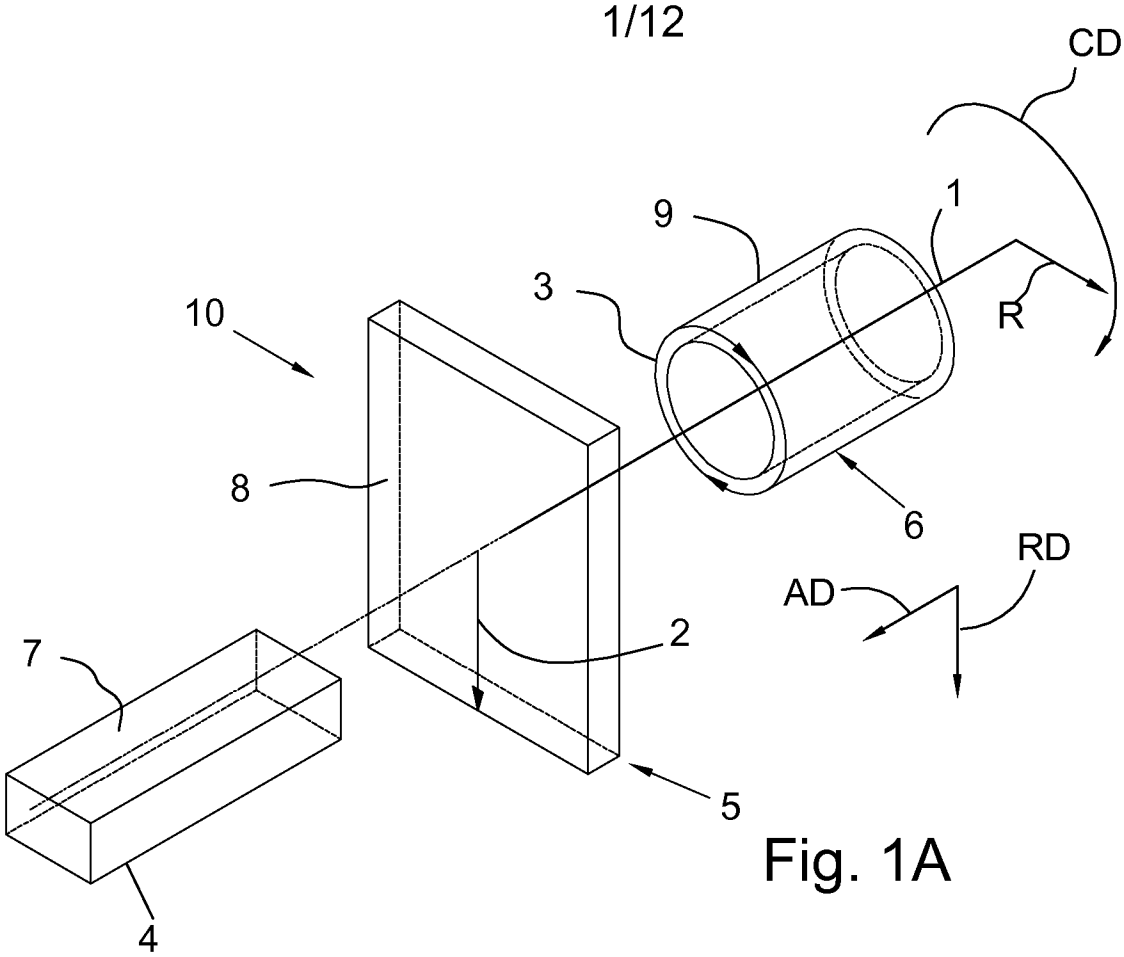


Fig. 1A

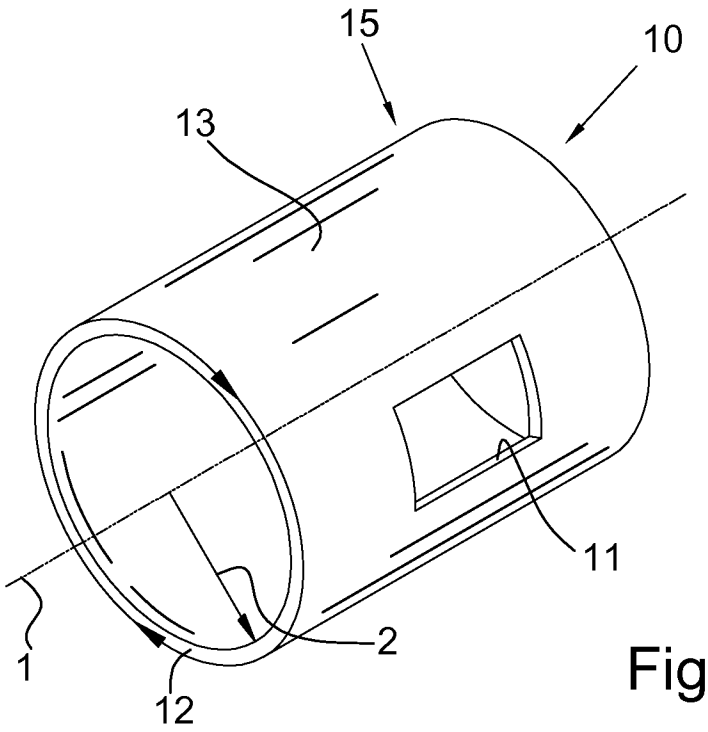


Fig. 1B

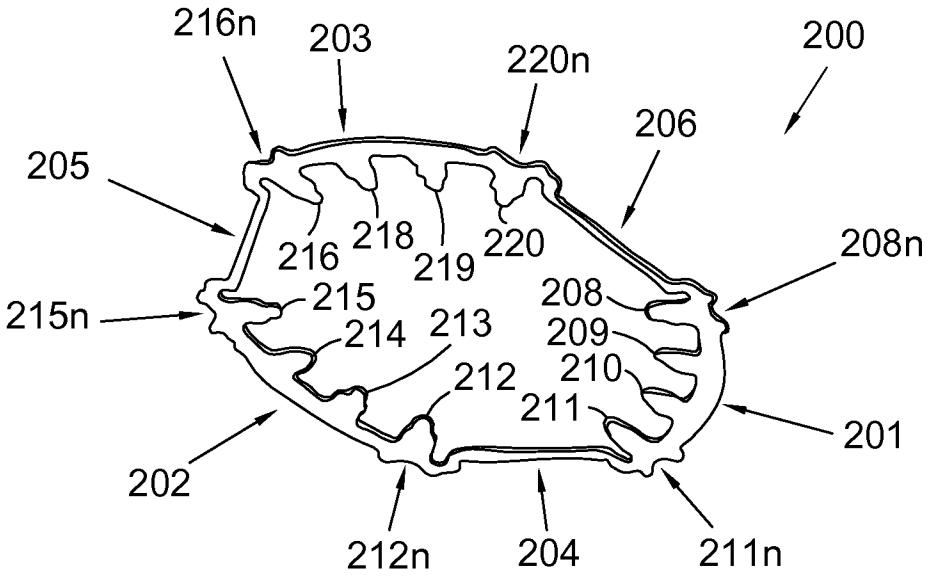

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208n
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204
211n

Fig. 2

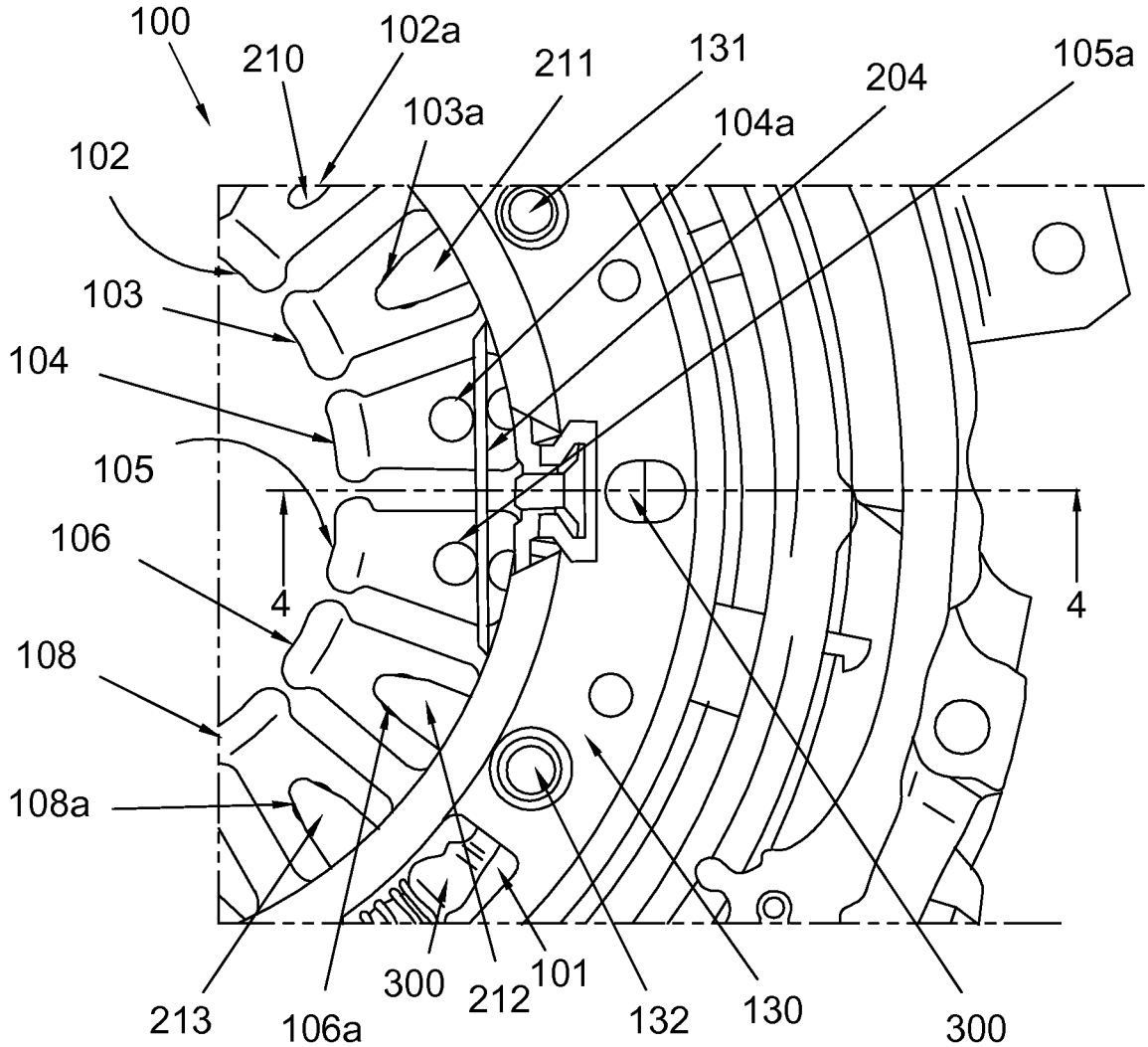

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212
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130
300

Fig. 3

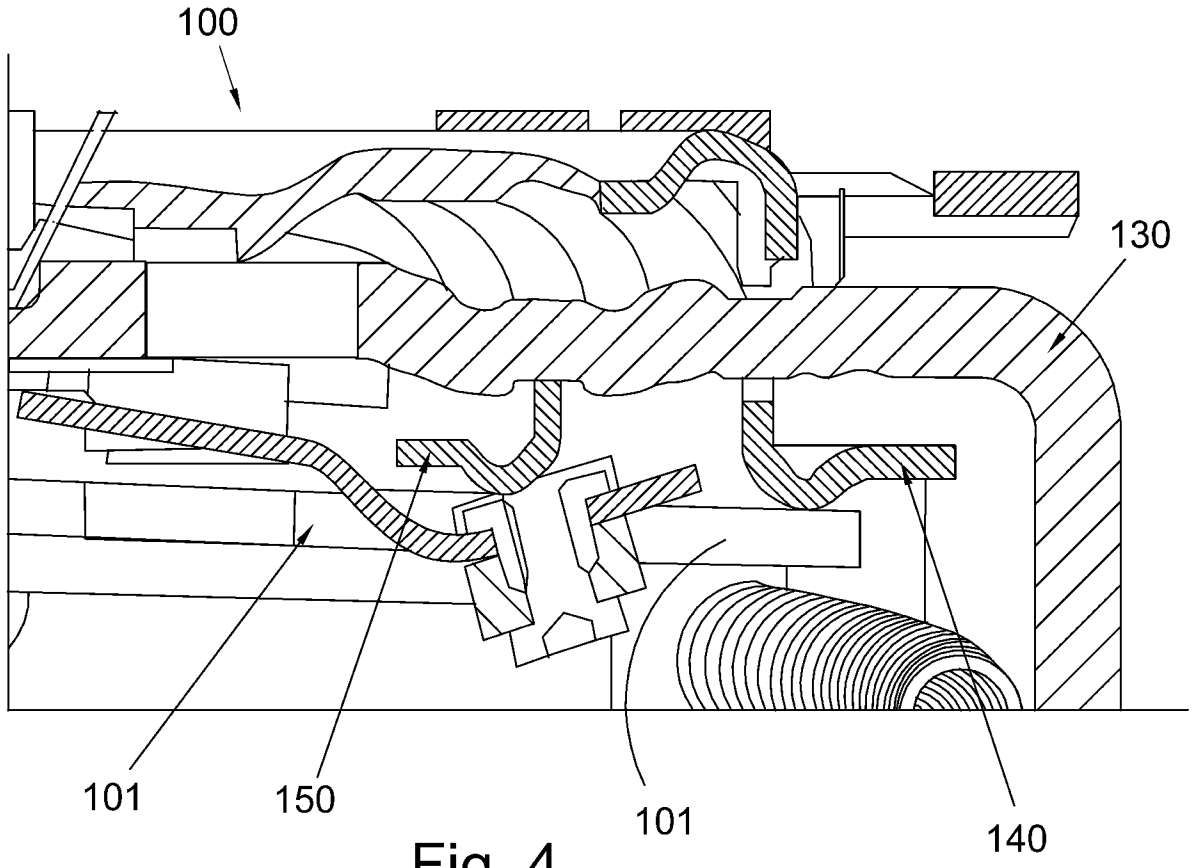

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150
101
140

Fig. 4

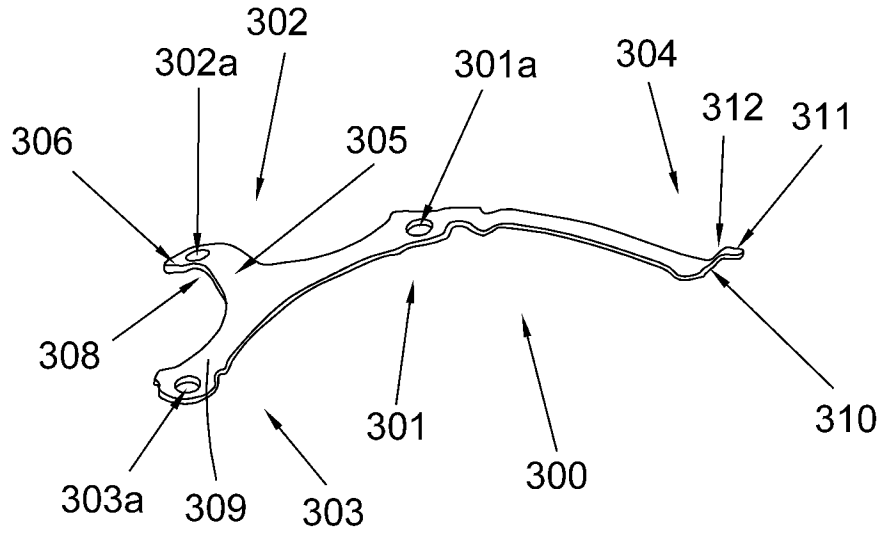

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Fig. 5

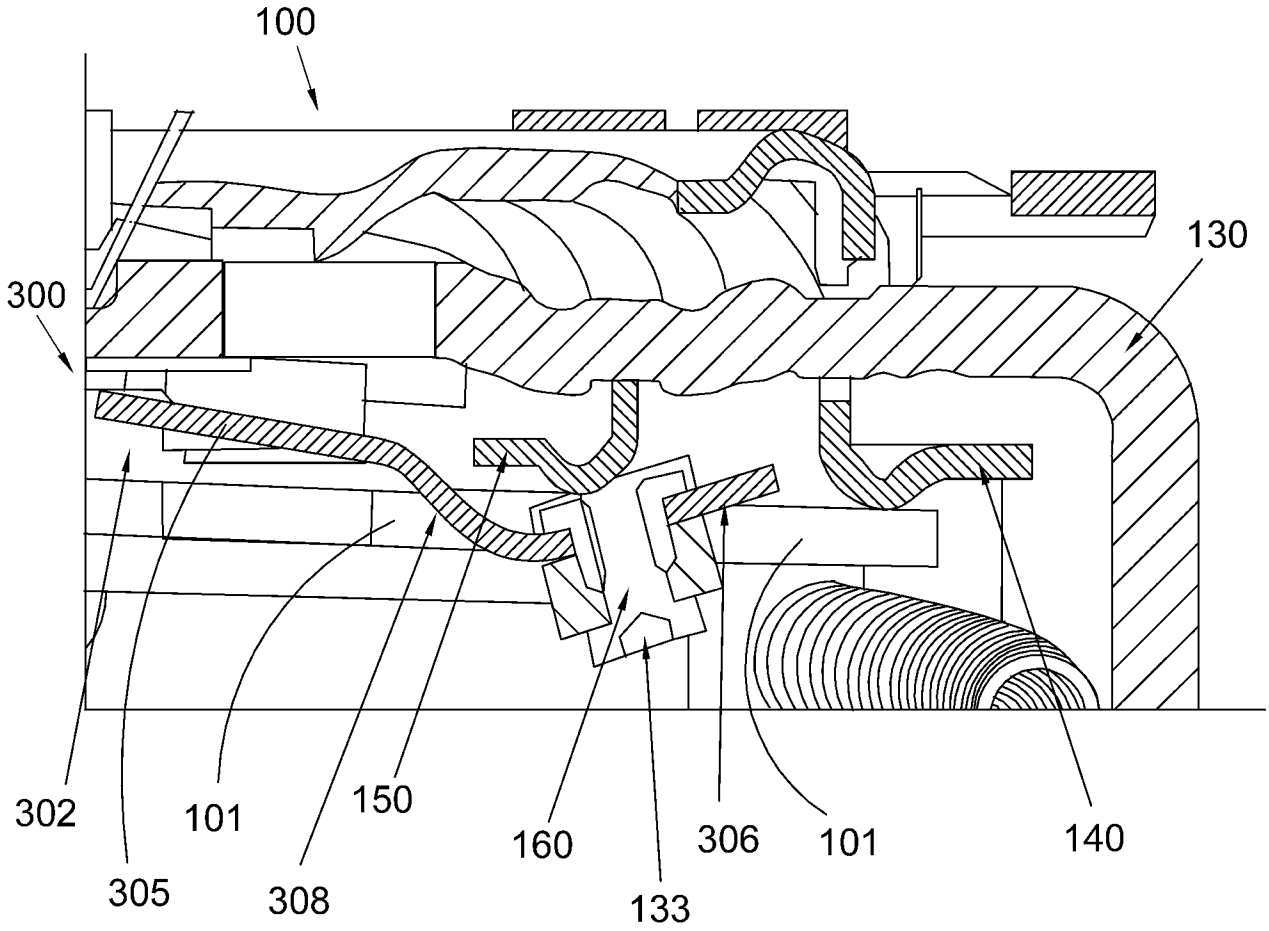


Fig. 6

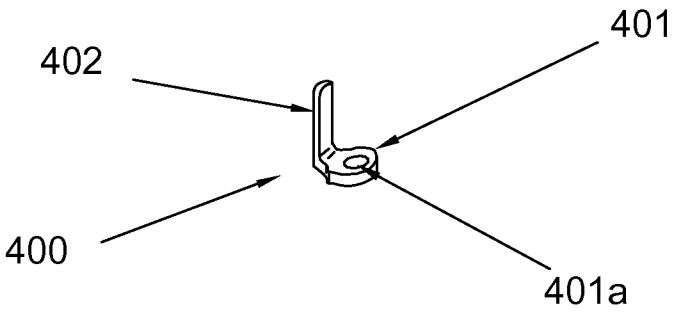


Fig. 7

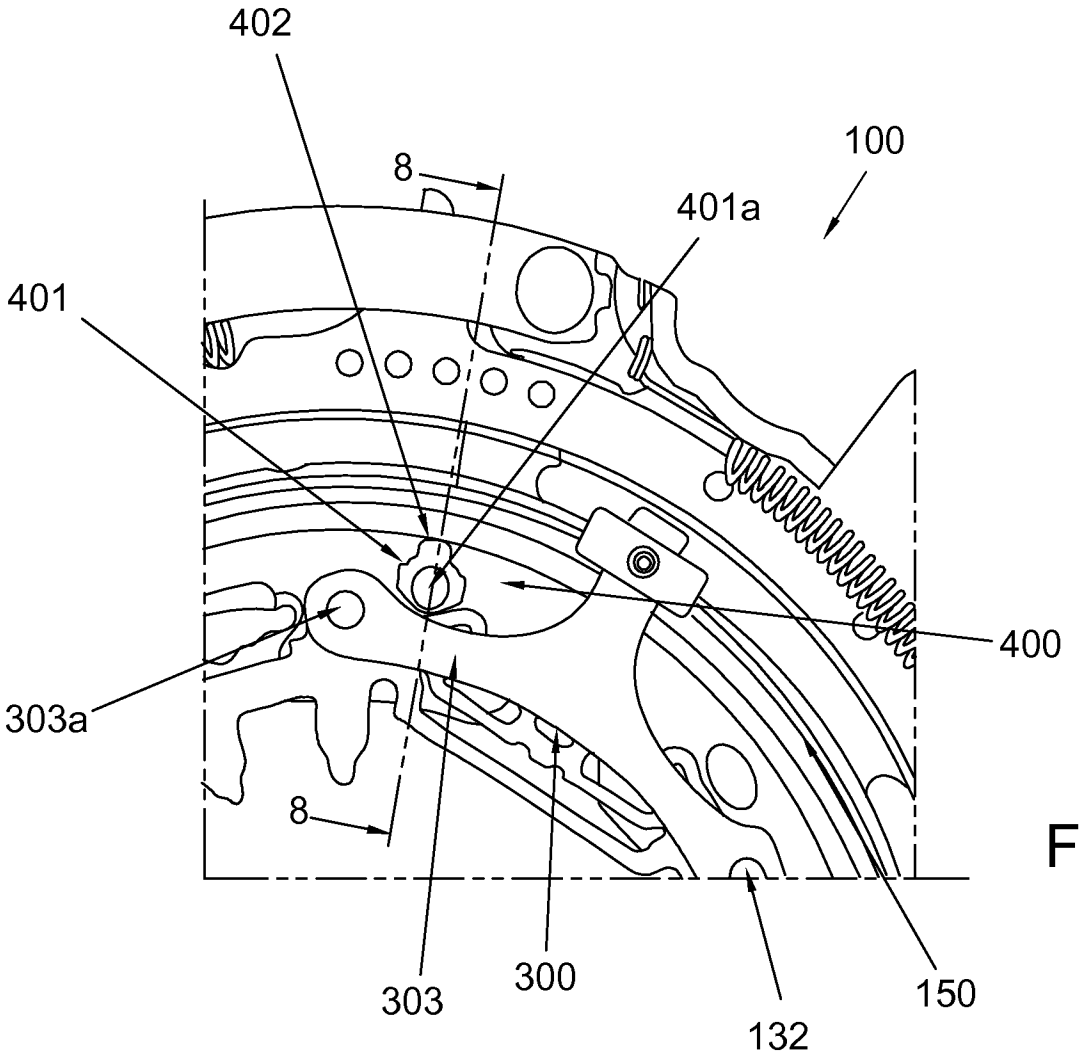


Fig. 8

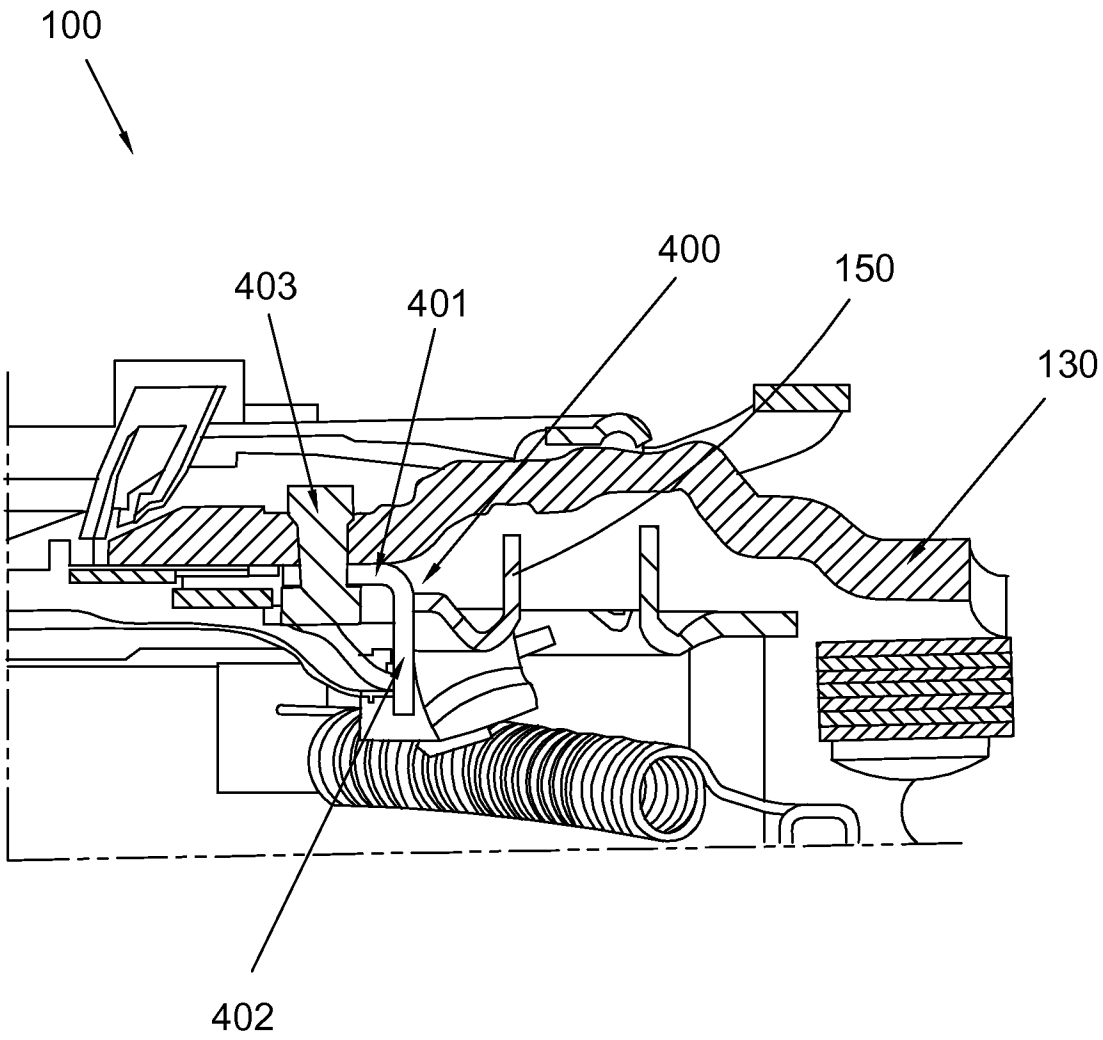


Fig. 9

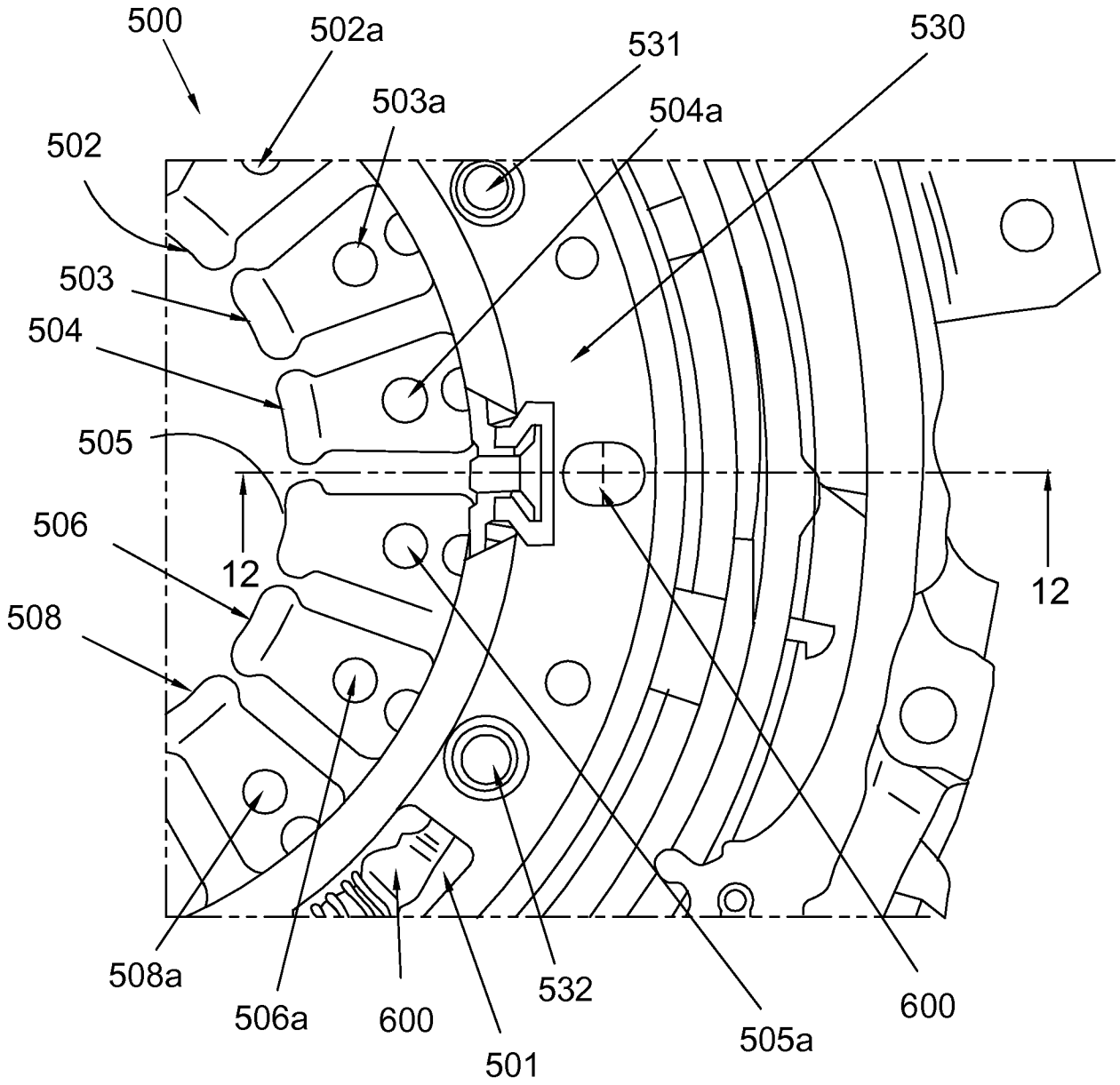

500
502a
531
530
503a
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503
504
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506
12
12
508
508a
506a
600
532
501
505a
600

Fig. 10

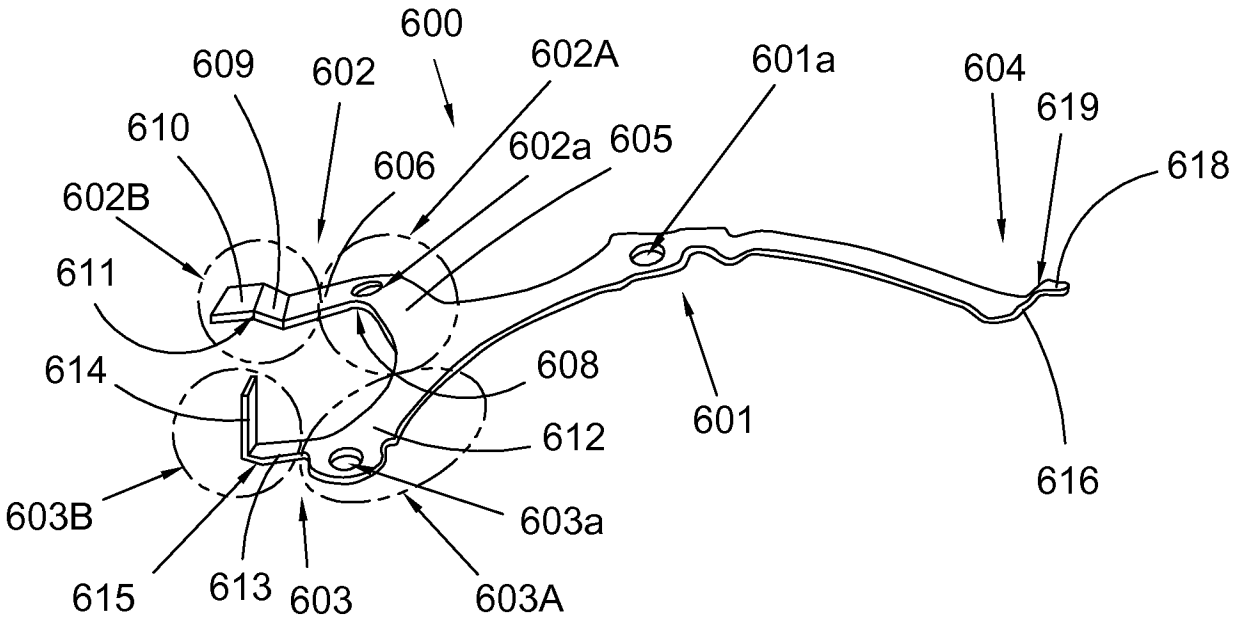


Fig. 11A

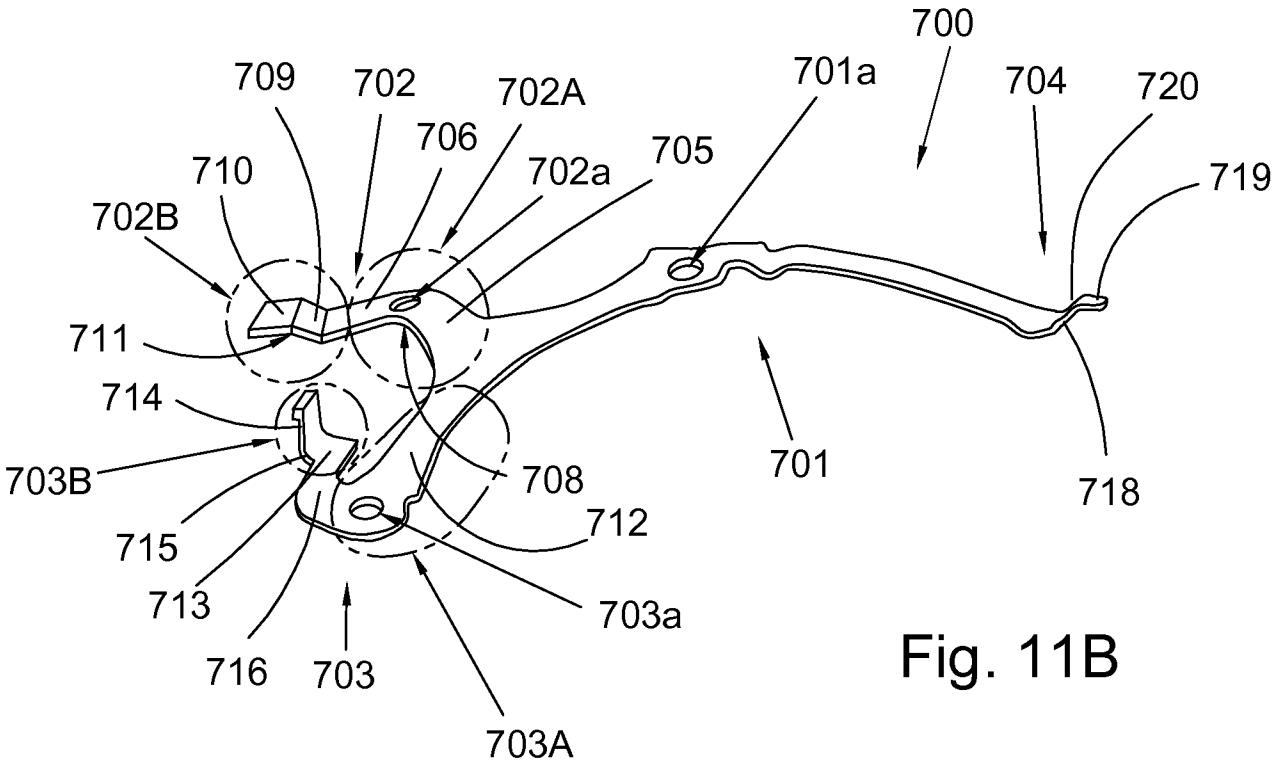


Fig. 11B

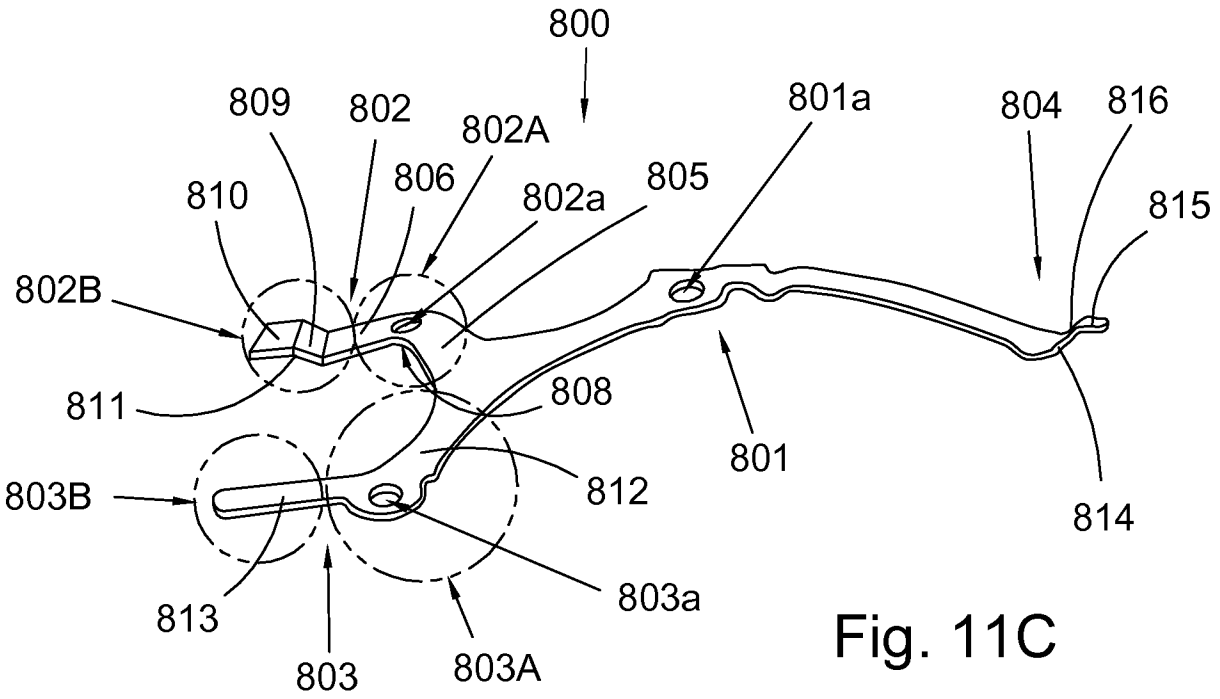


Fig. 11C

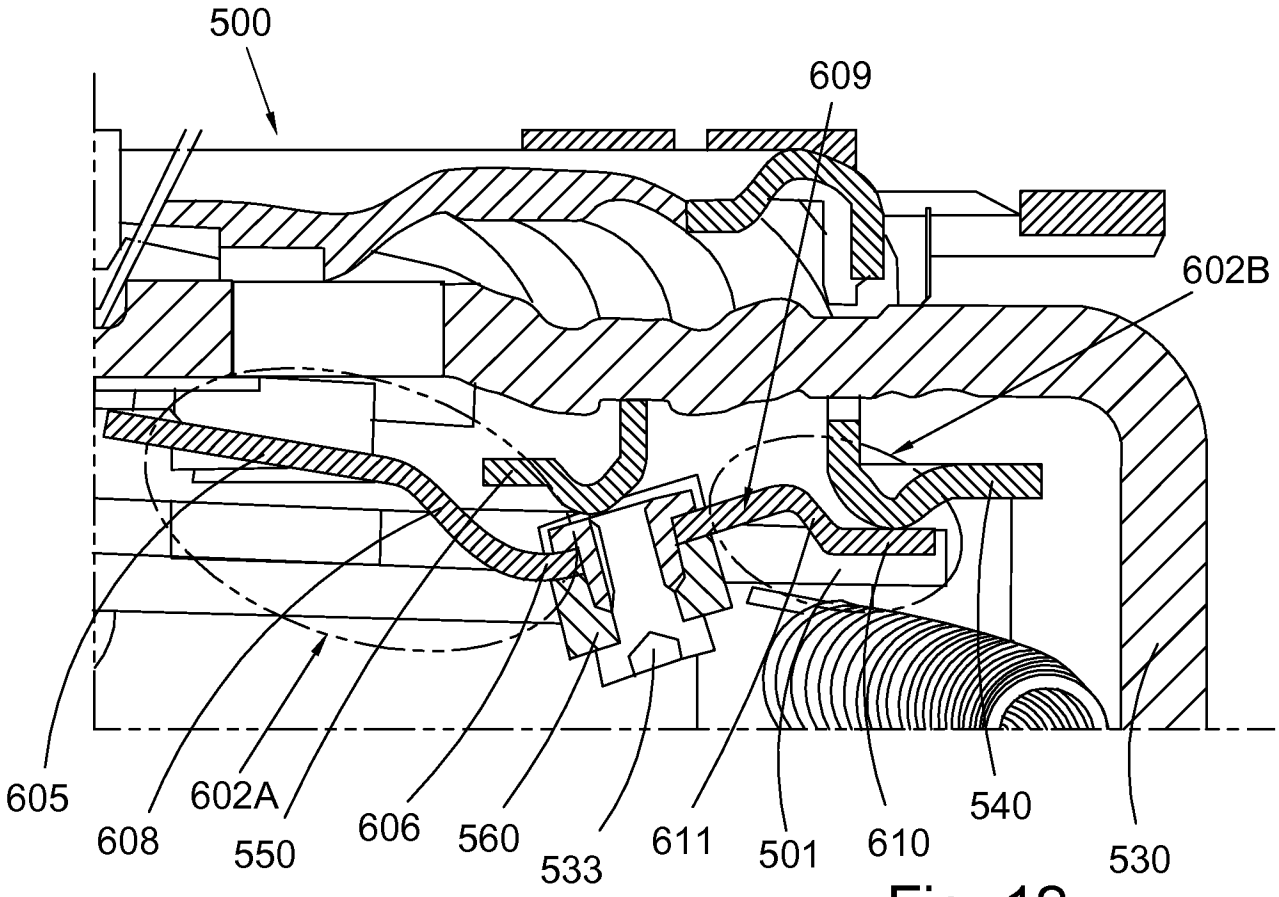


Fig. 12

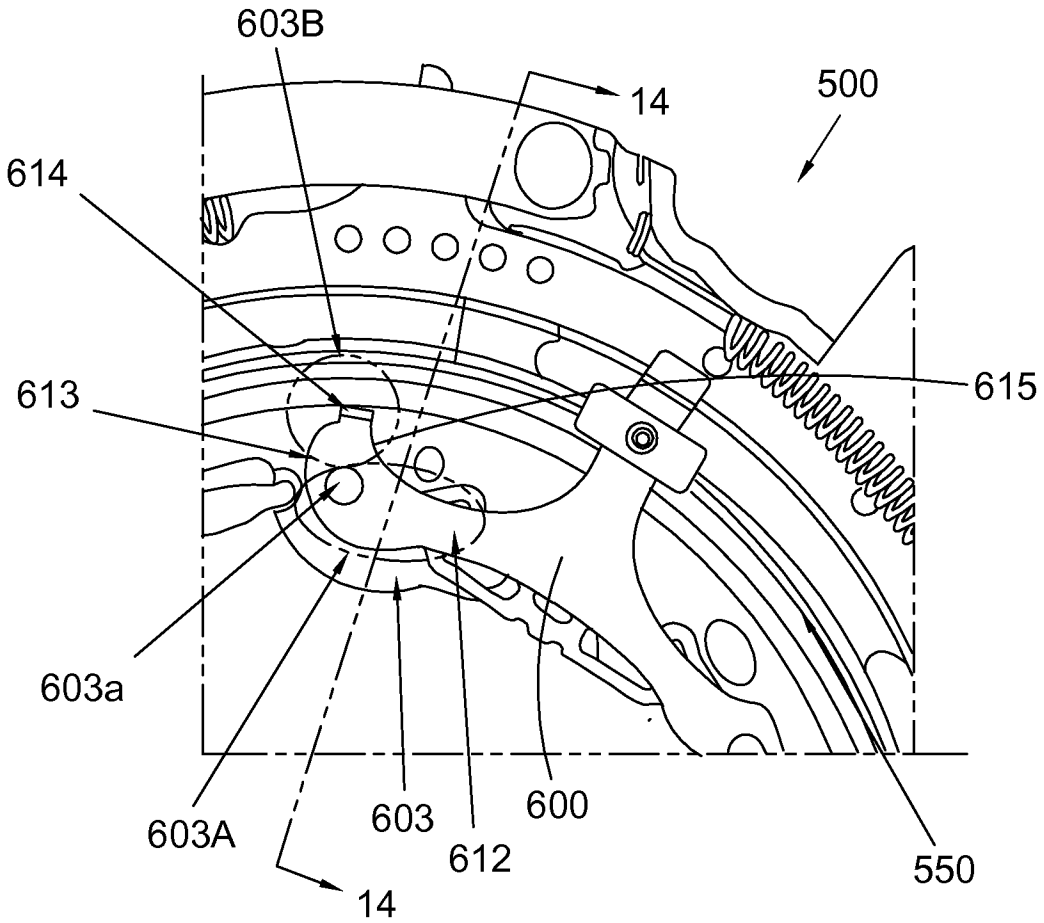

603B
14
500
614
615
613
603a
603A
603
612
600
550
14

Fig. 13

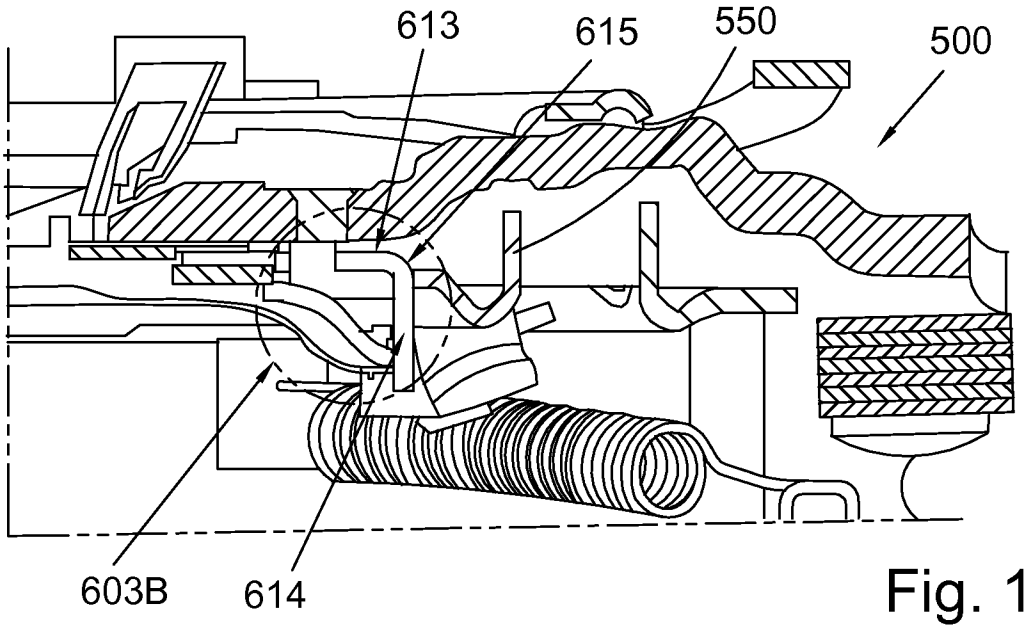

613
615
550
500
603B
614

Fig. 14

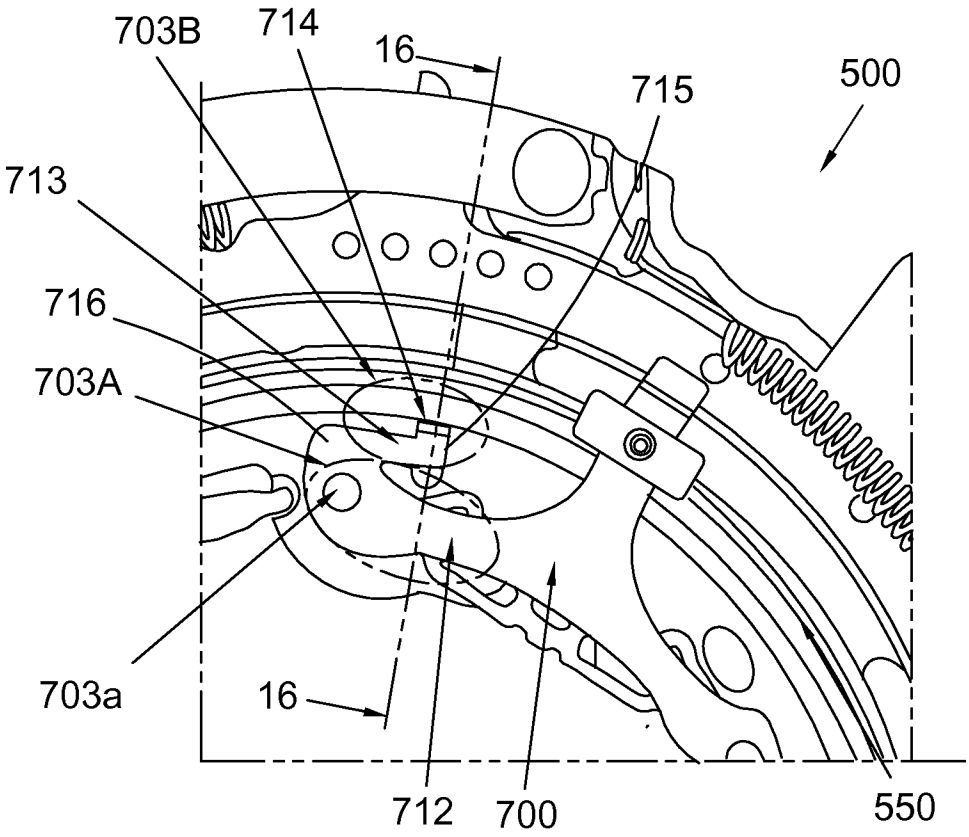

703B
714
16
715
500
713
716
703A
703a
16
712
700
550

Fig. 15

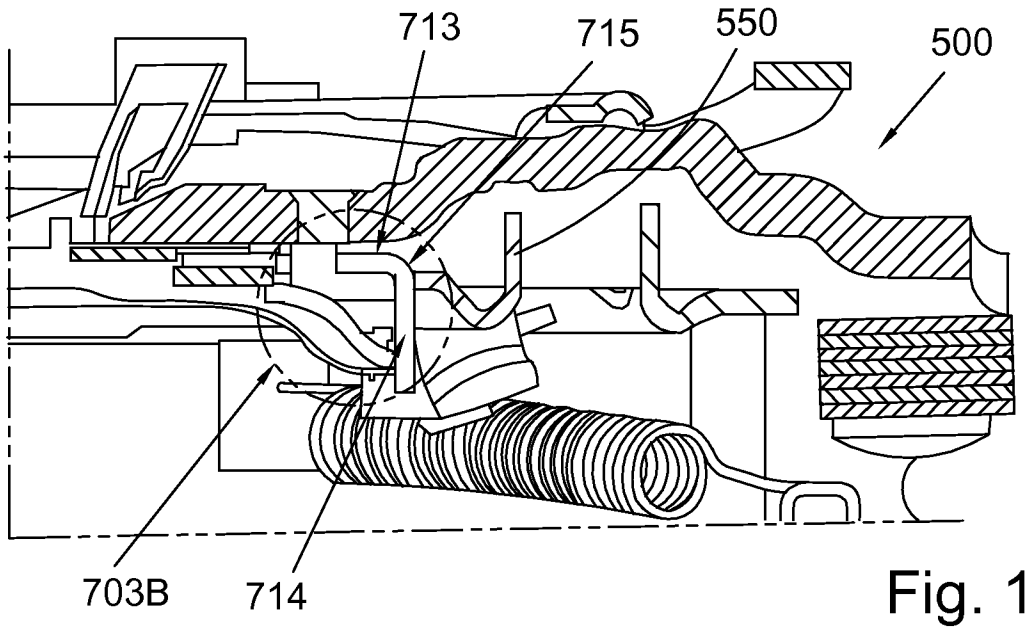

713
715
550
500
703B
714

Fig. 16

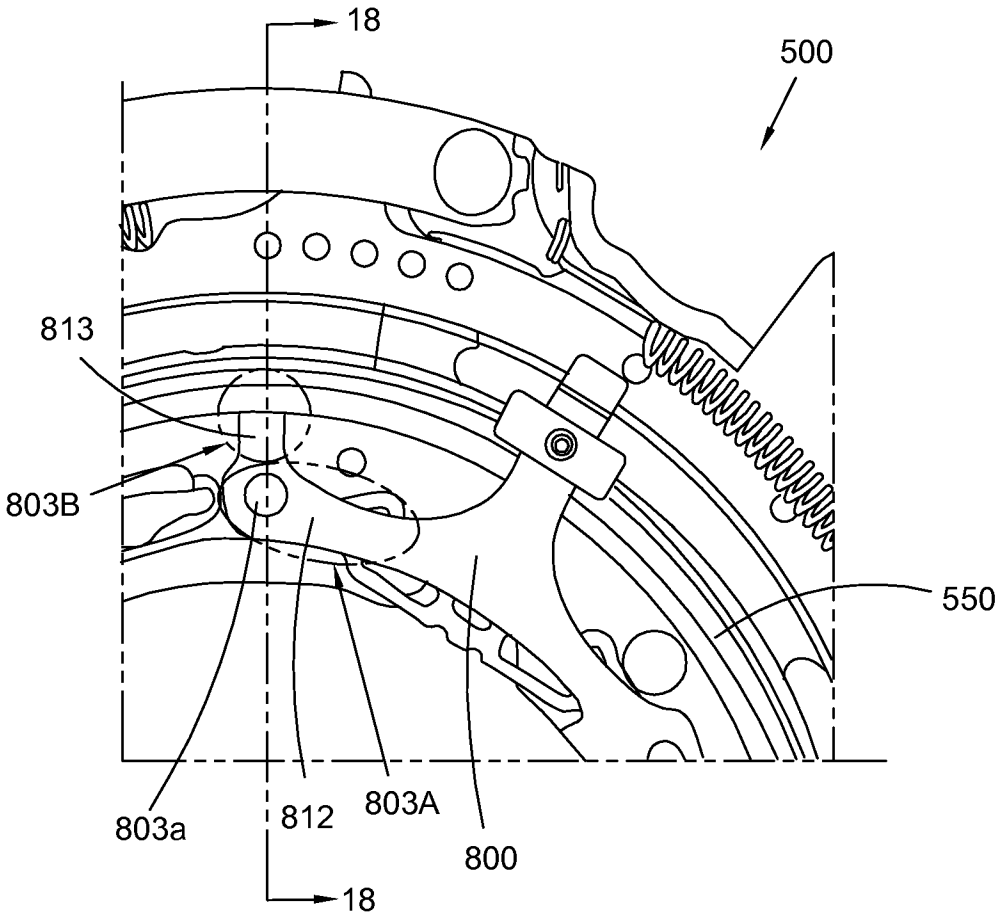


Fig. 17

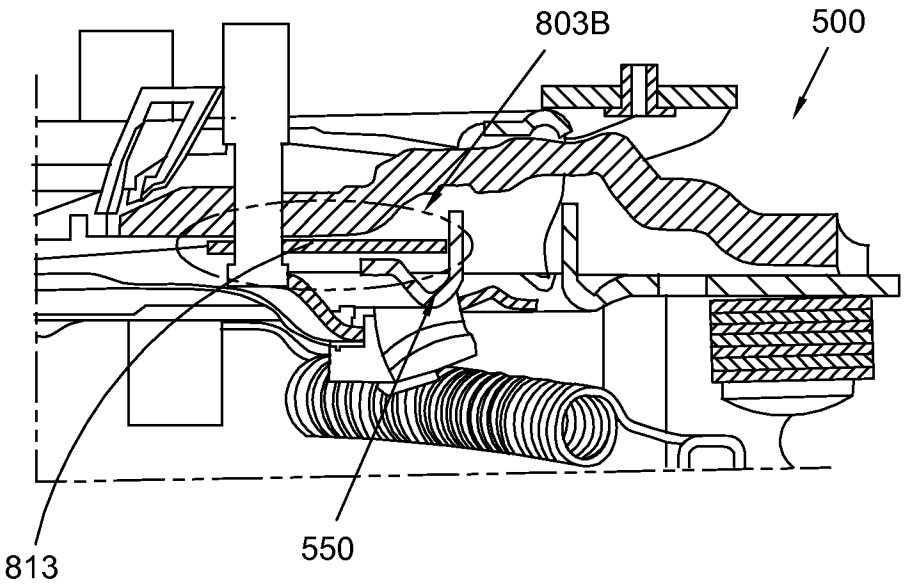


Fig. 18