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(71) Applicant: **MAKERSAN Makina Otomotiv Sanayi
Ticaret Ltd. Sti.**
41490 Kocaeli (TR)

(72) Inventor: **ERKOCAK, Levent**
41490 Kocaeli (TR)

(74) Representative: **Sevinç, Erkan**
Istanbul Patent A.S.
Plaza-33, Büyükdere Cad. No: 33/16
Sisli
34381 Istanbul (TR)

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(54) **A MULTI-AXIS CONTROL LEVER HAVING A SEALING FUNCTION**

(57) The present invention relates to a control lever (1) enabling a multi-axis control by being fitted on a control lever base (2) and comprising a front handle section (6) suitable to be hold by an user and capable of moving axially, a rear handle section (7) coupled with the front handle section (6); a plurality of switches (15) suitable to be controlled by the user and used as control elements, and at least one printed circuit board (18). Said control lever further comprises a front surface (30) arranged at the upper portion of the said front section (6) and a plurality of switch holes (31) provided on the front surface (30) and receiving a plurality of switches (15); at least one warning area (16), at the rear side of which there is located at least one light source (19); at least one printed circuit board housing (17a) in which at least one printed circuit board (18) is disposed, a wall (17b) extending into the control lever (1) integral with the said front surface (30), and a safety body (14) having a filler (20) which, when in use, at least partly covers its inner side in a sealing manner.

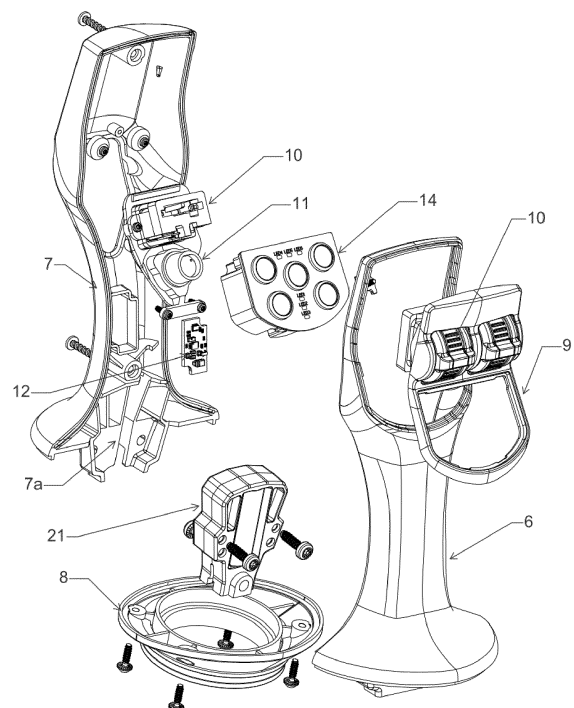


FIG: 2

Description

Relevant Technical Field of Invention

[0001] The present invention relates to an industrial control lever and more particularly to a control lever with improved sealing and durability which is suitable to be used in industry, agriculture, construction equipment, marine vessels, aviation and similar fields of operation.

Background Art

[0002] Currently, multi-axis control levers that are widely used in industrial field have become widespread. These multi-axis control levers are used to control complicated industrial machines operated under strict conditions. It is known to use the control levers, also called as joystick, with a plurality of control keys, switches and rollers. It is important that the switches and rollers which are provided on the control lever and serve as control elements are resistant to sealing problems especially at strict conditions. It is possible to provide said elements resistant to sealing problems in an individual manner, but due to the specific structure of the handle section of the control lever which is grabbed by the user; it may be problematic to appropriately insert them therein. It is not possible to fit a plurality of switches and rollers inside the control lever, with each one being sealed in itself.

[0003] Furthermore, the control lever is designed ergonomically, the outer surfaces of which are mainly consisted of inclined and curved surfaces. Therefore, manufactures apply one or more printed circuit boards (PCB) to the inner surface of the control lever so as to establish an interaction of the switches and rollers with the printed circuit boards. In cases where multiple switches and rollers are coupled to a printed circuit board, upper surface of the printed circuit board is left opened and thus the sealing problem cannot be solved. This may especially cause problem in non-cabin construction equipment and tractors. Moreover, the user does not know whether the switch is inactive in applications including contactless dead man's switches, and in applications where the dead man's switch is activated but not to be pressed for a certain period of time. The user cannot understand whether a controller area network (CAN) communication is in operation and there is a failure in the CAN line. To this end, another indicator is needed or failure detection should be performed by means of a diagnostic device.

[0004] It is quite hard to ensure that the printed circuit boards consisting of a number of elements are sealed at the inclined and curved inner surface of the control lever. Control levers are designed which are actuated by means of a capacitive sensor either mechanically or contactless, but when the user touches the respective switch, the signals from the control lever are taken into account whereas undesired lever movements and switch signals cannot be taken into account without touching the switch. Since it is necessary to continuously provide information to the

dead man's switch that detects presence of the user, once the control lever is pressed, the signals of the control lever are taken into account for a certain period of time depending on the client's demand, and then it is waited until it is pressed again. It is important for the user to understand whether the dead man's switch is activated or not.

[0005] In addition, the control levers consisting of a great number of switches and rollers require a substantial wire harness. For example, a control lever consisting of 6 switches, one dead man's control switch, and three rollers includes approximately 18 different cables. Being unwilling to handle such a high number of cables, the clients prefer to use a controller area network (CAA) that is used as a communication network. When a control lever with a controller area network communication system is used, a lower number of cables are sufficient but these cables should reach to the relevant printed circuit board, which is of utmost importance for the sealing of the relevant printed circuit board. The user demands to have a right and a left joystick control lever in double-hand applications. The right and left joystick control levers are designed 15 to 25 degrees oriented towards inside, in order to ensure that they are ergonomic. This requires production of two distinct joysticks, resulting in additional molding and stocking cost. If the control lever is also manufactured inclined, then 3 control lever assembly are created. When the control lever is sold alone, it is not possible for the client to find a suitable base.

Objects of the Invention

[0006] Principal object of the present invention is to provide a control lever suitable for use especially in open field applications in a reliable manner, which has improved sealing properties.

[0007] Another object of the present invention is to provide a control lever wherein the user may easily observe that the switch is activated by means of a warning light of a presence-absence switch provided on the front panel.

[0008] Another object of the present invention is to provide a control lever wherein it is easy to understand whether the controller area network (CAN) communication system is in operation or not, by means of a suitable warning light.

[0009] Another object of the present invention is to provide a symmetric right and left control lever assembly by arranging the control lever at a certain angle with respect to the base on which it is fitted.

Summary of the Invention

[0010] The present invention relates to a control lever enabling a multi-axis control by being fitted on a control lever base and comprising a front handle section suitable to be hold by an user and capable of moving axially, a rear handle section coupled with the front handle section;

a plurality of switches suitable to be controlled by the user and used as control elements, and at least one printed circuit board. Said control lever further comprises a front surface arranged at the upper portion of the said front section and a plurality of switch holes provided on the front surface and receiving a plurality of switches; at least one warning area for informing the user, at the rear side of which there is located at least one light source; at least one printed circuit board housing in which at least one printed circuit board is disposed, a wall extending into the control lever integral with the said front surface, and a safety body containing a filler which, when in use, at least partly covers its inner side in a sealing manner.

Brief Description of the Figures

[0011] The figures of the subject matter control lever, whose brief explanations are herewith provided, are solely intended for providing a better understanding of the present invention and are as such not intended to define the scope of protection or the context in which said scope is to be interpreted in the absence of the description.

Figure 1 is a perspective view of the control lever and the base on which this control arm rests according to the present invention.

Figure 2 is an exploded view of the control lever according to the present invention.

Figure 3 is another exploded view of the control lever according to the present invention.

Fig. 4a is an exemplary perspective view of the use of the control device according to the present invention in a left-handed inclination.

Figure 4b is a perspective view of an example of the symmetrical use of the control device according to the present invention.

Figure 5a is a perspective view partially cut away of the use of the control device according to the present invention in a left side inclined use.

Fig. 5b is a perspective view, partially cut away, of a symmetrical embodiment of the control device according to the present invention.

Fig. 5c is a perspective view of the control device according to the present invention, taken in partial cross-section, for use in a rightward inclined manner.

FIG. 6a is an exploded view of the safety body and the elements therein according to the present invention.

Figure 6b is another view of Figure 6a from a different angle.

Figure 7 is a section taken along the longitudinal axis of the control lever according to the present invention.

Fig. 8 is a cross-sectional view of the safety body according to the present invention.

Detailed Description of the Invention

[0012] The invention will now be described in detail with reference to the accompanying drawings, wherein reference numerals assigned to the parts therein are listed as follows;

1. Control lever
2. Control lever base
3. Control device
5. Cable assembly
6. Front handle section
- 6a. Front housing
7. Rear handle section
- 7a. Rear housing
8. Lower portion
9. Frame
10. Roller
11. Button
12. Dead man's switch
14. Safety body
15. Switch
16. Warning area
- 17a. Printed circuit board housing
- 17b. Wall
18. Printed circuit board
19. Light source
20. Filler
21. Connecting element
- 21a. Symmetric hole
22. Inclined connecting element
- 22a. Asymmetric hole
23. Connection rod
25. Switch hole
26. Bellows
30. Front surface
31. Switch hole
32. Connection hole

[0013] The control lever (1) according to the present invention is fitted on a control lever base (2) and has a conventional joystick form, comprising a control lever front handle section (6) suitable to be grabbed by the user, a rear handle section (7) coupled with the front handle section (6), one or more rollers (10) and switches (15) suitable to be placed preferably on the upper section of the front handle section (6), a safety body (14) in which said switches (15) and a printed circuit board (18) are arranged, a dead man's switch (12) for detecting whether the user is in active position, a connecting element (21) that allows for a symmetric connection, and a lower portion (8).

[0014] The safety body (14) preferably comprises a flat safety body front surface (30) in order to allow the printed circuit board (18) and switches (15) to be resistant against any impacts from outer environment and to operate leak-free under strict working conditions, and it comprises a plurality of switch holes (25) on the front surface (30)

which are preferably formed annularly. Each switch hole (25) has switches (15) suitable for contactless use, and it is possible to change the number of switches (15) and holes, and also the geometry of the said hole may change based on the shape of the switch. Referring to figure 6, on the flat front surface (30) of the safety body (14), there are 5 switches and again on the front surface (30), there is also a warning area (16) for providing information to the user. The warning area (16) may be disposed on the front surface (30) at different locations, and it is preferably consisted of a plurality of warning lights, arranged in an array, which are used to provide information to the user. On the warning area (16), there is also a section indicating the status of the dead man's switch (12). Again referring to figures 6a and 6b, a surface of the safety body (14) is closed whereas the opposite surface may be opened, and after the switches (15) and the printed circuit board (18) are inserted therein, the inner section is, at least partly, filled with a filler material (20). Said filler (20) at least covers the printed circuit board (18). The control lever base (2) is also enclosed by a bellows (26) made of an elastic element.

[0015] Said safety body (14) is particularly formed to be closed at three sides, and for such purposes, there is a wall (17b) enclosing it and a front surface (30) integral with the wall (17b). A printed circuit board (18) is inserted into a respective printed circuit board housing (17a) such that it is arranged inside the walls and immediately behind the switches. Preferably one printed circuit board (18) may be inserted, but said number may be increased. Thus, a control lever with improved sealing properties is achieved by relocating the printed circuit board (18) and switches (15) having vital importance for sealing into a safety body (14) which is robust and leak-free.

[0016] The multiple analog cable assembly (5) coming from the control lever (1) may be introduced into the data line of the client, if he demands an analog system. If a controller area network bus communication system is used, then there are two options: one is to manufacture an analog control lever (1) and to input multiple analog cable groups into the control lever base (2) of the CAN (controller area network) communication system and provide the user with CAN communication data output. The client may obtain both the data of the control lever (1) and the control lever base (2) through a single CAN (controller area network) communication line. Another option is that the control lever (1) is produced to include a CAN communication system and the cable assembly (5) that may be associated with the CAN communication is directly transmitted to the CAN communication line of the client. The CAN communication output is also transmitted to the client's line through the control lever base (2). Furthermore, the printed circuit board (18) is especially selected from a printed circuit board which will interact with the controller area network communication system.

[0017] With reference to figure 2, the control lever (1) is mainly consisted of a front section (6), a rear section

(7), a lower portion (8) and a front panel frame (9). At the upper section of the control lever, there are two rollers (10) disposed in a horizontal manner as well as another roller (10) located at the inner section. At the rear section (7), there is a button (11), at the bottom of which there is a dead man's switch (12). This switch (12), by means of which the operator checks whether it is operated or not, is disposed in the control lever (1).

[0018] The safety body (14) suitable to be arranged at the upper section of the control lever (1) and comprising a switch group of 2-10 switches, preferably 3-6 switches, more preferably 5 switches is made of a transparent material at least partly permeable to light. A plurality of light sources (19), preferably LEDs, are present on the PCB, the printed circuit board (18) arranged in the safety body (14) assembly, and it is informed through the warning area (16) which is disposed next to it.

[0019] With reference to figure 6a, the inner volume of the safety body (14) has a printed circuit board housing (17a) receiving a printed circuit board (18), with a wall (17b) being provided delimiting its periphery. After the said printed circuit board (18) is inserted into the safety body (14), it is completely filled with resin filler (20) so that the relevant printed circuit board (18) and all other elements therein are covered and fully sealed.

[0020] Connection of the control lever (1) with the control lever base (2) may be varied as desired by the user. It may be symmetric to the longitudinal axis of the control lever (1) or it may be inclined to the right or left side. There is a symmetric connecting element (21) under the control lever (1), which may in turn be symmetrically connected with the connection rod (23) erected from the control base (2) in the form of a rod. In this way, it is possible to provide the client with a multi-axis control device (3).

With reference to figure 4a, if the client demands a left-side inclined control device (3), the inclined connecting element (22) formed in an appropriate manner is fitted to the control lever base so that the control device (3) may be angularly inclined with respect to its longitudinal axis. If the said inclined connecting element (22) is fitted in a reverse direction as compared to its previous position, then a right-side inclined control lever (1) is formed.

[0021] Figure 4a shows the position of the control lever (1) after the inclined connecting element (22) is fitted whereas figure 4b shows attachment of a substantially symmetric connecting element (21) to the connection rod (23) and its position taken thereupon. The inclined connecting element (22) and the connecting element (21) are preferably arranged between the control lever front section (6) and the control lever rear section (7) and inside the lower portion (8), and it receives the connection rod (23) so as to restrict movement of the control lever to some extent, as seen in figures 5a-5c. Referring to figures 2 and 3, the inclined connecting element (22) and the connecting element (21) are disposed in a rear hole (7a) in the rear handle section (7) and in a front hole (6a) in the front section (6). The upper section of the connecting element (21) which is preferably formed by attach-

ment of the two elements by means of suitable fastening members has an extending rectangular prism form. Said inclined connecting element (22) is formed through superimposition of two similar parts, and when in use, it comprises an asymmetric hole (22a) such that it is close to one of the lateral walls when inserted into the connection rod (23). The inclined connecting element (22) may be bilaterally mounted in the front hole (6a) and the rear hole (7a) such that it changes the angle of the control lever (1) with respect to the control base (2). Figures 5a and 5c show the position of the control lever after the inclined connecting element (22) is inserted into the hole at different directions. With the inclined connecting element (22) which allows achieving a right-side inclined or left-side inclined control lever, the control lever is designed ergonomically and with an inclination of 15 to 25°.

Claims

1. A control lever (1) enabling a multi-axis control by being fitted on a control lever base (2), comprising:

a front handle section (6) suitable to be hold by an user and capable of moving axially, a rear handle section (7) coupled with the front handle section (6);

a plurality of switches (15) suitable to be controlled by the user and used as control elements, and

at least one printed circuit board (18), **characterized by** comprising:

a front surface (30) arranged at the upper portion of the said front section (6) and a plurality of switch holes (31) provided on the front surface (30) and receiving a plurality of switches (15);

at least one warning area (16) for informing the user, at the rear side of which there is located at least one light source (19);

at least one printed circuit board housing (17a) in which at least one printed circuit board (18) is disposed, a wall (17b) extending into the control lever (1) integral with the said front surface (30), and a safety body (14) having a filler (20) which, when in use, at least partly covers its inner side in a sealing manner.

2. A control lever (1) according to claim 1, **characterized by** comprising a dead man's switch (12) used for controlling presence of an operator.
3. A control lever (1) according to claim 2, **characterized by** comprising a section on the said warning area (16) indicating the status of the dead man's switch (12).

4. A control lever (1) according to claim 1, **characterized by** comprising at least one roller (10) disposed at the upper portion of the front handle section.

5. A control lever (1) according to claim 1, **characterized by** comprising a front hole (6a) and a rear hole (7a), respectively, on that part of the said front handle section (6) and the rear handle section (7) that is close to the control base (2), and at least one connecting element (21, 22) disposed between the said front hole (6a) and the rear hole (7a).

6. A control lever (1) according to claim 5, **characterized in that** said connecting element (21) comprises a symmetric hole (21a) for a connection rod (23) to be engaged therein, and is consisted of two similar pieces that will allow it be symmetrically associated.

7. A control lever (1) according to claim 5, **characterized by** comprising an inclined connecting element (22) wherein said connecting element (21) has an asymmetric hole (22a) which allows connection of the control lever (1) with the control base (2) in an inclined manner to the extent of a certain angle.

8. A control lever (1) according to claim 5, **characterized in that** said inclined connecting element (22) is formed through superimposition of two similar parts, and when in use, it comprises an asymmetric hole (22a) such that it is close to one of the lateral walls when inserted into the connection rod (23).

9. A control lever (1) according to claim 5, **characterized in that** said inclined connecting element (22) may be bilaterally mounted between the front hole (6a) and the rear hole (7a) such that it changes the angle of the control lever (1) with respect to the control base (2).

10. A control lever (1) according to any one of the preceding claims, **characterized in that** said printed circuit board (18) is a printed circuit board which interacts with a controller area network communication system.

11. A control lever (1) according to claim 1, **characterized in that** said safety body (14) is made of a material which is at least partly permeable to light.

12. A control lever (1) according to claim 1, **characterized by** comprising a plurality of light sources (19) for providing information to the user, which are arranged on the said printed circuit board (18).

13. A control lever (1) according to claim 1, **characterized in that** said filler (20) covers at least the printed circuit board (18).

14. A control device (3) comprising a control lever (1) according to any one of the preceding claims.

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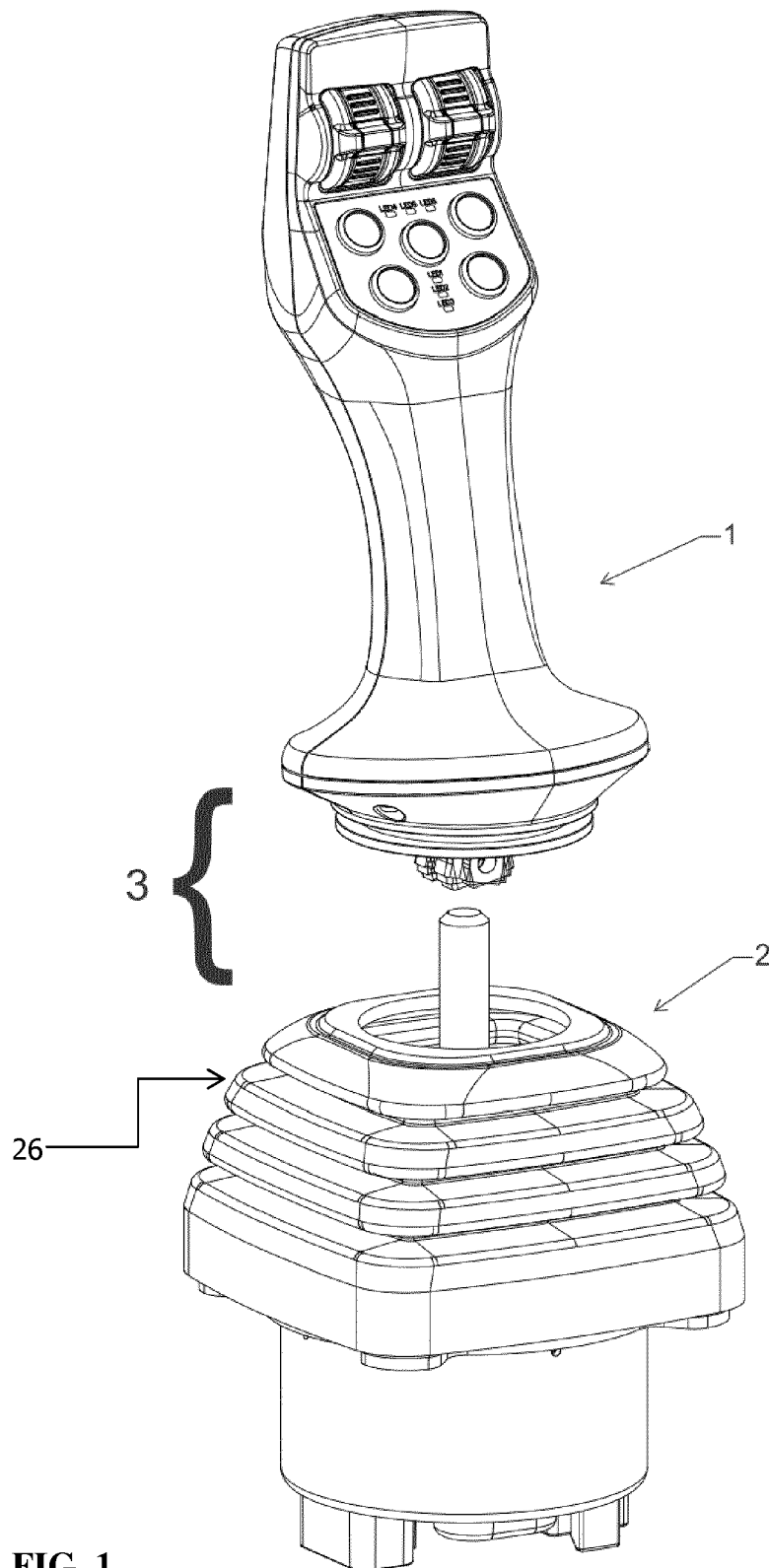


FIG. 1

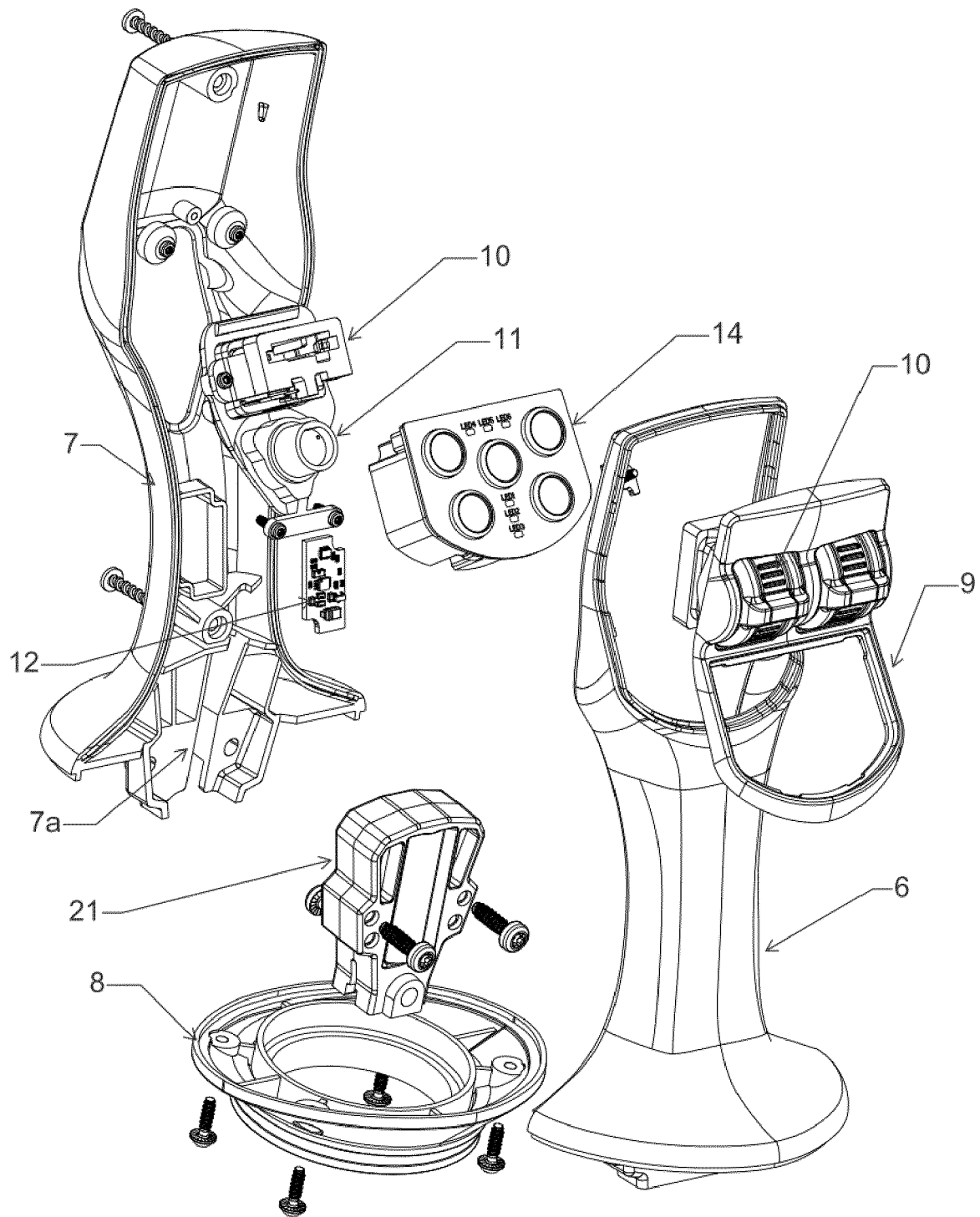


FIG: 2

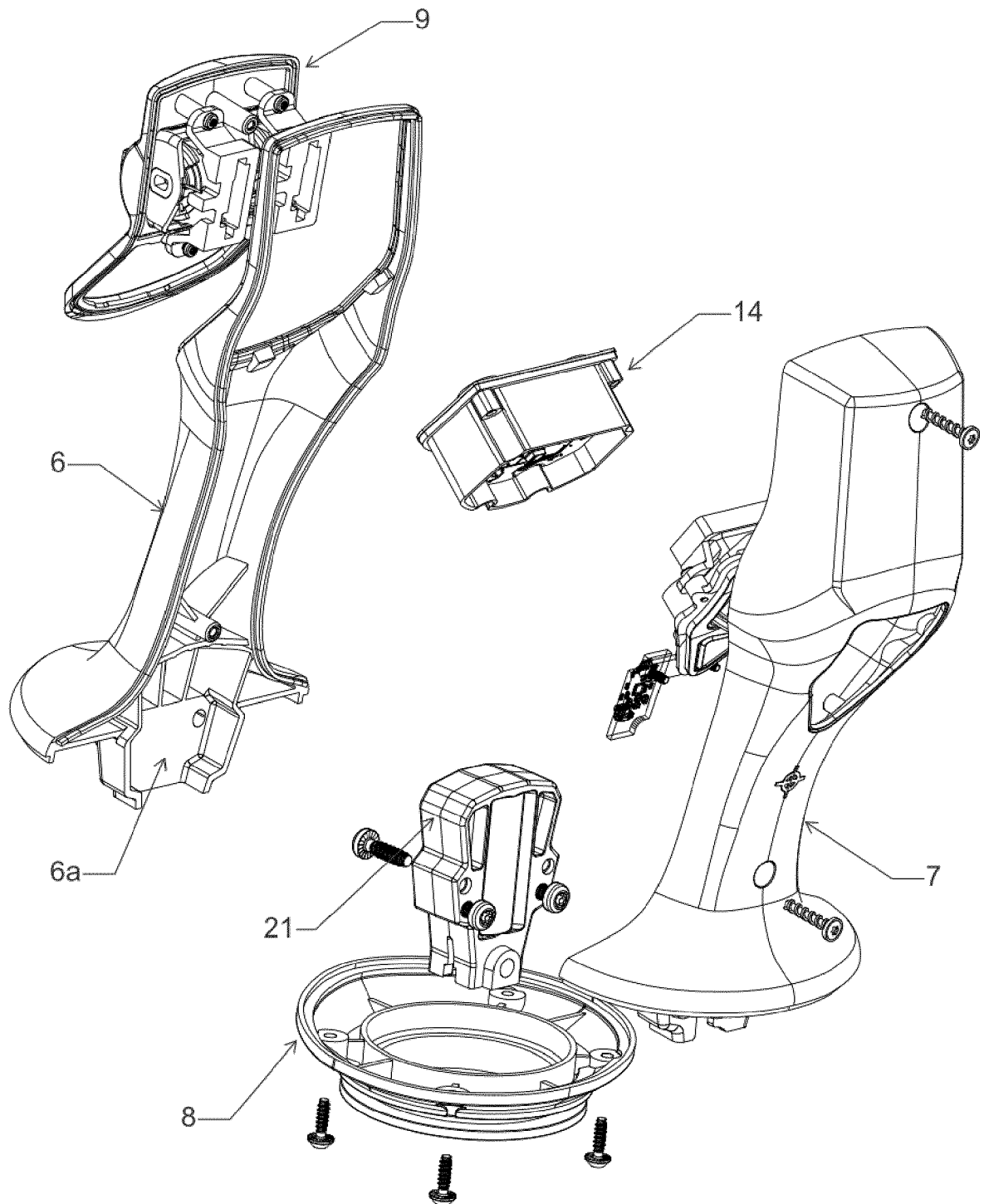


FIG. 3

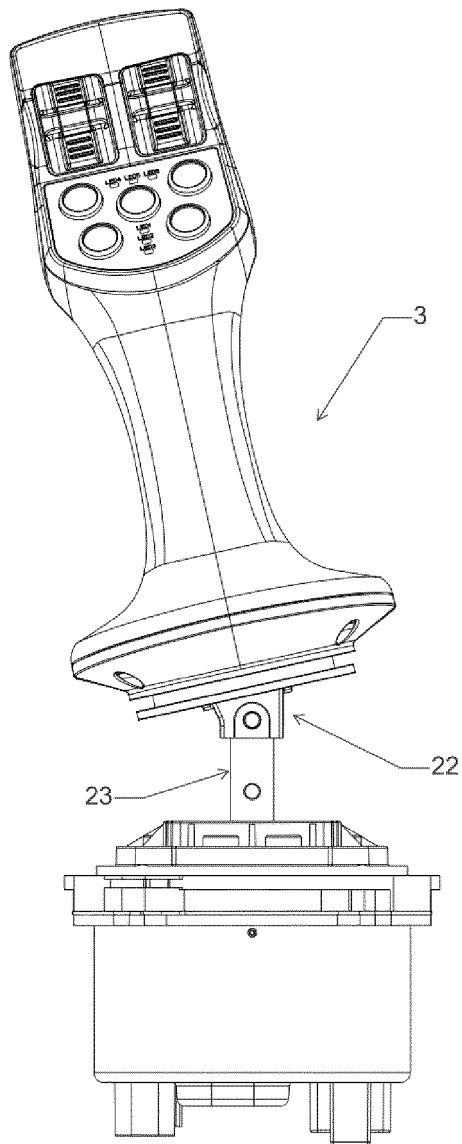


FIG. 4a

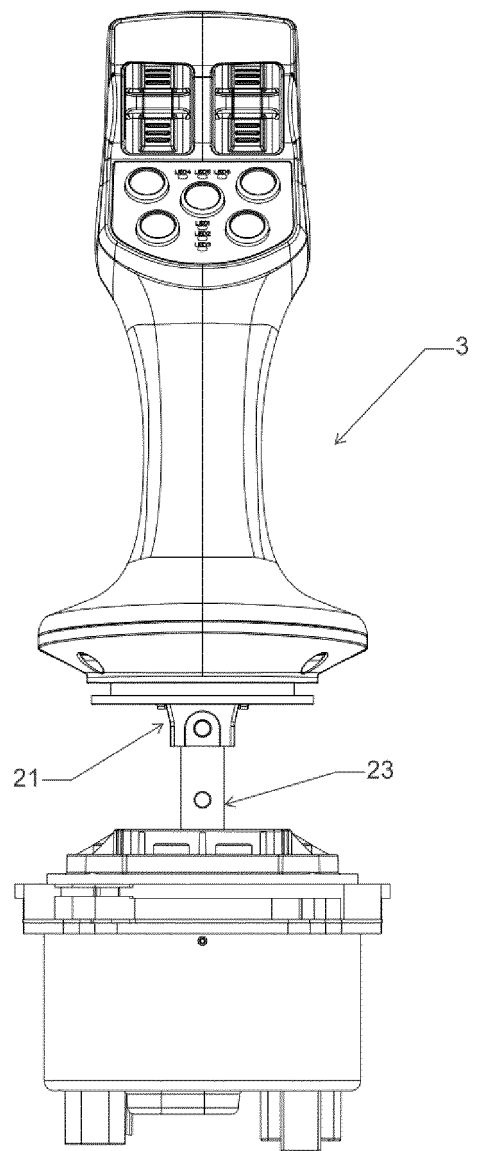


FIG. 4b

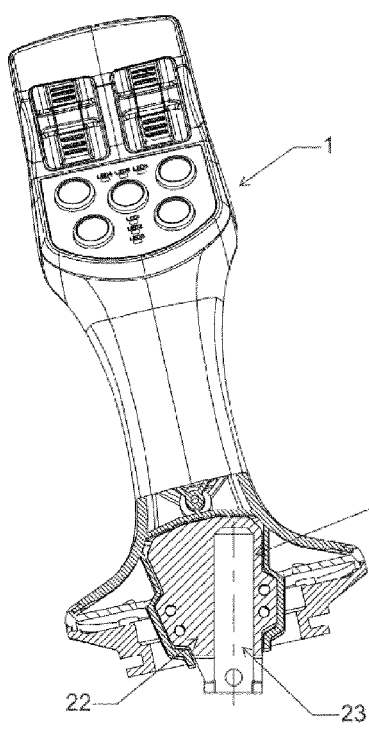


FIG. 5a

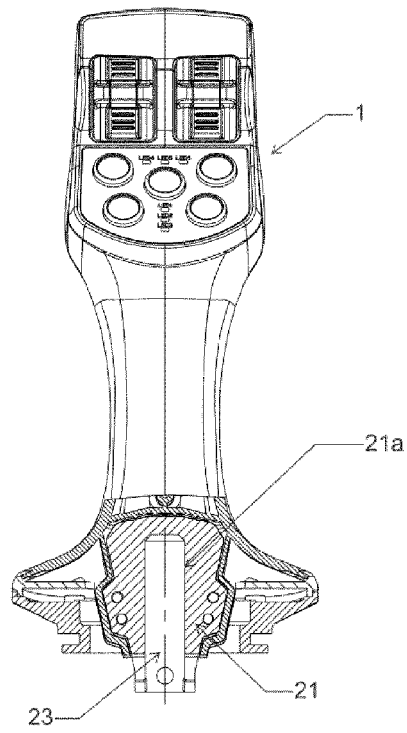


FIG. 5b

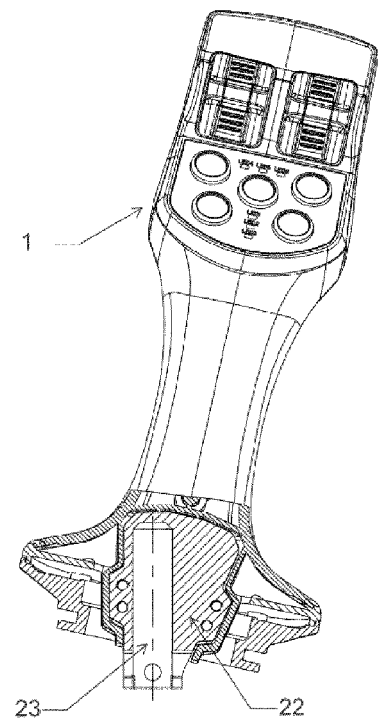


FIG. 5c

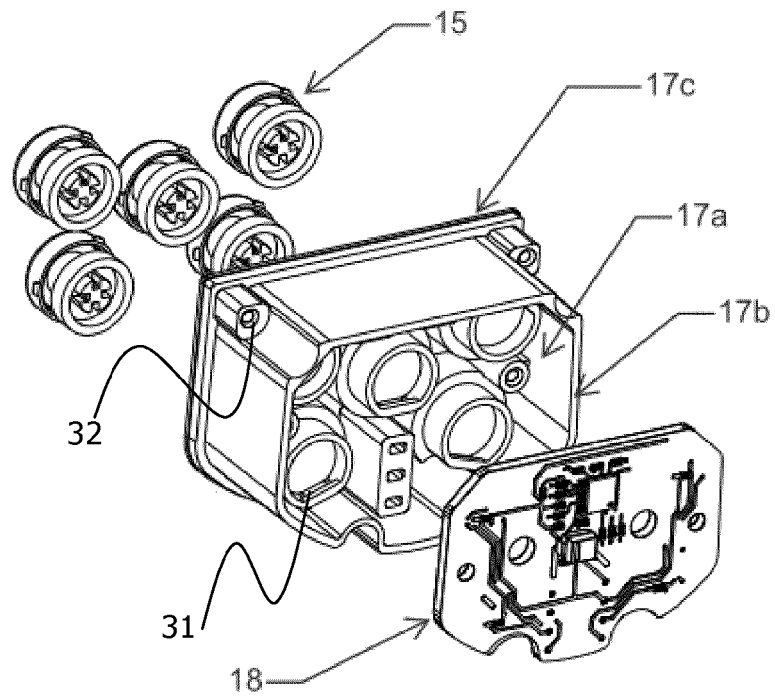


FIG. 6a

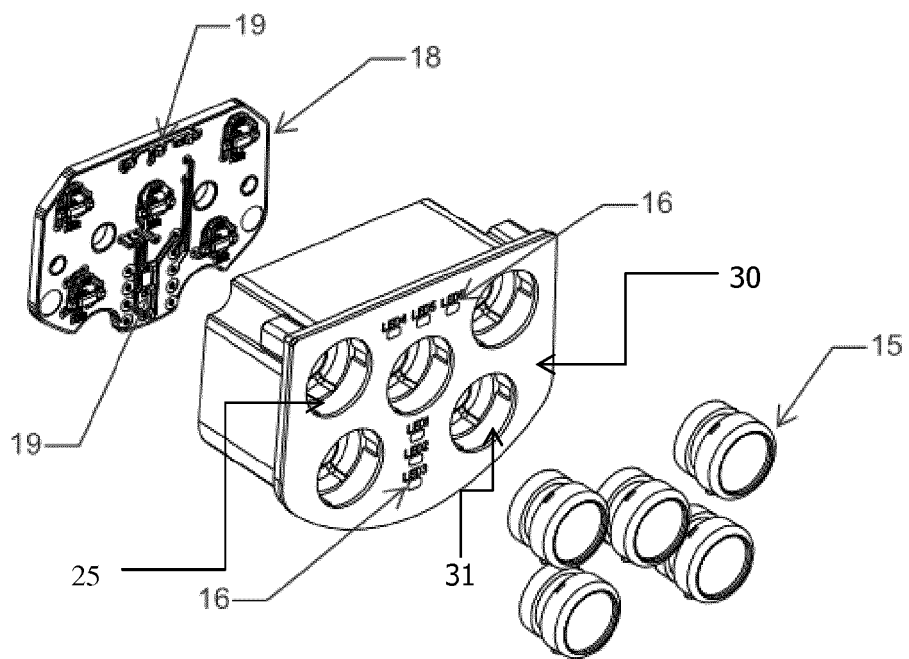


FIG. 6b

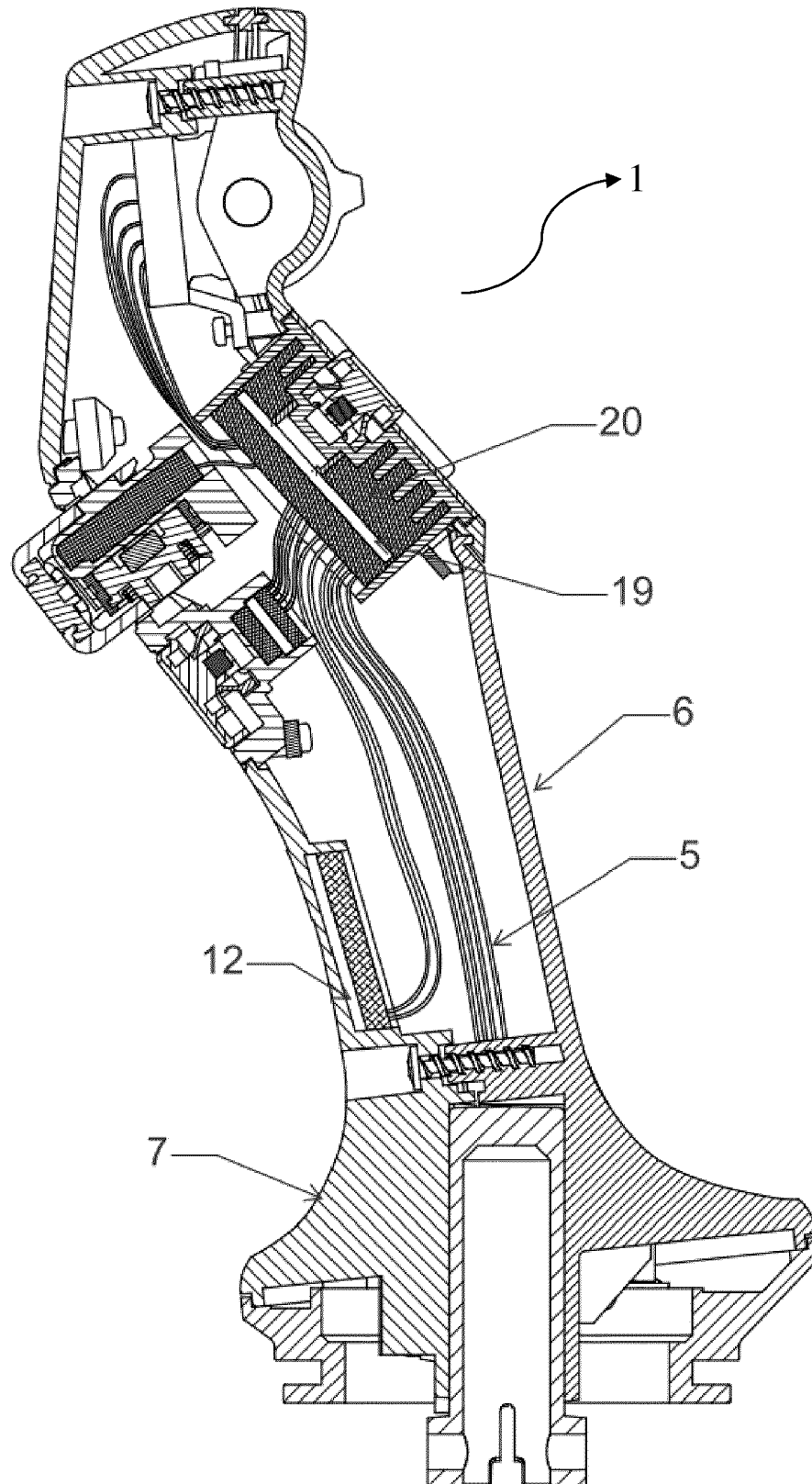


FIG. 7

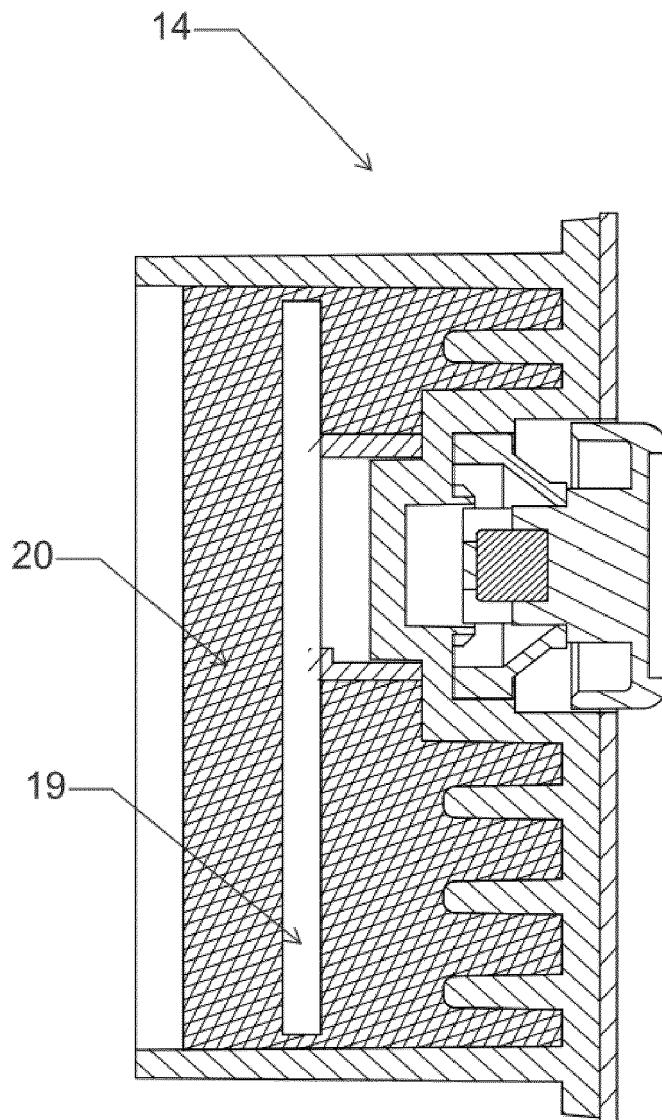


FIG. 8