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(54) **Transmission mechanism**

(57) The invention relates to a transmission mechanism and push-button module of a personal electronic measuring device. The transmission mechanism comprises: a transmission element for transmitting a pushing force provided by the user to an internal switch of a personal electronic measuring device at the extreme switch position of the transmission element; and a domed spring structure for directing a return force opposite to the pushing force provided by the user to the transmission element, the domed spring structure comprising support areas and being operationally connected from one support area to the transmission element and from another support area to a structure supporting the domed spring structure and having a collapsing phase that occurs close to the extreme switch position and provides a sudden reduction in the return force which the user can sense and which thus verifies the change in the state of the internal switch.

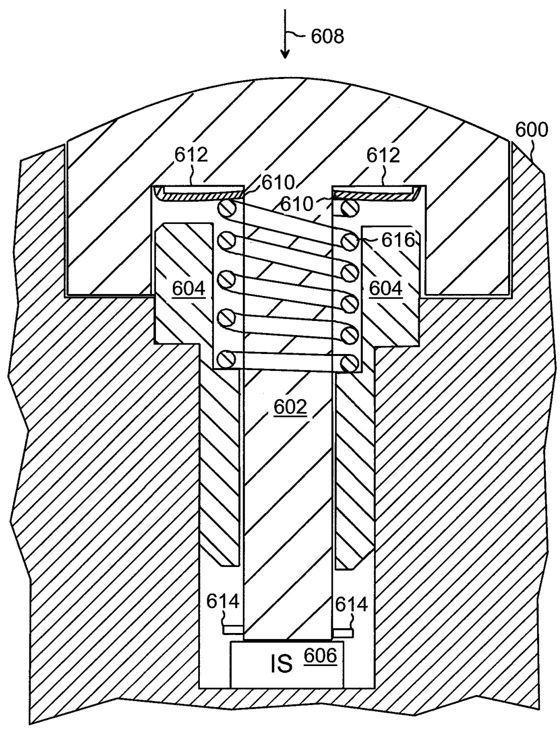

Fig. 7

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Description

FIELD

[0001] The invention relates to a transmission mechanism, push-button module, and personal electronic measuring device.

BACKGROUND

[0002] Personal electronic devices typically contain internal switches that are used from outside the device by means of a transmission mechanism penetrating the casing of the device. A change in the state of the switch typically produces the desired operation of the device that is verified by a pointer shown on the display of the device.

[0003] However, the operating situation of a personal electronic device may be such that the user cannot watch the display of the device. Therefore, it is advantageous to examine other means with which a change in the state of an internal switch is verified to the user.

BRIEF DESCRIPTION

[0004] It is an object of the invention to implement a transmission mechanism, push-button module, and personal electronic measuring device with which an easy usability of an internal switch can be achieved.

[0005] As a first aspect of the invention, a transmission mechanism is presented, which is installable in a personal electronic measuring device and contains: a transmission element for transmitting a pushing force provided by the user to an internal switch of a personal electronic measuring device at the extreme switch position of the transmission element; and a domed spring structure for directing a return force opposite to the pushing force provided by the user to the transmission element, the domed spring structure comprising support areas and being operationally connected from one support area to the transmission element and being operationally connected from another support area to a structure supporting the domed spring structure and having a collapsing phase that occurs close to the extreme switch position and provides a sudden reduction in the return force which the user can sense and which thus verifies the change in the state of the internal switch.

[0006] As a second aspect of the invention, a push-button module is presented for installation in the personal electronic measuring device, the push-button module comprising: a transmission element for transmitting a pushing force provided by the user to an internal switch of a personal electronic measuring device at the extreme switch position of the transmission element; a frame part for establishing adaptation between the transmission element and the personal measuring device, and which frame part is arrangeable to the personal electronic measuring device; and a domed spring structure for directing a return force opposite to the pushing force provided by the user to the transmission element, the domed spring structure comprising support areas and being operationally connected from one support area to the transmission element and being operationally connected from another support area to the frame part and having a collapsing phase that occurs close to the extreme switch position and provides a sudden reduction in the return force which the user can sense and which thus verifies the change in the state of the internal switch.

[0007] As another aspect of the invention, a personal electronic measuring device is presented comprising: an internal switch for controlling the personal electronic device; a transmission element for transmitting a pushing force provided by the user to an internal switch of the personal electronic measuring device at the extreme switch position of the transmission element; a frame part for establishing adaptation between the transmission element and the personal measuring device, which frame part is arrangeable to the personal electronic measuring device; and a domed spring structure for directing a return force opposite to the pushing force provided by the user to the transmission element, the domed spring structure comprising support areas and being operationally connected from one support area to the transmission element and being operationally connected from another support area to the frame part and having a collapsing phase that occurs close to the extreme switch position and provides a sudden reduction in the return force which the user can sense and which thus verifies the change in the state of the internal switch.

[0008] Preferred embodiments of the invention are described in the dependent claims.

[0009] The invention is based on connecting a transmission element using an internal switch to a domed spring structure that has a collapsing phase close to the extreme switch position of the transmission element. The collapsing phase can be sensed by the user, which means that the user knows that the state of the switch has changed without needing visual contact.

[0010] The transmission mechanism, push-button module, and personal electronic measuring device of the invention provide several advantages. One advantage is a safe and easy use of the internal switch, because the monitoring of the change in the state of the switch does not require monitoring the display of the measuring device. This also saves display resources and the battery of the measuring device.

LIST OF FIGURES

[0011] The invention will now be described in greater detail by means of preferred embodiments and with reference to the attached drawings, in which

Figure 1 is an isometric image of an embodiment of the personal electric device,
Figure 2 is a profile image of an embodiment of the

personal electric device,

Figure 3 is a first example of an embodiment of the push-button module,

Figure 4A is an example of the domed spring structure in rest position,

Figure 4B is an example of the domed spring structure under tension,

Figure 5 shows a second example of an embodiment of the push-button module,

Figure 6 shows a third example of an embodiment of the push-button module,

Figure 7 shows a forth example of an embodiment of the push-button module,

Figure 8 shows a fifth example of an embodiment of the push-button module,

Figure 9 shows a sixth example of an embodiment of the push-button module,

Figure 10 shows a seventh example of an embodiment of the push-button module.

DESCRIPTION OF EMBODIMENTS

[0012] With reference to Figures 1 and 2, let us now examine an example of a personal electronic measuring device 100. A personal electronic measuring device 100 is typically a device that the user carries along and that performs an electronic measurement. The measurement may relate to the user, the environment, and/or time. For the sake of simplicity, the personal electronic measuring device is herein called a measuring device 100.

[0013] In one embodiment, the measuring device 100 is a wrist-held device. The wrist device may be a watch and/or the wrist section of a performance monitor. A performance monitor is typically a system consisting of one or more parts that communicate over wire and/or wirelessly with each other and measures quantities related to the performance, such as exercise, of the user.

[0014] The measuring device 100 typically comprises a user interface, such as a display 106, and at least one push button 102. The push button 102 is connected through a transmission mechanism to an internal switch, and the user may control the operation of the measuring device 100 with the switch and provide a desired operation of the measuring device 100 by directing a pushing force 104 to the push button 102.

[0015] With reference to Figure 3, let us now examine the transmission mechanism that comprises a transmission element 302 and a domed spring structure 310. In the presented embodiment, the transmission element 302 penetrates the domed spring structure 310. In Figure 3, the transmission element 302 is in its extreme rest position.

[0016] The transmission element 302 is typically an elongated structure extending from the surface section of the casing 300 of the measuring device 100 to the interior 100 of the measuring device 100. The transmission element 302 transmits the pushing force 308 of the user to an internal switch (IS) 306 of the measuring device and thus generates a change in the state of the internal switch 306.

[0017] The transmission element 302 may be made of metal or elastomer, such as plastic or rubber. The metal may be steel or aluminium. The elastomer may also be a thermoplastic elastomer.

[0018] The transmission element 302 is arranged to the casing 300 or support structure of the measuring device 100 through a frame part 304 that can be arranged to the measuring device 100.

[0019] The frame part 304 may be made of metal or plastic, for instance. The frame part 304 may be part of the casing 300 of the measuring device 100.

[0020] The transmission element 302 may be connected to the internal switch 306 through a connection element 316.

[0021] The internal switch 306 may be a mechanical switch or an electric switch.

[0022] The domed spring structure 310 directs to the transmission element 302 a return force opposite to the pushing force 308 provided by the user, in which case the transmission element 302 returns toward its rest position as the pushing force 308 provided by the user diminishes. A cotter structure 314 settling against the frame part 304 may be fastened to the transmission element 302 to prevent the transmission element 302 from sliding away from the frame part 304 when the pushing force 308 is smaller than the return force generated by the domed spring structure 310.

[0023] With reference to Figures 4A and 4B, the domed spring structure 400 comprises support areas 404, 406, of which support area 404 is the edge support area and support area 406 is the centre support area. In one embodiment, the domed spring structure 400 also comprises a through-hole 402 for the transmission element 302. The domed spring structure can also generally be called a dome spring.

[0024] When directing to the edge support areas 404 and centre support area 406 an opposite force that compresses the domed spring structure 400, the domed spring structure 400 goes through a compression phase, wherein the spring-back force of the domed spring structure 400 increases as a function of the spring deflection. During the compression phase, the domed spring structure 400 deforms from the structure of Figure 4A to the structure of Figure 4B.

[0025] When the spring deflection increases further, the domed spring structure 400 goes through a collapsing phase, wherein the spring-back force suddenly decreases, which the user feels as a sudden decrease in the return force. The user can then on the basis of his or her sensation determine that the state of the internal switch 306 has changed. The collapsing phase is reversible, i.e. the domed spring structure 400 returns from the collapsing phase to the rest position.

[0026] In one embodiment, the domed spring structure 400 is arranged to generate an audio signal during the collapsing phase. The user then hears the click of the domed spring structure 400 as a sign of the change in the state of the switch 306.

[0027] With reference to Figure 3, the domed spring structure 310 may be supported from the edge support area 404 to the terrace area 312 of the transmission element 302. In addition, the domed spring structure 310 may be supported from the centre support area 406 to the frame part 304. Thus, when the transmission element 302 is pushed toward the inside, the domed spring structure 310 remains between the terrace area 312 and frame part 304, and the deformation of the domed spring structure 310 according to Figures 4A and 4B takes place.

[0028] With reference to Figure 5, let us examine the transmission mechanism close to the extreme switch position, where the domed spring structure 310 is in the collapsing phase or past the collapsing phase.

[0029] The state change position of the domed spring structure 310 and internal switch 306 is preferably selected in such a manner that the collapsing phase of the domed spring structure 306 takes place close to the extreme switch position of the transmission element 302, i.e. in a position where the state of the internal switch 306 changes. The decrease in the return force related to the collapsing phase then indicates to the user that the state of the internal switch 306 has changed.

[0030] With reference to Figures 6 and 7, let us now examine an embodiment where the transmission mechanism comprises a return mechanism for returning the transmission element to its extreme rest position. The return mechanism may comprise a helical spring structure 616 wound around the transmission element 602 to direct to the transmission element 602 a return force opposite to the pushing force 608 provided by the user. The transmission element 602 is connected to an internal switch 606. In Figure 6, the transmission element 602 is in its rest position, and in Figure 7, the transmission element 602 is close to the extreme switch position. The helical spring structure 616 serves as the return mechanism of the transmission element 602 and increases the distance the transmission element 602 travels.

[0031] In one embodiment, the return mechanism comprises a contact plate.

[0032] In one embodiment, the return mechanism comprises an elastomer spring that acts like a spring when compressing and releasing from compression. In one embodiment, the transmission element 602 is made of elastomer and also acts as the return mechanism.

[0033] In the embodiment of Figures 6 and 7, the end of the helical spring structure 616 that is on the side of the domed spring structure 610 is connected to the domed spring structure 610. In the embodiment of Figures 6 and 7, the same compression force acts on the helical spring structure 616 and domed spring structure 610. The spring coefficients of the helical spring structure 616 and domed spring structure 610 would be selected so that the spring-back force of the helical spring structure 616 is sufficient to bend the domed spring structure 610 in such a manner that the collapsing phase of the domed spring structure 310 is achieved during the free movement of the transmission element 602 close to the extreme switch position. The bottom end of the helical spring structure 616 may be supported to the terrace area of the frame part 604 or the casing 600 of the measuring device.

[0034] In the embodiment of Figure 8, the domed spring structure 610 and the helical spring structure 616 are dimensioned in such a manner that when the transmission element 602 is pushed, the domed spring structure 610 remains between the terrace area 612 and frame part 604, and the deformation of the domed spring structure 610 according to Figures 4A and 4B takes place.

[0035] In the embodiment shown in Figures 6, 7, and 8, the transmission element 604 may be fastened to the cotter structure 614 to restrict the movement of the transmission element 604.

[0036] With reference to the embodiment of Figures 9 and 10, the domed spring structure 910 may be connected from the centre support area 406 to the transmission element 902 on the concave side of the domed spring structure 910, and from the edge support area 404 to the casing 900 of the measuring device, whereby the convex side of the domed spring structure 910 forms an actuator for receiving the pushing force 908 provided by the user. The transmission element 902 is connected to an internal switch 906. The domed spring structure 910 may be directly in contact with the transmission element 902 or through a spring adapter 912. In Figure 9, the domed spring structure 910 is rest or close to being rest. In Figure 10, the domed spring structure 910 is close to the collapsing state.

[0037] The casing 900 may comprise embeddings 918 for the edge support area 404 of the domed spring structure 910. In one embodiment, the frame part 904 extends close to the outer edge of the casing 900, and the domed spring structure 910 is fastened to the frame part 904.

[0038] The material of the domed spring structure 910 may for instance be stainless steel with a good wear and corrosion resistance.

[0039] The embodiment shown in Figures 9 and 10 may also contain a helical spring structure 916 whose top end may be supported against the bottom edge of the spring adapter 912. The bottom edge of the helical spring structure 916 may be supported against the terrace area of the frame part 904. In the embodiment shown in Figures 9 and 10, the transmission element 902 may comprise a cotter structure 914.

[0040] The material of the helical spring structure 316, 616, 916 may be stainless steel, for instance.

[0041] A push-button module is presented as one aspect of the invention. The push-button module comprises a transmission element 302, 602, 902, a frame part 304, 604, 904, and a domed spring structure 310, 610, 910. In one embodiment, the push-button module comprises a helical spring structure 316, 616, 916. Between the frame part 304, 604, 904 and the casing 300, 600, 900, there may be sealing structures, such as O-rings, that are not shown in the figures.

[0042] The push-button module is typically a unit that is assembled separately from the measuring device 100 and can be mounted to the measuring device using an interference fit, screw fit and/or glue. The push-button module may be made of stainless steel, for instance.

[0043] Even though the invention has above been described with reference to the examples in the attached drawings, it is apparent that the invention is not limited thereto, but may be modified in many ways within the scope of the attached claims.

Claims

1. Transmission mechanism for installation in a personal electronic measuring device, **characterised in that** the transmission mechanism comprises:

   a transmission element (302, 602, 902) for transmitting a pushing force provided by a user to an internal switch of the personal electronic measuring device at the extreme switch position of the transmission element (302, 602, 902); and
   a domed spring structure (310, 610, 910) for directing a return force opposite to the pushing force provided by the user to the transmission element (302, 602, 902), the domed spring structure (310, 610, 910) comprising support areas (404, 406) and being operationally connected from one support area (404, 406) to the transmission element (302, 602, 902) and being operationally connected from another support area (404, 406) to a structure supporting the domed spring structure (310, 610, 910) and having a collapsing phase that occurs close to the extreme switch position and provides a sudden reduction in the return force which the user can sense and which thus verifies the change in the state of the internal switch.

2. A transmission mechanism as claimed in claim 1, **charac - terised in that** the transmission mechanism also comprises a return mechanism (616, 916) for returning the transmission element (602, 902) to its extreme rest position.

3. A transmission mechanism as claimed in claim 1, **charac - terised in that** the domed spring structure (910) is from one support area (406) connected to the transmission element (902) on the concave side of the domed spring structure (910), and in another support area (404) to the casing (900) of the personal electronic measuring device, whereby the convex side of the domed spring structure (910) forms an actuator for receiving the pushing force provided by the user.

4. A transmission mechanism as claimed in claim 1, **charac - terised in that** the domed spring structure (310, 610, 910) is arranged to generate an audio signal in the collapsing phase.

5. A transmission mechanism as claimed in claim 1, **charac - terised in that** the transmission mechanism is part of a push-button module installable in the personal electronic measuring device that comprises a frame part for establishing adaptation between the transmission element (302, 602, 902) and the personal measuring device and the frame part is arrangeable to the personal electronic measuring device.

6. A push-button module for installation in a personal electronic measuring device, **characterised in that** the push-button module comprises:

   a transmission element (302, 602, 902) for transmitting a pushing force provided by the user to an internal switch of a personal electronic measuring device at the extreme switch position of the transmission element (302, 602, 902);
   a frame part (304, 604, 904) for establishing adaptation between the transmission element (302, 602, 902) and the personal measuring device, which frame part (304, 604, 904) is arrangeable to the personal electronic measuring device; and
   a domed spring structure (310, 610, 910) for directing a return force opposite to the pushing force provided by the user to the transmission element (302, 602, 902), the domed spring structure (310, 610, 910) comprising support areas (404, 406) and being operationally connected from one support area (404, 406) to the transmission element (302, 602, 902) and being operationally connected from another support area (404, 406) to the frame part (304, 604, 904) and having a collapsing phase that occurs close to the extreme switch position and provides a sudden reduction in the return force which the user can sense and which thus verifies the change in the state of the internal switch.

7. A push-button module as claimed in claim 6, **character-** ised in that the push-button module also comprises a return mechanism (616, 916) for returning the transmission element (602, 902) to its extreme rest position.

8. A push-button module as claimed in claim 6, **character-** ised in that the domed spring structure (910) is from one support area (404) connected to the transmission element (902) on the concave side of the domed spring structure (910) and from another support area (406) to the casing (900) of the personal

electronic measuring device, whereby the convex side of the domed spring structure (910) forms an actuator for receiving the pushing force provided by the user.

9. A push-button module as claimed in claim 6, **character- ised in that** the domed spring structure (310, 610, 910) is arranged to generate an audio signal in the collapsing phase.

10. A personal electronic measuring device, **characterised in that** it comprises:

an internal switch (306, 606, 906) for controlling the personal electronic device;
a transmission element (302, 602, 902) for transmitting a pushing force provided by the user to the internal switch (306, 606, 906) of the personal electronic measuring device at the extreme switch position of the transmission element (302, 602, 902);
a frame part (304, 604, 904) for establishing adaptation between the transmission element (302, 602, 902) and the personal measuring device and the frame part (304, 604, 904) is arrangeable to the personal electronic measuring device; and
a domed spring structure (310, 610, 910) for directing a return force opposite to the pushing force provided by the user to the transmission element (302, 602, 902), the domed spring structure comprising (310, 610, 910) support areas (404, 406) and being operationally connected from one support area (404, 406) to the transmission element (302, 602, 902) and being operationally connected from another support area (404, 406) to the frame part (304, 604, 904), the domed spring structure (310, 610, 910) having a collapsing phase that occurs close to the extreme switch position and provides a sudden reduction in the return force which the user can sense and which thus verifies the change in the state of the internal switch (306, 606, 906).

11. A personal electronic measuring device as claimed in claim 10, **characterised in that** the personal electronic measuring device also comprises a return mechanism (616, 916) for returning the transmission element (602, 902) to its extreme rest position.

12. A personal electronic measuring device as claimed in claim 10, **characterised in that** the domed spring structure (910) is from one support area (404) connected to the transmission element (902) on the concave side of the domed spring structure (910), and from another support area (404) to the casing (900) of the personal electronic measuring device, whereby the convex side of the domed spring structure (910) forms an actuator for receiving the pushing force provided by the user.

13. A personal electronic measuring device as claimed in claim 10, **characterised in that** the domed spring structure (310, 610, 910) is arranged to generate an audio signal in the collapsing phase.

14. A personal electronic measuring device as claimed in claim 10, **characterised in that** the frame part (304, 604, 904) is the frame of a push-button module that is mounted in the casing of the personal electronic measuring device.

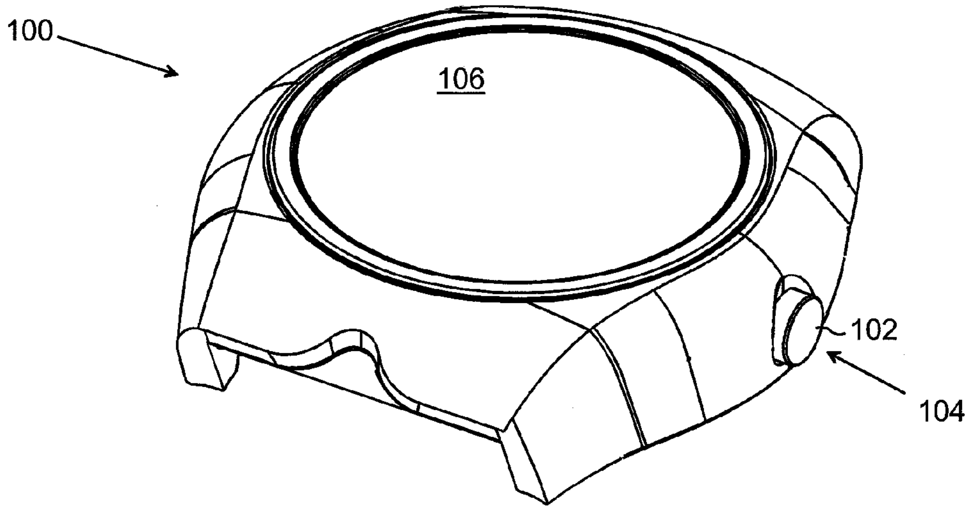

Fig. 1

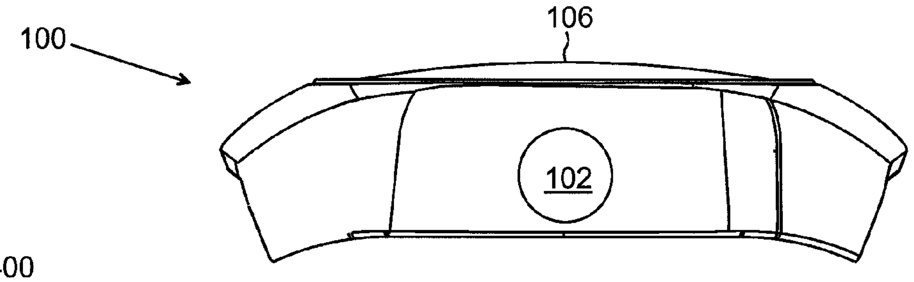

Fig. 2

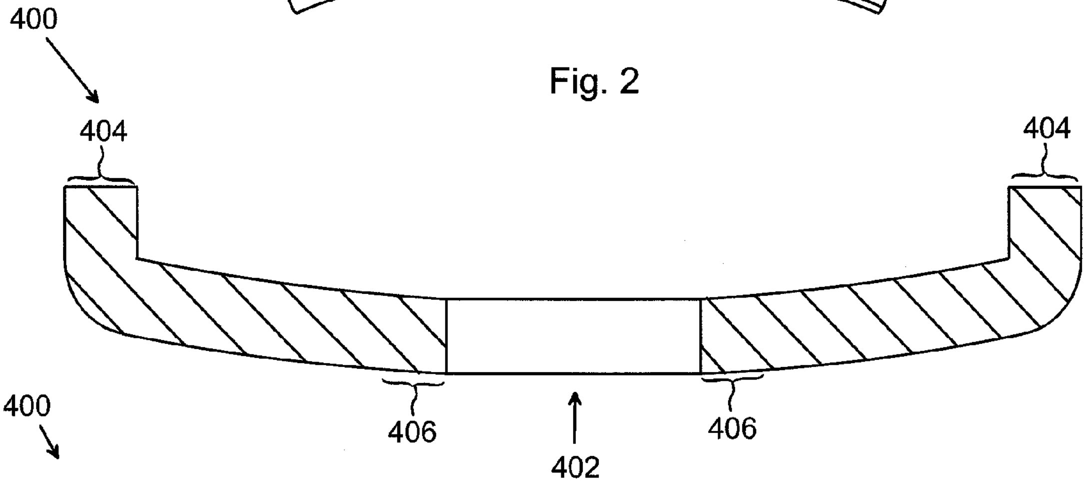

Fig. 4A

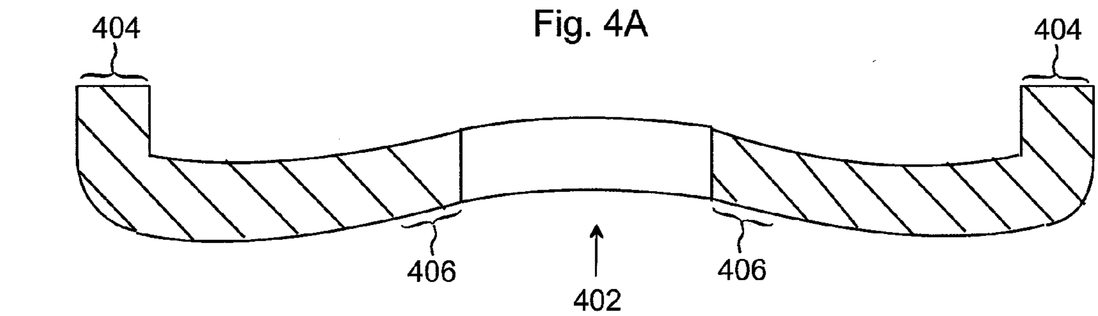

Fig. 4B

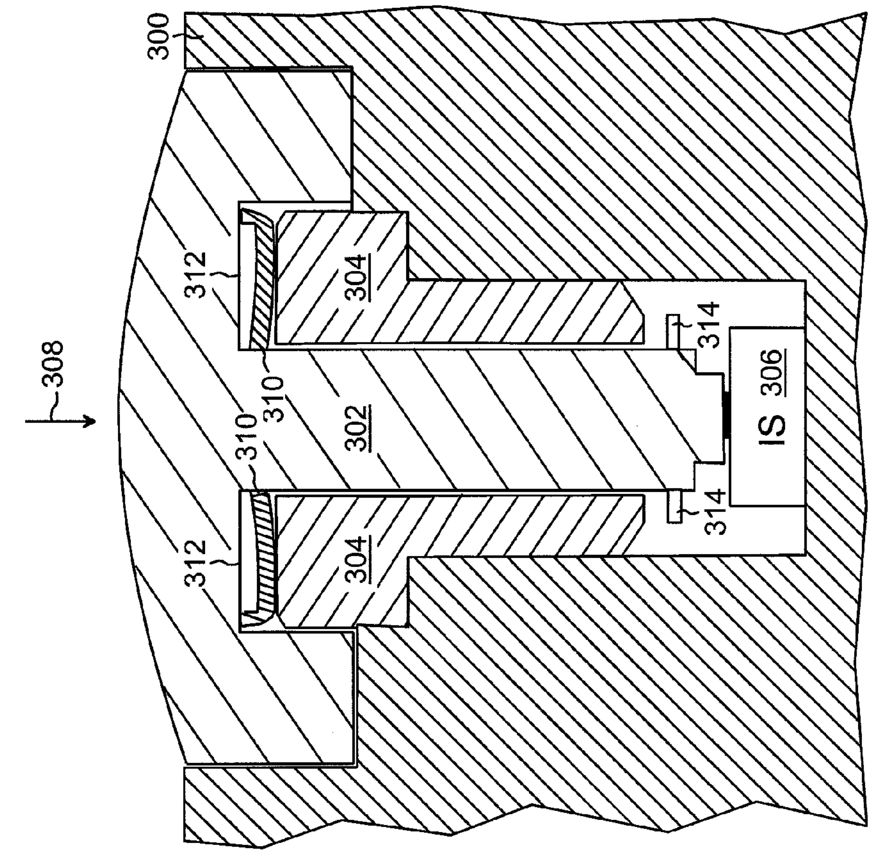
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Fig. 5

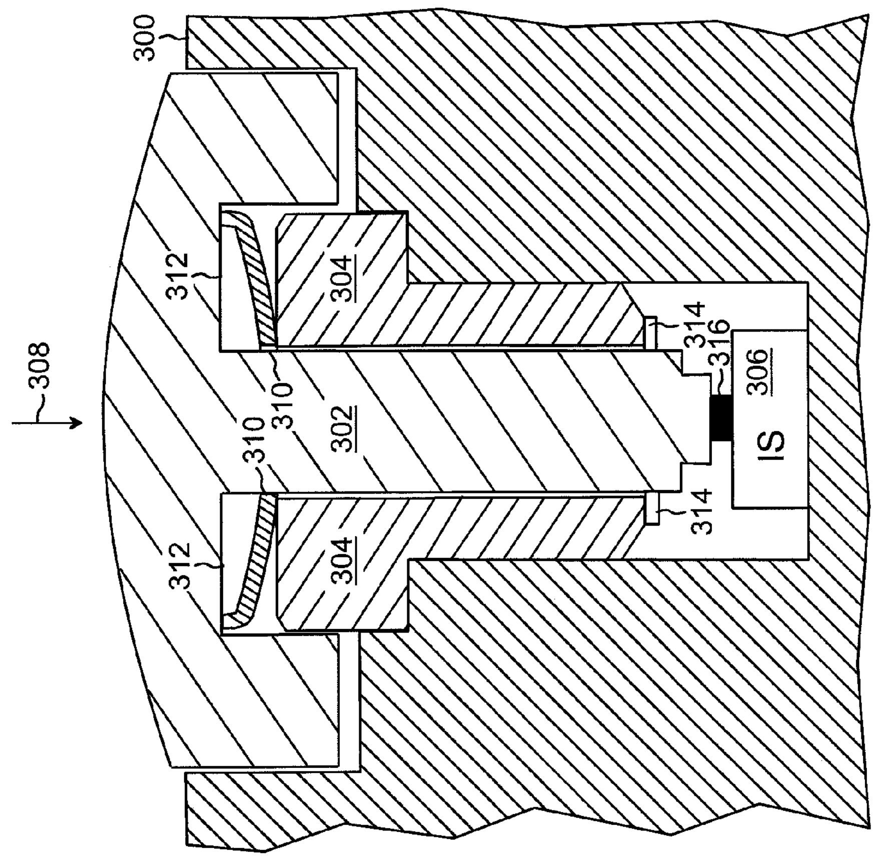
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Fig. 3

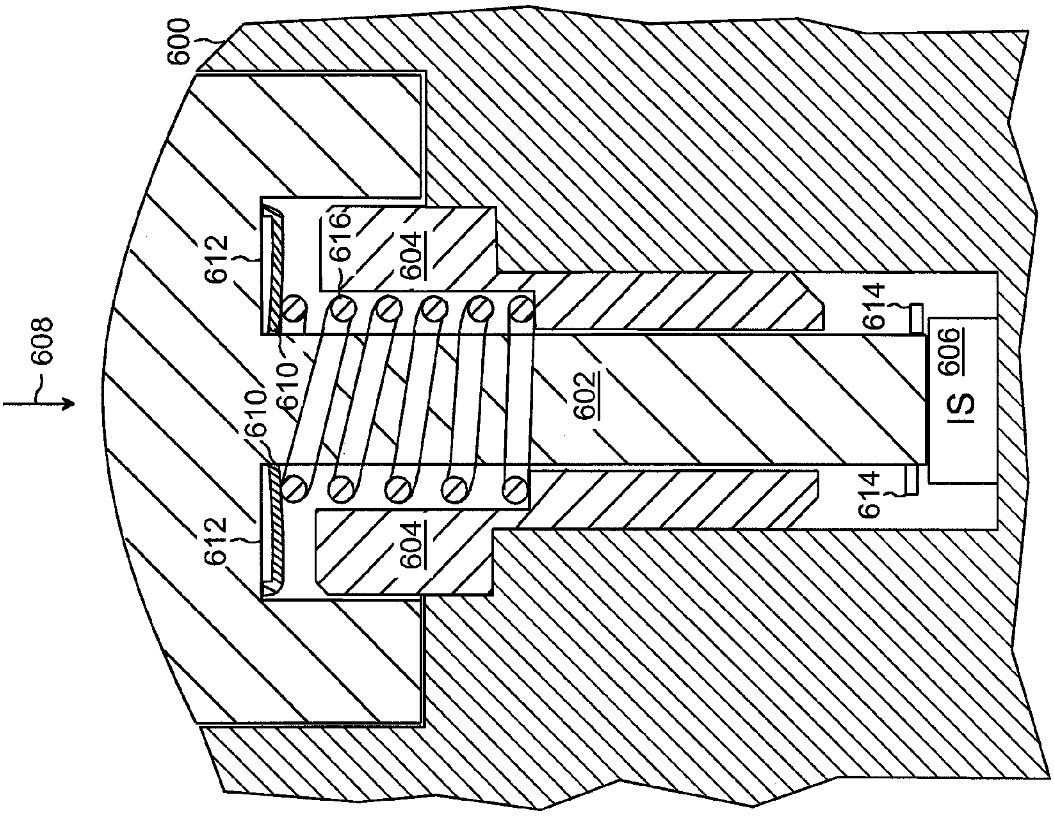
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Fig. 7

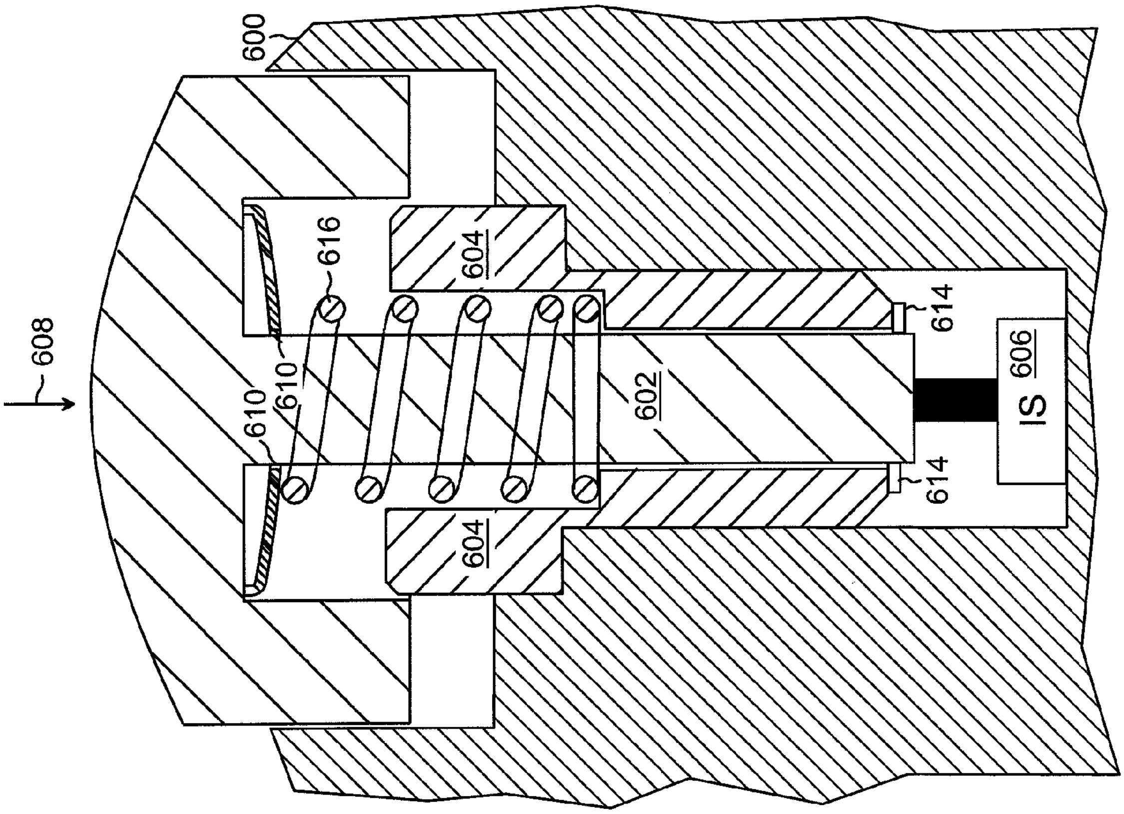
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Fig. 6

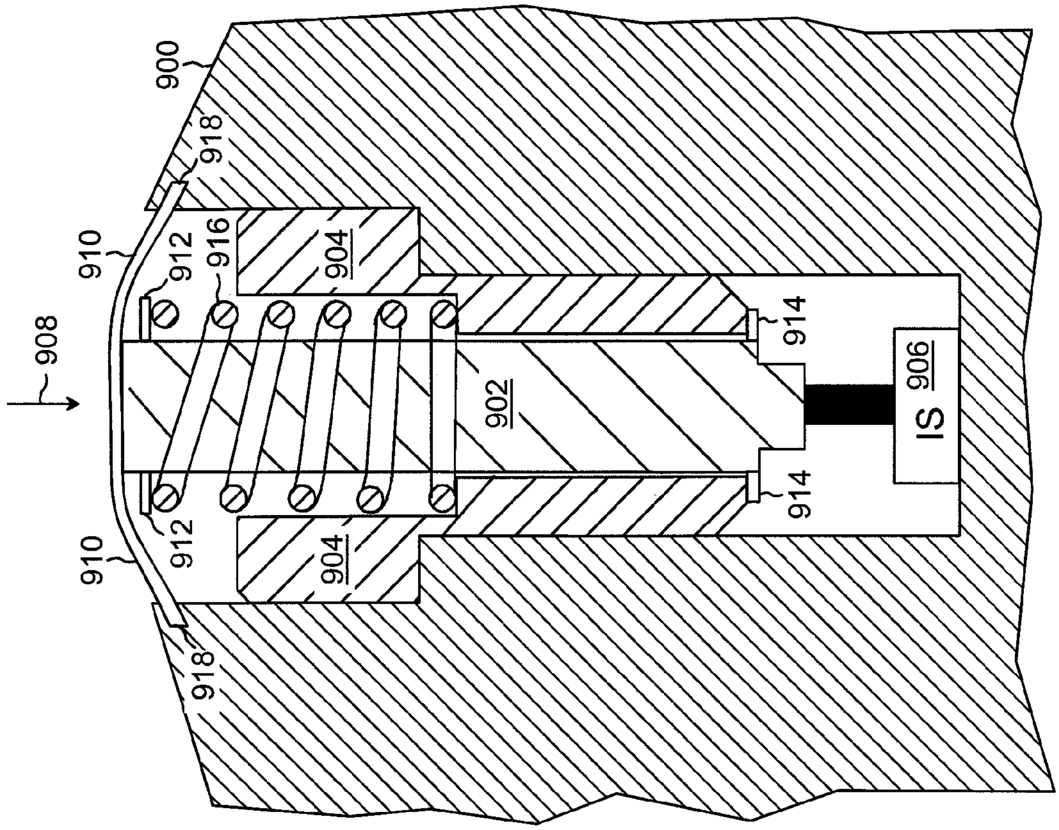
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Fig. 9

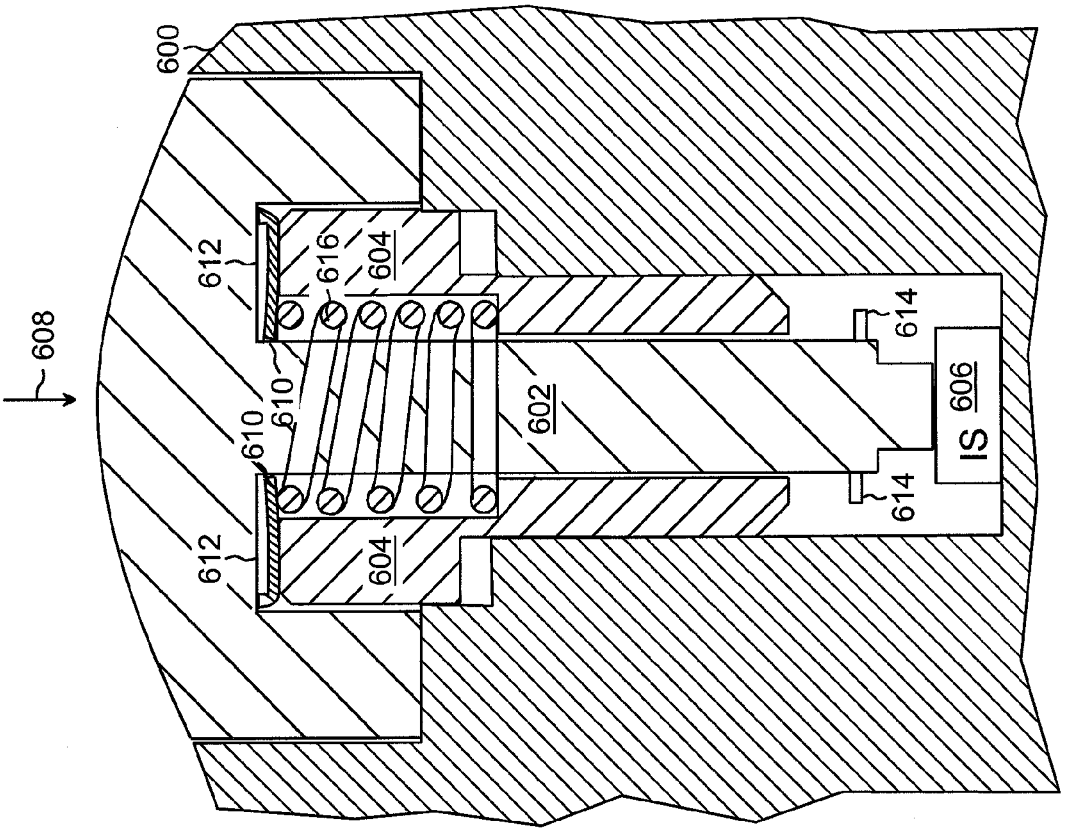
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Fig. 8

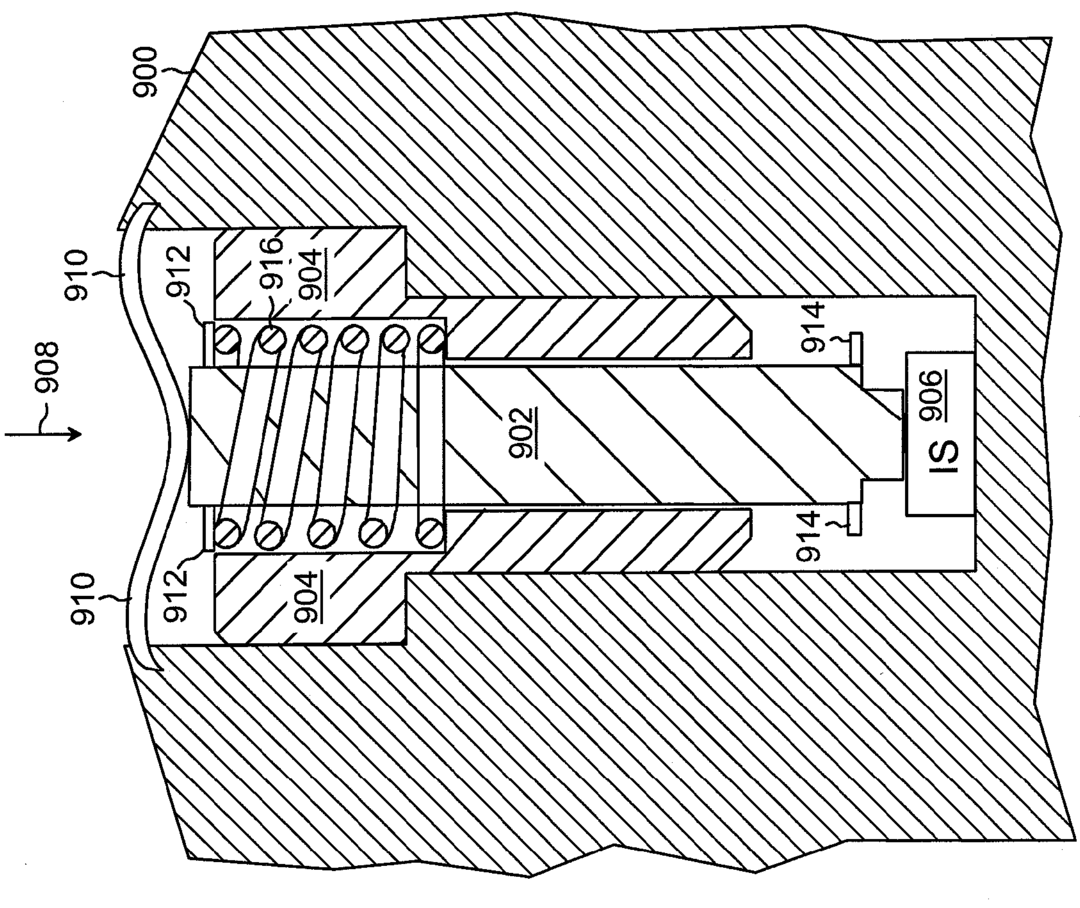

Fig. 10