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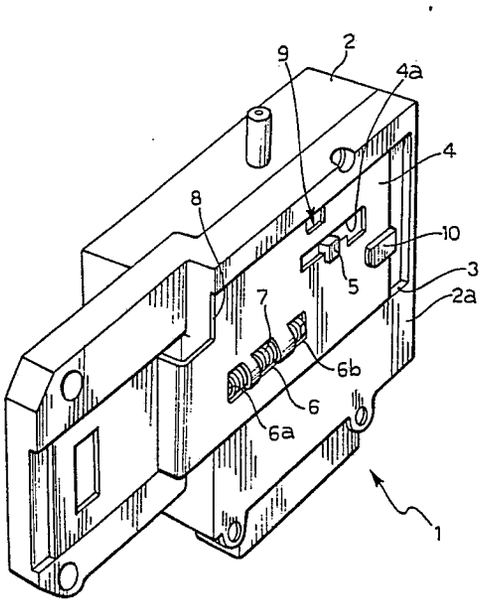
(54) A door lock for a washing machine or drier.

(57) A door lock for a washing machine or drier includes a support casing (2) which is adapted to be fixed to the machine. The casing (2) contains a control and timing device with a resistive heater element, an electrical switch with a bistable resilient blade operated by a locking slide (4) which is movable relative to the casing (2), and a sensor for sensing the water level in the washing chamber to keep the door closed when the level exceeds a predetermined value.

FIG. 1



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Description

A door lock for a washing machine or drier

The present invention relates to a door lock for a washing machine or drier.

In particular, it concerns a lock comprising a support casing which is adapted to be fixed to the machine and has at least a first and a second terminal for connection to the electrical supply system when the machine is switched on, and a third terminal for connection to electrical devices of the machine to enable their supply; a locking slide which is movable relative to the casing and is adapted, in an operative position, to keep the door closed; a control and timing device housed in the casing and including a resistive heating element and a bimetal device which can be heated by the resistive element and deformed as a result of the supply of voltage to the first and second terminals and, in the deformed condition, can connect the third terminal to one of the first two and hold a stop peg in engagement with the locking slide to keep the latter in the operative position; a sensor for detecting the water level in the washing chamber, supported by the casing and having a movable stop member which, in use, can assume a rest position when the water in the washing chamber is below a predetermined level, and an operative position, in which it is adapted to lock the locking slide in the operative position, when the water in the washing chamber exceeds the predetermined level; and an electrical switch supported by the casing and having a pair of terminals for connection to electrical devices of the machine to control their supply, the switch being operated by the locking slide when the latter is in the operative position.

A lock of the type specified above is described in the English application GB-A-8525244 filed by the Applicant, to which reference is made. These devices are quite bulky and somewhat complex to produce since both the safety liquid-level sensor and the electrical switch must be fitted to the support casing which has already been assembled.

The object of the present invention is to provide a lock which does not have the above disadvantages and which, as well as being compact, is cheap and easy to produce.

According to the invention, this object is achieved by virtue of the fact that the sensor and the electrical switch are housed within the casing.

Thus, as well as being of reduced bulk, the lock has improved reliability since all its components are protected by the casing.

The electrical switch is preferably of the bistable resilient-blade type and includes a switching member constituted by a lever having a first end articulated to the casing and a second end in abutment with the resilient blade, the lever also having an operating portion for cooperating with a cam portion of the locking slide to close the switch when the slide slides towards its operative position.

The instant at which the electrical switch opens/closes upon operation of the slider can thus be determined precisely by the appropriate selection of the position of the cam portion on the locking slide.

A lock according to the invention is also more manageable as regards the statistical controls of the production process, to the benefit of its reliability.

Further characteristics and advantages of the present invention will become clear from the detailed description which follows with reference to the appended drawings, provided by way of non-limiting example, in which:

Figure 1 is a perspective view of a lock according to the invention.

Figure 2 is a perspective view of the lock of Figure 1 from a different angle, without its cover,

Figure 3 is a plan view taken on the arrow III of Figure 2,

Figure 4 is a side view taken on the arrow IV of Figure 2.

Figure 5 is a schematic view taken on the arrow V of Figure 2 and shows a detail of the lock in a rest configuration,

Figure 6 is a view similar to Figure 5 and shows a detail of the device in an operative position,

Figure 7 is a view similar to Figure 5 and shows a variant of a component of the lock in a rest configuration,

Figure 8 is a view of the component of Figure 7 in an operative configuration,

Figure 9 is a schematic view taken on the arrow IX of Figure 2 and shows a component of the lock in a rest configuration,

Figure 10 is a view similar to Figure 9 and shows the component in an operative configuration,

Figure 11 is a view similar to Figure 9 and shows a different embodiment of the component,

Figure 12 is a view similar to Figure 11 and shows the component in an operative configuration,

Figure 13 is a detail of Figure 11 on an enlarged scale, and

Figure 14 is a view taken on the arrow XIV of Figure 11.

With reference to Figure 1, a lock, generally indicated 1, includes a support casing 2 which is adapted to be fixed to the structure of a washing machine (not illustrated). A recessed guide 3 is formed in correspondence with a cover element 2a of the casing 2 and a locking slide 4 mounted for sliding therein is adapted, in an operative position, to keep the door of the washing machine closed. The cover 2a has an L-shaped guide peg 5 in correspondence with the guide 3 for acting as a guide for the slide 4 in cooperation with a longitudinal slot 4a therein.

The slide 4 also has a slot 6 with two ends 6a and 6b for cooperating with a helical spring 7 which biases the slide into a rest position (corresponding to the position illustrated in Figure 1). The slide 4

also has a front abutment edge 8, a notch 9 in correspondence with one of its lateral edges, and a shaped cam portion 10, whose respective functions will become clear from the following description.

When the cover 2a is removed, the inside of the casing 2 appears as in Figures 2 and 3. Three different regions of the casing can be distinguished, which are differentiated by their functions. A first region A houses a control and timing device which is connected to a first terminal 11, a second terminal 12, a third terminal 13 and a fourth terminal 14, all in the form of flat pins. A second region B houses a bistable resilient-blade microswitch connected to a respective pair of flat pins 15 and 16. The third region C of the casing 2 houses a pneumatic sensor of the type described and illustrated in the English application GB-A-8525244 filed by the Applicant.

The control and timing device includes a known type of bistable resilient-blade switch 17 constituted by a frame-like, resilient metal element 17a joined at 18 to a substantially rigid central limb 17b having an end which is adapted to cooperate with the frame-shaped element 17a with the interposition of a biconical spring 19. The frame-like element 17a of the bistable blade switch 17 has a movable contact 20 for cooperating with a first upper fixed contact 21 and with a second lower fixed contact 22 which faces the first fixed contact 21 (Figures 5 and 6). The element 17a of the bistable resilient blade 17 is connected electrically to the first terminal 11 which is intended to be connected to one of the leads of the electrical supply line of the washing machine. A metal rocker arm 24 is pivoted at 23 on the casing 2 beside the bistable resilient blade 17 and has a first end 24a for operating the bistable switch 17 and a second end 24b which is adapted to be acted upon by a bimetal device, generally indicated 25.

With reference to Figures 5 and 6, the bimetal device 25 comprises a pair of rectangular, plate-shaped bimetallic actuator elements 26 which are guided by rod-shaped projections 2c integral with the casing 2 and between which a pellet 27 of resistive material with a positive temperature coefficient (PTC) is interposed. The bimetallic elements 26 are arranged in contact with respective intermediate conductor elements 28a and 28b having right-angled-bridge shapes. The lower intermediate conductor elements 28a (with reference to Figure 5) is interposed between one of the bimetal actuator elements 26 and a bimetallic control or compensator element 29 situated in contact with an adjustment screw 30 screwed into the base wall of the casing 2. The bimetallic compensator element 29 is connected electrically to the second terminal 12 which is adapted to be connected to the other lead of the electrical supply line of the machine, whilst the fixed contact 21 connected to the third terminal 13 is intended to be connected to the electrical supply circuits of the machine. The second fixed contact 22 is intended to be connected by the terminal 14 to, for example, a warning light for indicating that the washing machine is switched off.

When the machine is switched off, the region A of the casing 2 is as shown in Figures 2 and 5, with the movable contact 20 closed onto the second fixed contact 22. In this condition,the fixed contact 22, for example, lights a warning light for indicating that the machine is switched off. As soon as the machine is started, a voltage is applied to the terminals 11 and 12 so that the PTC pellet starts to heat up, causing the expansion of the bimetallic actuator elements 26 and the bimetallic compensator element 29 (see Figure 6). During this heating, the intermediate conductor element 28b acts on the first end 24a of the rocker arm 24 to pivot the rocker arm on its fulcrum 23 against the action of a biassing spring 31 interposed between the casing 2 and the central rigid limb 17b of the bistable resilient blade 17. When a predetermined deformation of the bimetallic elements 26 corresponding to a predetermined delay time has been reached, the rocker arm 24 causes the blade 17 to snap, bringing the movable contact 20 onto the first fixed contact 21 and enabling the supply of electricity to the circuits of the machine, for example, to the electric motor for rotating the drum. Moreover, in known manner, a locking pin 32 is connected to the movable contact 20 and, in the operative configuration of the bimetal device 25, is adapted to project from a suitable hole in the cover 2a of the casing 2 to cooperate with the front edge 8 of the slide 4 in order to lock the latter in its operative position.

When the washing machine has been switched on, the presence of the bimetallic compensator element 29 enables the reduction to an acceptable time of the delay with which the stop pin 32 returns into the casing 2, allowing the door to be opened. With the arrangement as described, the bimetal device 25 is not affected by the increase in temperature due to the Joule effect resulting from the passage of current through the contacts associated with the bistable resilient blade 17. In fact, the rocker arm 24 effectively separates the region of the PTC pellet from the region corresponding to the contacts 20 and 21, through which the current passes.

Figures 7 and 8 show a second embodiment of the bimetal device 25 which substantially corresponds to that shown in Figures 5 and 6. It differs from the first embodiment in having intermediate bridge-shaped conductor elements 33 constituted by shaped bimetal plates which are in contact with the bimetallic actuator elements 26 at their ends 33a. As is clearly shown in Figure 8 (the operative configuration of the bimetal device) the deformation of the intermediate conductor elements 33 has the opposite effect from that of the bimetallic actuator elements 26.

During the heating of the PTC pellet (the starting cycle of the machine), the bridge shape of the bimetallic compensators 33, which are not affected by the ambient temperature of the device, enables the entire displacement caused by the metallic actuator elements 26 to be transmitted. This displacement causes the switching of the electrical contacts 20, 21 and the protrusion of the locking pin 32.

After the switching of the bistable blade 17 due to the temperature and the consequent deformation of the bimetallic actuator elements 26, the bimetallic compensators 33 are deformed with an opposite

effect so as to "subtract" a certain travel from the bimetallic actuators and place the rocker arm 24 in a condition nearer to the switching point of the bistable blade switch 17, thus reducing the delay in the opening of the contacts 20, 21 (end of cycle).

The microswitch housed in the region B of the casing 2 also includes a bistable resilient blade 34 defining a frame element 34a and a rigid central limb 34b. The bistable resilient blade 34 is electrically connected to the terminal 16 and its frame element 34a defines a movable contact 35 which can cooperate with a fixed contact 36 connected to the terminal 15. The terminals 15 and 16 are adapted for connection to devices of the washing machine for controlling their supply.

The bistable resilient blade 34 is provided with a switching member constituted by a plastics lever 37 having one end 37a articulated at 38 to the casing 2 and a second end 37b in contact with the central rigid limb 34b of the bistable resilient blade 34 for controlling its operation. The end 37b of the lever 37 also has a portion 39 for cooperating with the cam surface 10 of the slide 4.

As is clear from Figures 9 and 10, the sliding of the slide 4 as the door is closed causes the bistable resilient blade 34 to snap against the action of a biassing spring 40, closing the contacts 35 and 36 and thus operating an actuator device of the washing machine independently of the bimetal delay device 25. When the door of the machine is opened, the sliding of the slide 4 (Figure 9) causes the opening of the contacts 35 and 36.

A plastics rocker-arm element 41 pivoted on the casing 2 at 42 (Figures 11 and 12) may be used instead of the lever 37. The rocker-arm element 41 has a first end 41a provided with a T-shaped peg 43 connected to the central rigid limb 34b in correspondence with an aperture 44 therein. The end 41a of the rocker-arm element 41 may be connected to the central rigid limb 34b of the bistable resilient blade 34, for example, by the insertion of the T-shaped peg 43 through the aperture 44 and its subsequent rotation through about 90°. The first end 41a of the rocker-arm element 41 has a portion 45 for cooperating with a first cam surface 46 of the slide 4, whilst the second end 41b of the rocker-arm element 41 has a portion 46a for cooperating with a second cam surface 47 of the slide 4. It is clear, that, as a result of the movement of the slide 4 towards its operative position, the first cam surface 46 acts on the end 41a of the rocker-arm element 41 to cause the closure of the contacts 35 and 36. When the door is opened, the sliding of the slide 4 positively controls the opening of the contacts 35 and 36 by means of the second cam surface 47 and the second end 41b of the rocker-arm element 41, by virtue of the connection between the rod 43 and the central limb 34b.

This system for controlling the bistable blade switch 34 makes the movement of the slide 4 independent of the hysteresis of the switch itself, affording very reliable control of the opening/closing of the contacts 35, 36 on the part of the cam surfaces 46 and 47 of the slide. As well as not requiring the use of a biassing spring, the positive opening and closing of the contacts 35 and 36 enables the microswitch to be made with very wide tolerances, with a consequent reduction in cost and with an improvement in the reliability of the switch.

The region C of the casing 2 defines a chamber 50 which communicates by means of a connector 51, situated in the wall of the casing 2, with a tube (not illustrated) one end of which is connected to an opening of the washing chamber of the washing machine beneath the door. Above the chamber 50, a resilient diaphragm (not illustrated) is sealingly interposed between the cover 2a and the casing 2 and is provided with a central pin which passes through a hole in the cover 2a and is adapted to cooperate with the lateral notch 9 of the slide 4 to lock the latter in the operative position when the water in the washing chamber is above a predetermined level. This eliminates the problem resulting from the possibility of the water contained in the washing chamber overflowing through the loading aperture as a result of the opening of the door by the user, for example, in the event of an accidental interruption of the electrical supply to the machine.

Claims

1. A door lock for a washing machine or drier, comprising

- a support casing which is adapted to be fixed to the machine and has at least a first and a second terminal for connection to the electrical supply system when the machine is switched on, and a third terminal for connection to electrical devices of the machine to enable their supply,
- a locking slide which is movable relative to the casing and adapted, in an operative position, to keep the door closed,
- a control and timing device housed in the casing and including a resistive heating element, and a bimetal device which can be heated by the resistive element and deformed as a result of the supply of voltage to the first and second terminals and, in the deformed condition, can connect the third terminal to one of the first two and hold a stop peg in engagement with the locking slide to keep the latter in the operative position,
- a sensor for detecting the water level in the washing chamber, supported by the casing and having a movable stop member which, in use, can assume a rest position when the water in the washing chamber is below a predetermined level, and an operative position, in which it is adapted to lock the locking slide in the operative position, when the water in the washing chamber exceeds the predetermined level, and
- an electrical switch supported by the casing and having a pair of terminals for connection to electrical devices of the machine to control their supply, the switch being operated by the locking slide when the latter is in the operative position, characterised in that the sensor (50,

51) and the electrical switch (34, 37, 10) are housed within the casing (2).

2. A lock according to Claim 1, characterised in that the electrical switch (34) is of the bistable resilient-blade type and includes a switching member constituted by a lever (37) having a first end (37a) articulated to the casing (2) and a second end (37b) in abutment with the resilient blade (34b), the lever (37) also having an operating portion (39) for cooperating with a cam portion (10) of the locking slide (4) to close the switch when the slide (4) slides towards its operative position.

3. A lock according to Claim 1, characterised in that the electrical switch (34) includes a switching member constituted by a rocker-arm element (41) pivoted centrally on the casing (2) and having a first end (41a) connected to the bistable resilient blade (34b) and provided with a portion (45) for cooperating with a first cam surface (46) of the slide (4) to close the switch, and a second end (14b) provided with a portion (46a) for cooperating with a second cam surface (47) of the slide (4) to open the switch.

4. A lock according to Claim 1, characterised in that the control and timing device includes a bistable resilient blade (17) which is connected electrically to the first terminal (11) and defines a movable contact (20) for cooperating with a fixed contact (21) connected to the third terminal (13), and a metal rocker arm (24) pivoted on the casing (2) and having a first end for operating the bistable resilient blade (17b) and a second end (24b) in contact with the bimetal device (25), the rocker arm (24) acting both as the electrical connection between the first terminal (11) and the second terminal (12) with the interposition of the resistive heating element (27), and as a member for operating the bistable resilient blade (17b) as a result of the deformation of the bimetal device (25).

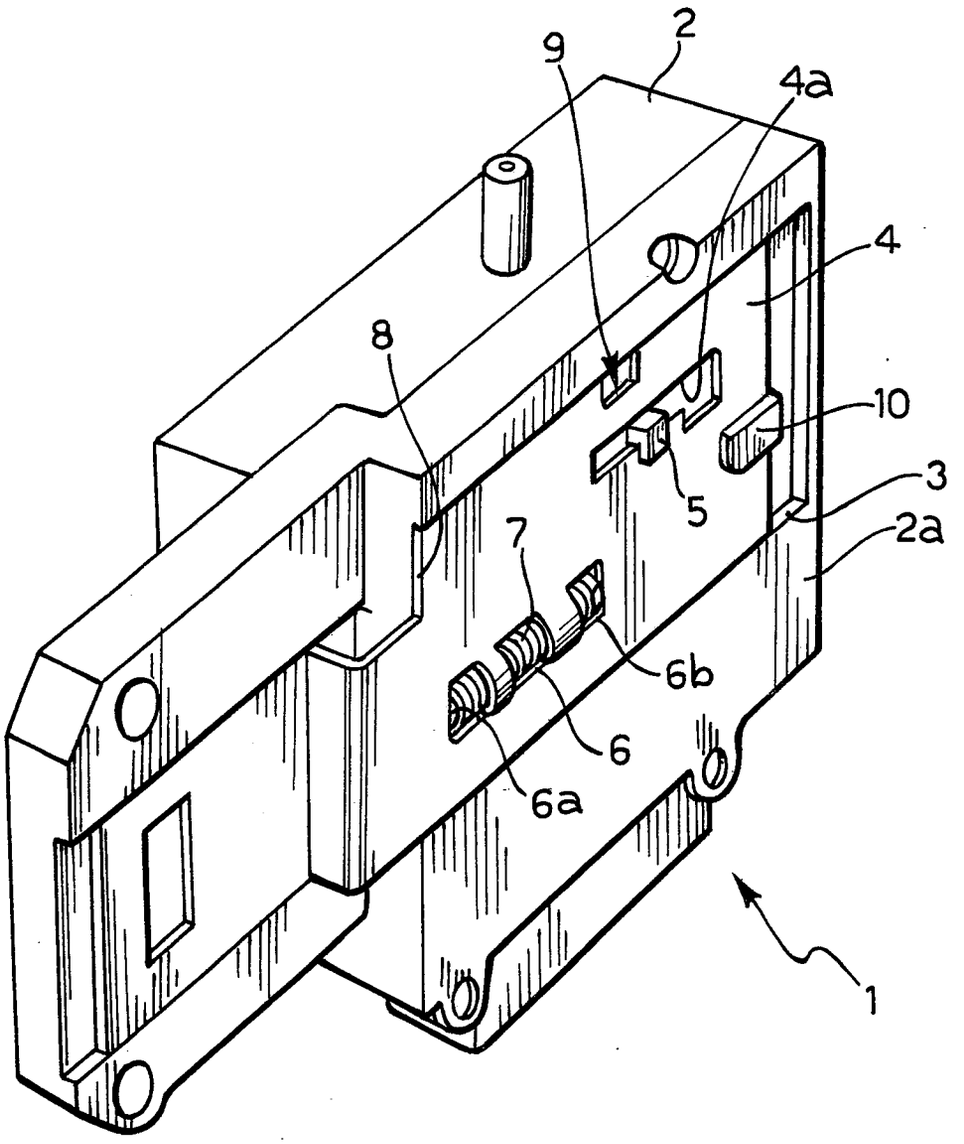
5. A lock according to Claim 4, characterised in that the movable contact (20) of the bistable resilient blade (17) of the control and timing device is adapted to cooperate, when the machine is switched off, with an auxiliary fixed contact (22) connected to a fourth terminal (14) for providing a signal indicative of the fact that the machine is switched off.

6. A lock according to Claim 3, characterised in that the connection between the first end (41a) of the rocker-arm element (41) and the bistable resilient blade (34b) includes a T-shaped peg (43) connected to the first end (41a) and adapted to be inserted through a corresponding aperture (44) in the bistable resilient blade (34b), the subsequent rotation of the rocker-arm element (41) connecting the rocker-arm element and the blade together.

7. A lock according to Claim 4, characterised in that the bimetal device (25) comprises:
- a pair of bimetallic actuator elements (26) in contact with opposite faces of the resistive heating element (27),
- a first and a second intermediate conductor element (28a, 28b) in contact with the bimetallic actuator element (26),
- a bimetallic control element (29) which is interposed between the casing (30, 2) and the first conductor element (28a) and, as a result of its heating, can assume a deformation with the opposite effect from that of the bimetallic actuator elements (26), the second intermediate conductor element (28b) being in contact with the second end (24b) of the rocker arm (24).

8. A lock according to Claim 4, characterised in that the bimetal device (25) comprises:
- a pair of bimetallic actuator elements (26) in contact with opposite faces of the resistive heating element (27),
- a pair of bridge-shaped bimetallic control elements (33) having ends (33a) which are in contact with the bimetallic actuator elements (26), the bimetallic control elements (33) being able, as a result of their heating, to assume a deformation with the opposite effect from that of the bimetallic actuator elements (26).

FIG. 1



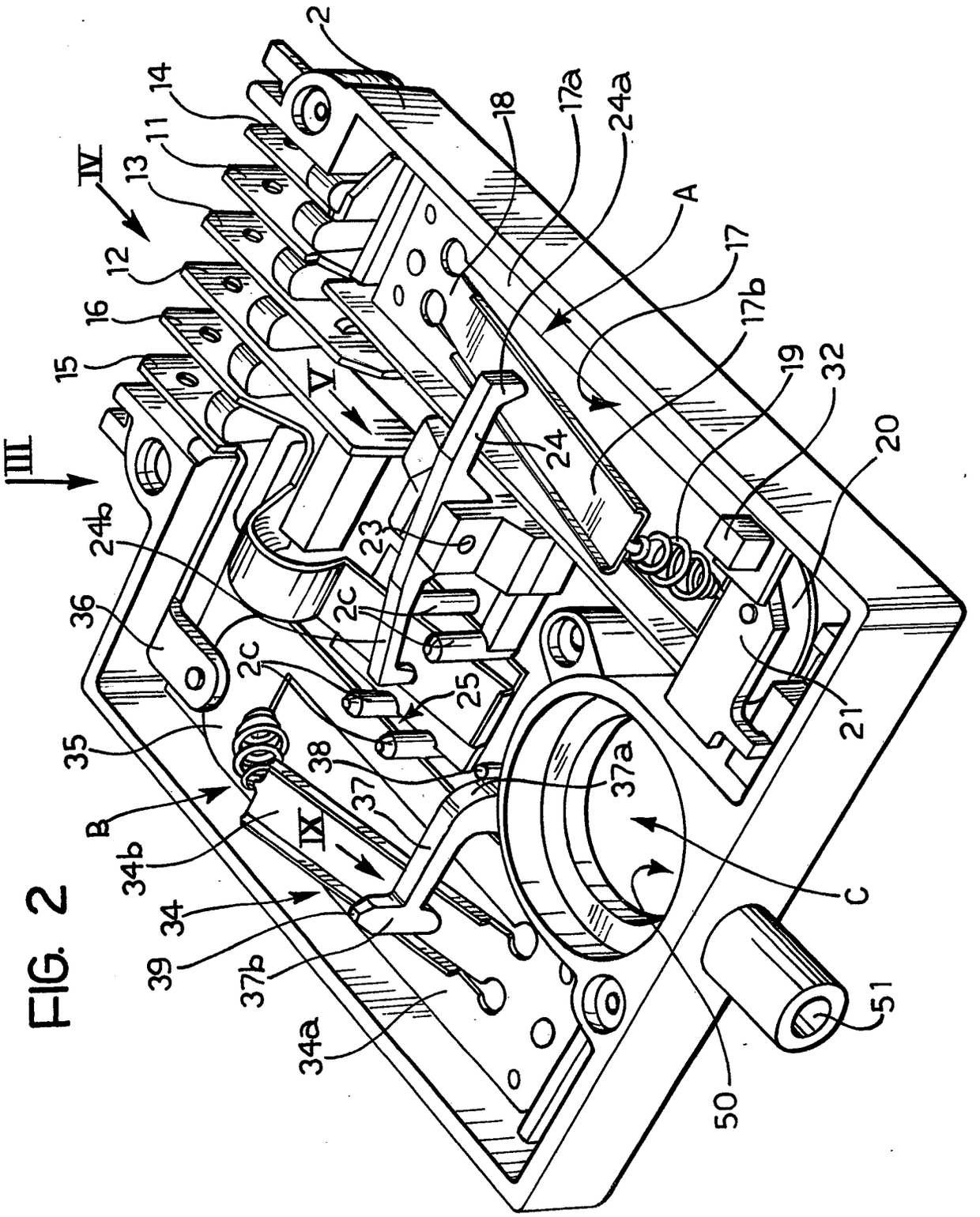
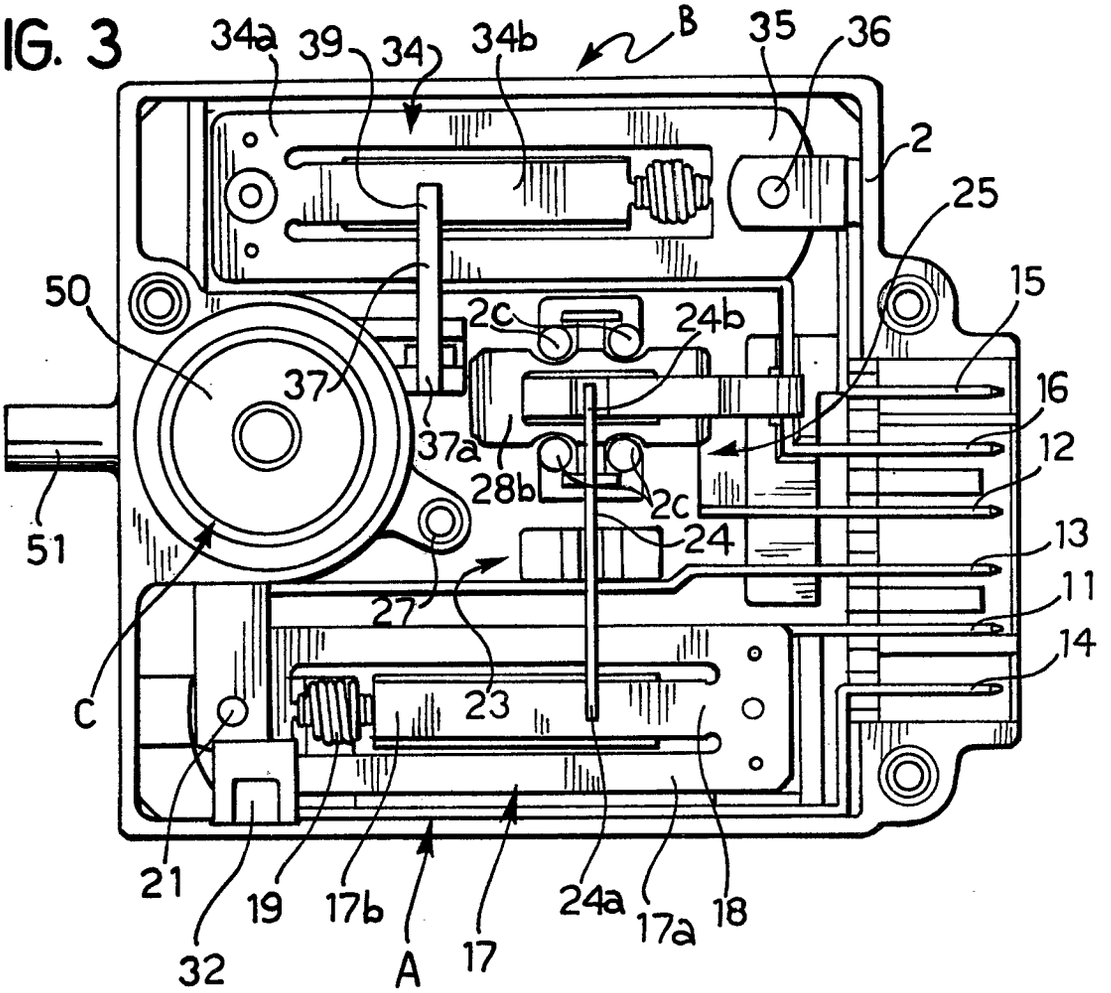

2
14
11
13
12
16
15
III
IV
V
IX
18
17a
24a
A
17
17b
19
32
20
24
23
24b
36
2c
2c
25
35
38
37
37a
B
34b
34
39
37b
34a
21
C
50
51

FIG. 2

FIG. 3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34b
B
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25
50
2c
24b
15
37
16
37a
12
28b
2c
51
24
13
27
11
14
C
23
21
19
17b
A
17
24a
17a
18
32

FIG. 4

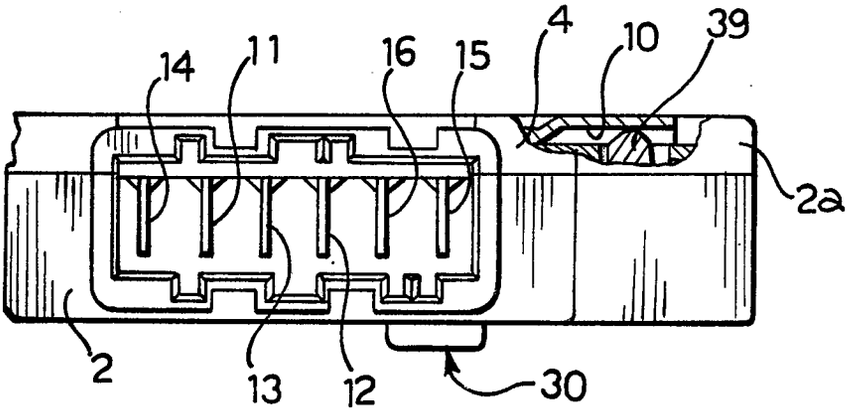
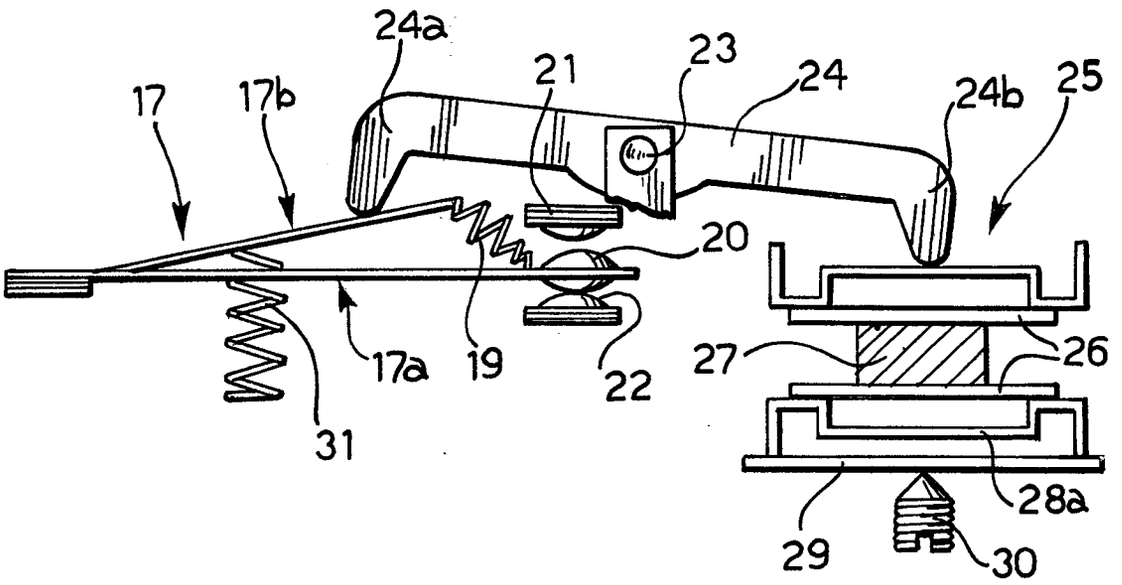

14
11
16
15
4
10
39
2a
2
13
12
30

FIG. 5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24b
25
17
17b
20
27
26
17a
19
22
28a
31
29
30

FIG. 6

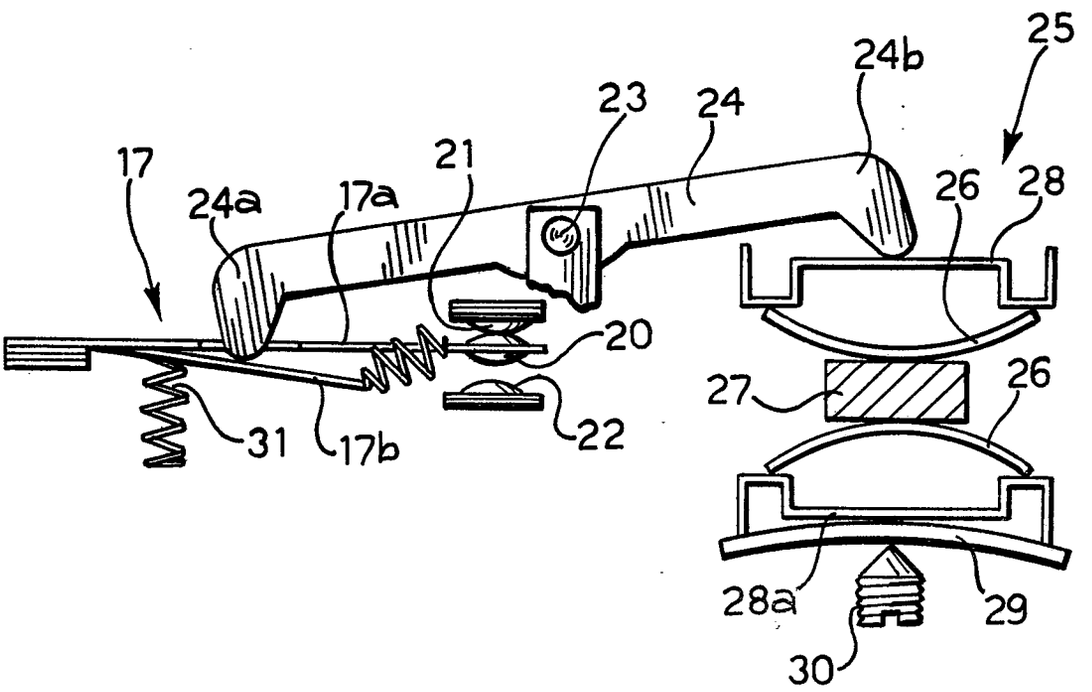
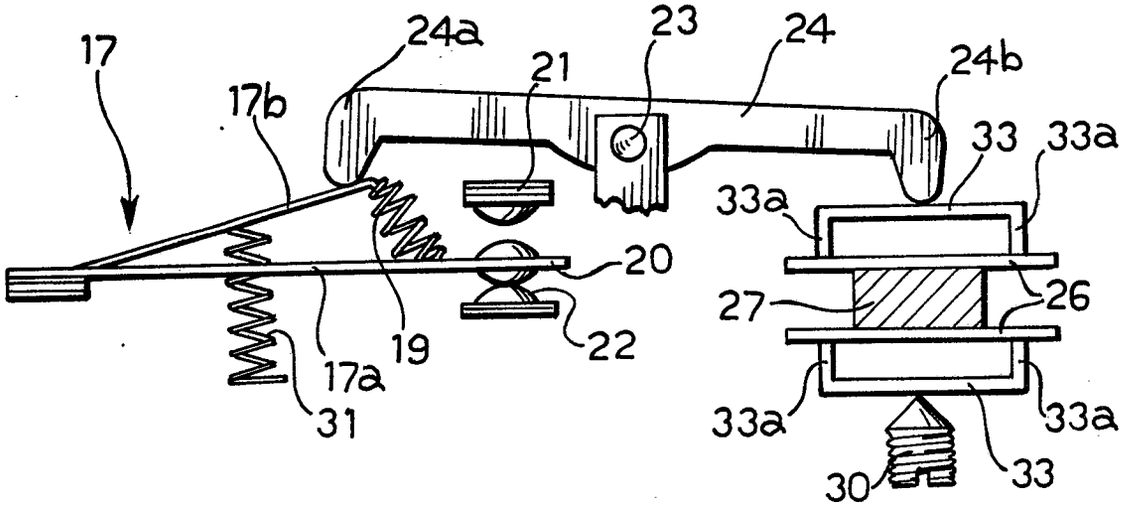

25
24b
23
24
17
21
24a
17a
26
28
20
27
26
31
17b
22
28a
29
30

FIG. 7


17
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24
24b
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33a
33a
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27
26
19
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17a
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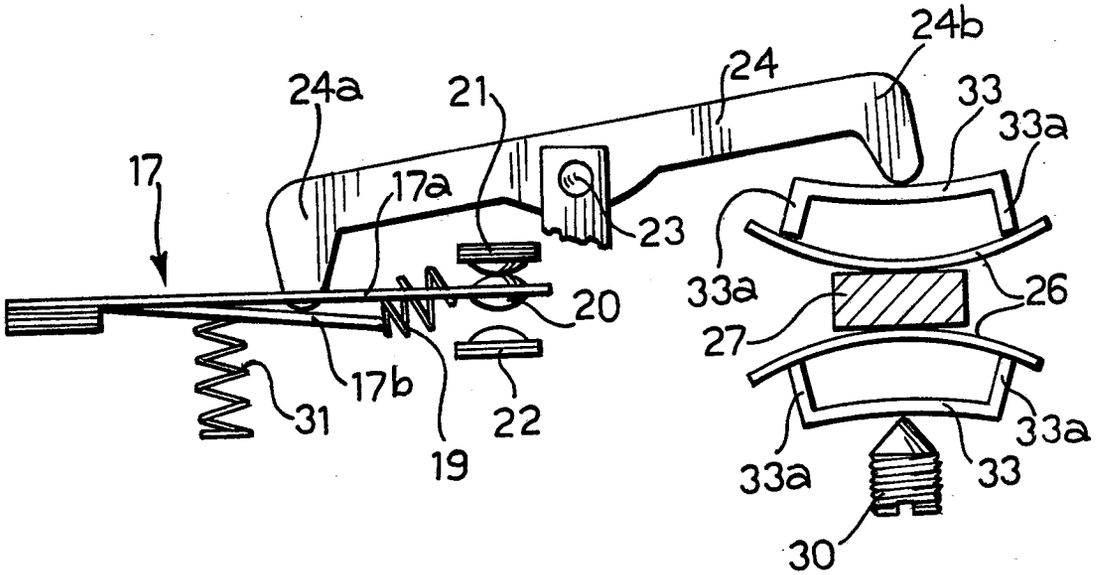
33a
30
33

FIG. 8


24b
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24
21
33
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23
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26
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17b
31
22
33a
19
33a
33
30

FIG. 9

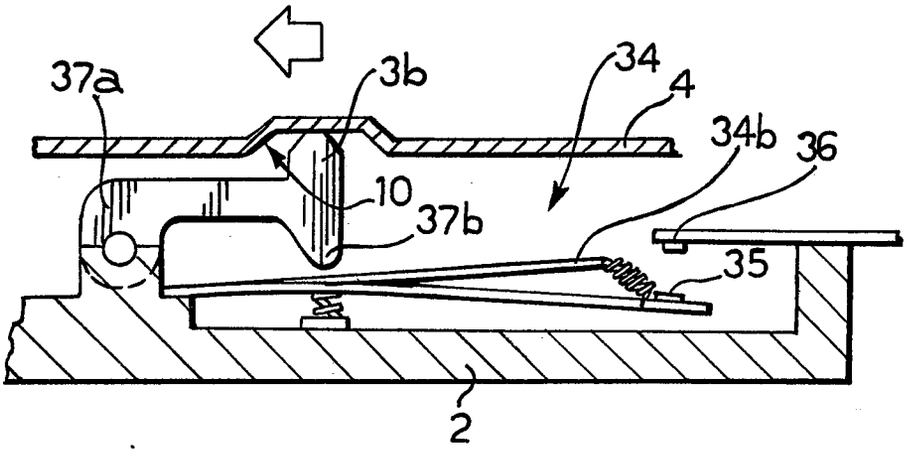


FIG. 10

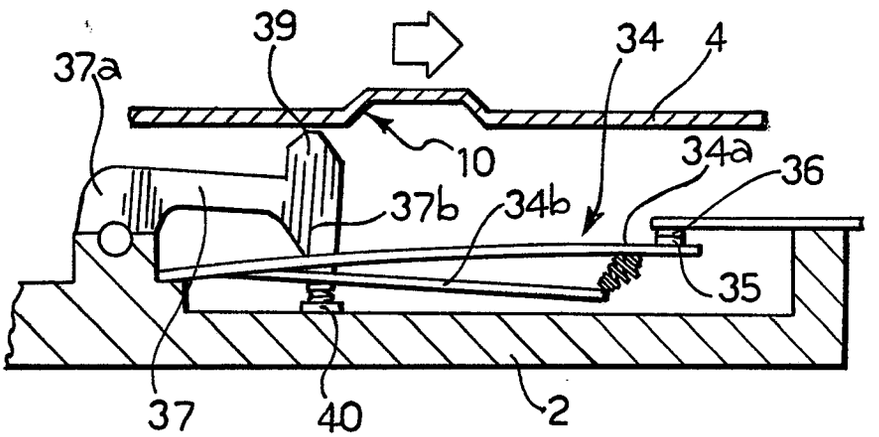


FIG. 13

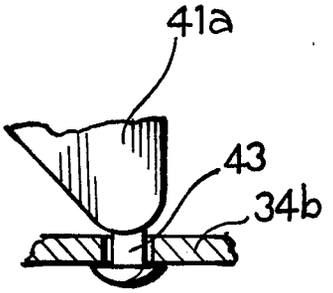
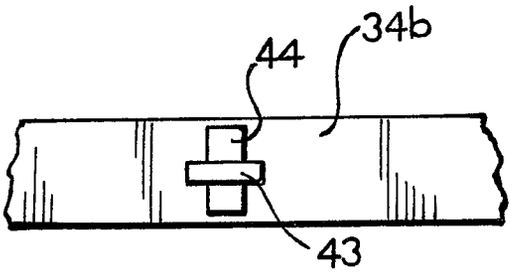
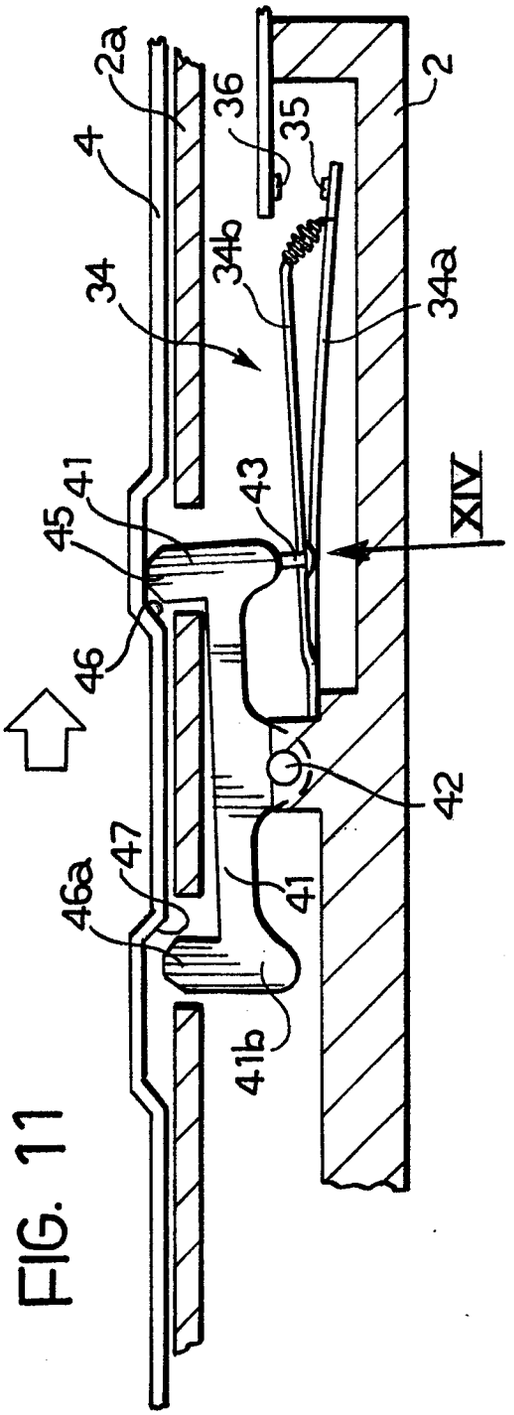


FIG. 14




2a
4
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2
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34b
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41
45
43
XIV
46
42
47
46a
41
41b

FIG. 11

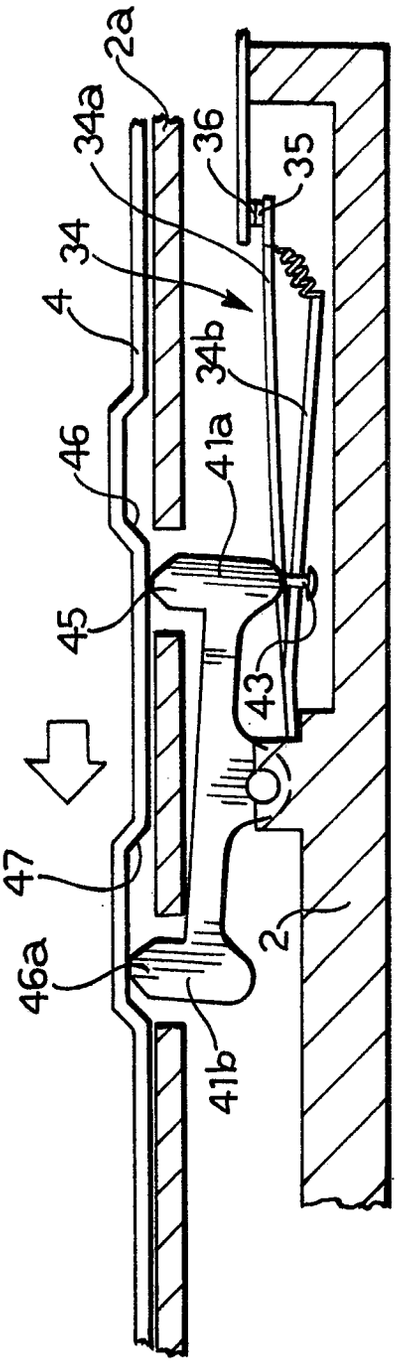
2a
34a
36
35
34
4
34b
46
41a
45
43
47
2
46a
41b

FIG. 12