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(54) **A device for locking and unlocking the door of an electric household appliance**

(57) The device (1) comprises:

and connected to the locking member
(11).

a support housing (2) with an opening (5) for the
introduction of a hook member (A) connected to the
door (P),

retaining and locking devices (6, 11, 21-34) com-
prising:

a retaining member (6) which is mov-
able between a rest position in which
it allows the hook member (A) to be in-
troduced into the opening (5) and a
working position in which it can re-
strain the hook member (A) which has
been introduced into the opening (5),

a locking member (11) which is mova-
ble between release and engagement
positions in which it allows and pre-
vents the movement of the retaining
member (6) from the working position
to the rest position, respectively, and

control devices (21 to 34) which can
control the position of the locking
member (11), and

a switch (12) including a first electrical
contact and a second electrical con-
tact (13, 17). The first electrical con-
tact (13) is carried by a first flexible plate
(14) made of electrically-conductive
material, mounted in the housing (2)

The second contact (17) is movable between an op-
erative position and an inoperative position in which it
can be reached and cannot be reached by the first con-
tact (13), respectively, and is connected to the retaining
and locking devices (6, 11, 21-34) in a manner such that
it can adopt the operative position solely when the lock-
ing member (11) is restrained in its working position, and
can be arranged in the inoperative position when the re-
taining member (6) returns to the rest position.

FIG. 7

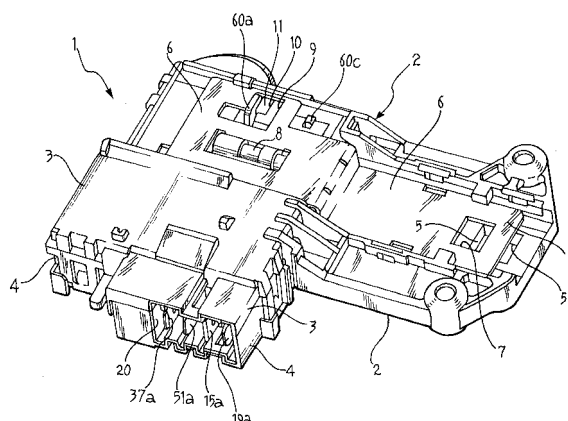
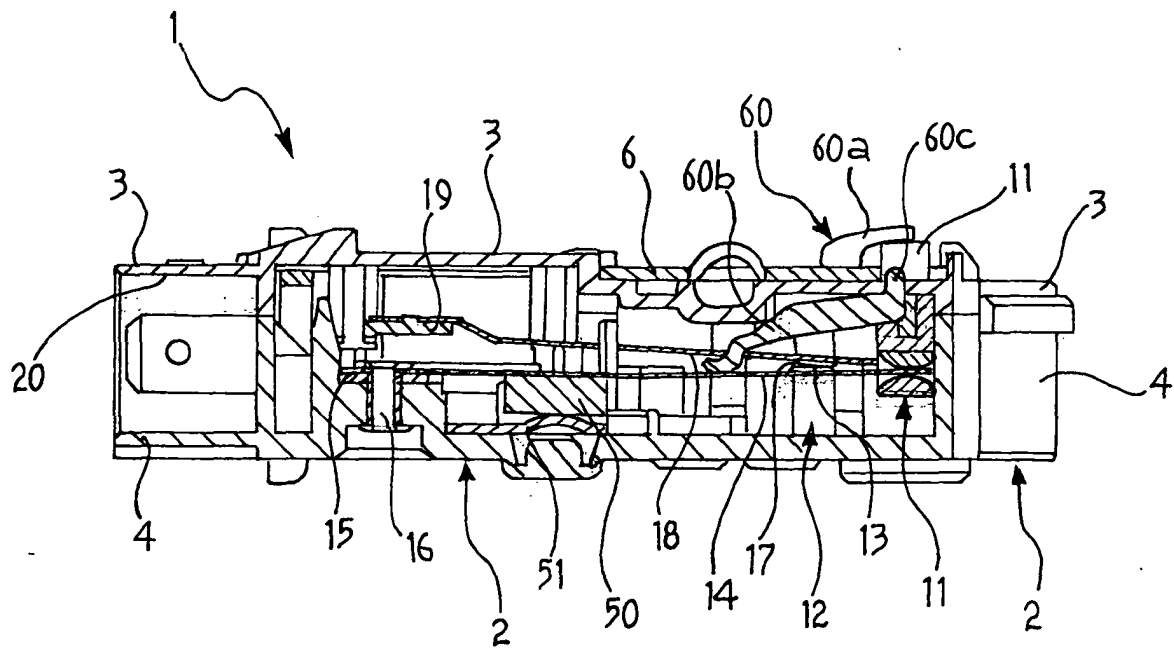


FIG. 8



Description

[0001] The present invention relates to a device for locking and unlocking the door of an electric household appliance such as, for example, a washing machine or a combined washing machine/drier.

[0002] More specifically, the subject of the invention is a locking and unlocking device comprising:

a support housing with an opening for the introduction of a hook member connected to the door,

retaining and locking means including:

a retaining member which is mounted so as to be movable in the housing between a rest position in which it allows the hook member to be introduced into the opening and a working position in which it can restrain the hook member which has been introduced into the opening,

a locking member which is movable in the housing between a release position and an engagement position in which it can allow and prevent the movement of the retaining member from the working position to the rest position, respectively, and

control means which can be activated electrically and can control the position of the locking member, and

a switch including a first electrical contact and a second electrical contact, the first electrical contact being carried by a first flexible plate made of electrically-conductive material, mounted in the housing and connected to the locking member in a manner such that the plate can move the first contact towards the second electrical contact when the locking member moves to the engagement position in which it prevents opening of the door.

[0003] A device for locking and unlocking the door of an electric household appliance of the type specified above is known, for example, from the Applicant's United States patent No. 6,334,637.

[0004] This known device is generally reliable and safe in operation. However, if the locking member shears in operation, the slidable retaining member or slide can return to the release position in which it allows the door to be opened. In that condition, the associated electrical switch remains closed and continues to supply to a control unit of the electric household appliance a signal indicating that the door is closed and locked. This may result in a potential danger.

[0005] An object of the present invention is to provide a device of the type specified above which overcomes

the disadvantage outlined above.

[0006] This and other objects are achieved, according to the invention, by a device for locking and unlocking the door of an electric household appliance of the type specified above, characterized in that the second contact of the switch is mounted so as to be movable in the housing between an operative position and an inoperative position in which it can be reached and cannot be reached by the first contact carried by the first plate, respectively, and is connected to the retaining and locking means in a manner such that it can adopt the operative position solely when the retaining member is restrained in its working position, and can be arranged in the inoperative position when the retaining member returns to the rest position.

[0007] In one embodiment, the second electrical contact of the switch is carried by a second plate which is made of electrically-conductive material, is mounted so as to be movable in the support housing, and is associated with a control member which can control its position in dependence on the position of the retaining member.

[0008] The control member is advantageously a rocker mounted pivotably in the support housing and having a first arm which can cooperate with the locking member and a second arm cooperating with the second plate.

[0009] Further characteristics and advantages of the invention will become clear from the following detailed description which is given purely by way of non-limiting example with reference to the appended drawings, in which:

Figure 1 is a perspective view of a locking and unlocking device according to the invention,

Figures 2 and 3 are partial perspective views of the locking and unlocking device of Figure 1,

Figure 4 is a partial view sectioned on the line IV-IV of Figure 3,

Figure 5 is a partial plan view of the device of the preceding drawings,

Figure 6 is a view sectioned substantially on the line VI-VI of Figure 1,

Figure 7 is a perspective view similar to that of Figure 1 and shows the locking and unlocking device in a different condition, and

Figures 8 and 9 are two views similar to that of Figure 6 and show the locking and unlocking device in other operative conditions.

[0010] With reference to the drawings and in particular to Figure 1, a locking and unlocking device according to the invention is generally indicated 1.

[0011] The device comprises a support housing 2

made of electrically-insulating material (for example, a moulded plastics material), which is intended to be fixed to the structure of an electric household appliance (not shown) in the vicinity of a loading or access opening with which a door P is associated (Figure 1), the door P being provided, in known manner, with a hook member A. In the embodiment shown by way of example, the support housing is formed by two half-shells 3 and 4 connected to one another.

[0012] As can be seen in Figures 1 and 7, the housing 2 of the device 1 has an opening 5 for the introduction of the hook member A carried by the door.

[0013] A retaining member or slide 6 is mounted slidably in the support housing 2 of the device 1 and has a window-like opening 7 through which the hook member A can extend.

[0014] When the door P is open (Figure 1), an associated helical spring 8 keeps the retaining member 6 in a rest position in which its window 7 faces the opening 5 of the housing 2. In this condition, the hook member A of the door P can be introduced into the opening 5 and into the window 7 when the door is closed and, conversely, can be released from the window and from the opening when the door is opened.

[0015] The retaining member or slide 6 has a further opening 9 which is substantially L-shaped in the embodiment shown by way of example.

[0016] When the retaining member or slide 6 is in the rest position, its portion that is disposed between the two portions of the opening 9 covers an opening 10 which is formed in the upper half-shell 3 of the housing and is shown in broken outline in Figure 1 and in solid outline in Figure 7. A locking member 11 extends so as to be translatable in that opening.

[0017] In known manner, the arrangement is such that, when the door P is closed, the hook member A engages in the opening or window 7 of the retaining member or slide 6 and brings about a translation thereof (towards the left as seen in Figure 1) so as to expose the opening 10, as shown in Figure 7.

[0018] With reference to Figures 2 to 4, 6, 8 and 9, a switch, generally indicated 12, is disposed inside the lower half-shell 4 of the housing 2. The switch comprises a first movable contact 13 carried by one end of a metal plate 14 the other end of which is disposed on top of a shaped metal member 15 (Figures 3, 6, 8 and 9) and is restrained firmly on the support housing 2 with the member, for example, by means of a rivet 16.

[0019] The switch 12 further comprises a second electrical contact 17 (see, for example, Figures 3, 6 and 9) carried by an end of a second metal plate 18 the other end of which is fixed to a shaped metal member 19. The plate 18 extends above and spaced from the plate 14. The shaped metal member 19 has an end 19a which is shaped as a flat pin which extends as a connection terminal in a recessed seat 20 of the support housing 2 (Figures 1 to 3).

[0020] The shaped metal member 15 also has a flat

pin-like end 15a which extends in the seat 20.

[0021] The movable electrical contacts 13 and 17 face one another and are normally spaced apart. In other words, the switch 12 is normally open.

[0022] In the non-limiting embodiment shown in the drawings, the plate 14 which carries the movable contact 13 is not a simple metal plate but a bimetal plate. A resistor with a positive temperature coefficient (PTC), indicated 50, is disposed beneath the plate 14. The resistor 50 bears on a shaped, electrically-conductive member 51, an end 51a of which is shaped as a flat pin and extends in the seat 20 for connection to a control unit of the electric household appliance.

[0023] As can be seen in Figure 4, at the end remote from the plate 14, the locking member 11 has a lower transverse appendage 11a. As will become clearer from the following description, this appendage cooperates with a cam profile or teeth of a toothed wheel 21 which is mounted so as to be rotatable in the support housing about a pin 21a adjacent the locking member 11. The toothed wheel 21 is advantageously made of plastics material. It may be monolithic or - for ease of moulding - may be formed in two parts which are glued or otherwise fixed together. In the embodiment shown by way of example, the lower portion of the wheel 21 has a lower set of saw teeth 22 (Figures 2, 4 and 5). The upper portion of the wheel 21 has a plurality of equiangularly spaced cams or face teeth 23 separated by gaps 24 (Figures 2-4).

[0024] In a preferred embodiment, the teeth 23 have a right-angled trapezium shape of which one side or end is inclined and the other side or end is upright.

[0025] In the embodiment shown by way of example, the wheel 21 has twelve saw teeth 22 and four upper teeth 23. The width of the gaps 24 between consecutive teeth 23 is slightly less than the angular distance corresponding to two adjacent saw teeth 22. The arrangement is such that, when the radial appendage 11a of the locking member 11 extends beneath a cam or tooth 23 of the wheel 21, the locking member 11 is restrained in the lowered or release position, as shown in particular in Figure 4.

[0026] When, on the other hand, as a result of an angular movement, the wheel 21 has the appendage 11a of the locking member 11 in a gap 24 between two consecutive teeth or cams 23, the locking member 11 can move to the extended, engagement or locking position under the thrust exerted by the plate 14, as will be described further below.

[0027] An electrically-operated actuator is generally indicated 25 in Figures 2, 3 and 5. In the embodiment shown by way of example, the actuator comprises a coil or solenoid 26 inside which a ferromagnetic core 27 is mounted so as to be axially translatable; a rod 28 (see Figure 5 in particular) is connected to one end of the core 27. The end of the rod 28 remote from the core 27 bears against a shaped member generally indicated 29. This member has, in its central portion, a slot-shaped

opening 30 through which a fixed guide peg or pin 31, fixed firmly to the lower half-shell 4 of the support housing 2 of the device, extends (see Figure 5 in particular).

[0028] The end 29a of the member 29 remote from the actuator 25 is hooked and engages between a pair of consecutive saw teeth 22 of the toothed wheel 21 (Figure 5).

[0029] A pawl, indicated 32, is mounted for pivoting about a fixed pin 33 and is also engaged between a pair of consecutive saw teeth 22 of the toothed wheel 21, under the thrust of a helical spring 34 which is interposed between the pawl and the end of the shaped member 29 that is adjacent the actuator 25.

[0030] The arrangement described above is such that, each time the actuator 25 is excited, the core 27 translates (upwards as seen in Figure 5) and, by means of the rod 28, brings about a movement of the shaped member 29 which in turn brings about a rotation of the toothed wheel 21 by one step, that is, by a distance corresponding to one saw tooth 22. When this angular movement has been performed, the pawl 32 stabilizes the angular position of the toothed wheel 21 again.

[0031] In the embodiment shown by way of example, the winding or solenoid 26 of the electromagnetic actuator 25 has its terminals connected, respectively, to a shaped electrically-conductive member 35 and to the connecting member 51, 51a by means of a conductive bridge 36 (Figures 2 and 3).

[0032] The shaped connection member 35 may, advantageously but not necessarily, be connected to a conductor member 37 (Figure 2) having an end 37a which extends in the seat 20 of the housing of the device and is shaped as a flat pin in order to act as a connection terminal. A resistor with a positive temperature coefficient (PTC), indicated 38 in Figures 2 and 5, is preferably interposed between the connection members 35 and 37. The resistor 38 advantageously enables the intensity of the current supplied to the coil 26 of the electromagnetic actuator 25 to be limited automatically when the duration of the supply of that current exceeds a predetermined period of time. The use of the PTC resistor 38 thus permits the use of an electromagnetic actuator 25 having a small and relatively inexpensive coil 26.

[0033] The end of the plate 14 which carries the movable contact 13 is engaged in a lateral seat or notch 11b of the locking member 11, as can be seen in Figure 4. As will become clearer from the following description, when the resistor 50 is heated, it can consequently cause the plate 14 to bend upwards and the end of that plate which carries the movable contact 13 consequently tends to urge the locking member 11 from the lowered or release position of Figures 1 and 6 towards the raised or engagement position shown in Figure 8. In this position, the locking member 11 protrudes partially outside the opening 10 (Figure 7) and is disposed on the path of the retaining member or slide 6, preventing it from returning towards the rest position in which it allows the door P to be opened.

[0034] With reference to Figures 2 to 4 in particular, a rocker, generally indicated 60, is mounted pivotably at 61 in the lower half-shell 4 of the support housing 2 of the device. The rocker 60 has a first arm 60a which extends above the top of the locking member 11 and a second arm 60b cooperating with the plate 18.

[0035] The rocker 60 also has a third arm 60c extending in the same direction as the first arm 60a and operatively cooperating with the retaining slide 6 (Figures 2-4 and 7).

[0036] The arrangement of the rocker 60 is such that, when the locking member 11 moves from the lowered, rest position to the raised, engagement position in which it restrains the slide 6 in the door-locking condition, the arm 60b of the rocker keeps the plate 18 and the associated movable contact 17 in a lowered, operative position shown in Figure 8. When the plate 18 is in that operative position, its contact 17 can be reached by the movable contact 13 carried by the plate 14 when the plate bends owing to the heating brought about by the resistor 50.

[0037] When the locking member 11 is in the lowered, rest position (door P open), on the other hand, the plate 18, owing to its own resilience, is disposed in the inoperative, raised position shown in Figure 6 in which its contact 17 cannot be reached by the movable contact 13 carried by the plate 14.

[0038] The rocker 60 is also such that, when the door-locking device 1 is at rest (door open - Figure 1), the arm 60a of the rocker extends through a portion of the opening 9 of the retaining slide 6, above the portion of the slide 6 which covers the opening 10 in which the movable locking member 11 is mounted. In this condition, a further portion of the retaining member 6 covers an opening in the upper shell 3 of the housing of the device, through which the arm 60c of the rocker can extend. This opening is in fact exposed (Figure 7) when the retaining slide 6 is in the working position shown in Figure 7 in which the slide 6 also covers the opening 10 through which the locking member 11 is translatable.

[0039] The device described operates in the following manner.

[0040] When the door P is open, the locking and unlocking device is in the condition shown in Figures 1-6; the locking member 11 is restrained in the retracted, release position by a trapezoidal tooth 23 of the toothed wheel 21 which bears on the radial appendage 11a of that member; the locking member 11 is also "covered" by the retaining member or slide 6.

[0041] When the door P is closed, the slide 6 translates and "exposes" the locking member 11. During this stage, the locking member 11 is nevertheless restrained in the retracted, release position by the toothed wheel 21 which is still in the same angular position which it adopted in the preceding stage.

[0042] When the user of the electric household appliance sets the appliance in operation, a control unit of the electric household appliance brings about excitation

of the actuator 25 in known manner. As a result of this excitation, the member 29 brings about a rotation of the toothed wheel 21 of a magnitude equal to the angular extent of one tooth 22 of that wheel. The wheel is thus disposed in an angular position in which a gap 24 between two consecutive trapezoidal teeth 23 is presented to the radial appendage 11a of the locking member 11. As soon as the PTC resistor 50 reaches a temperature sufficient to bring about switching of the bimetal plate 14, the locking member 11 consequently moves to the extended position of Figure 8 and, by acting on the rocker 60, causes the plate 18 of the associated contact 17 to be arranged in the operative position. The contact 13 of the plate 14 is thus brought against the contact 17 and the closure of the switch 12 formed thereby represents an indication of the fact that the door P is closed and locked.

[0043] Upon completion of an operating cycle of the electric household appliance, to allow the door P to be opened, the control unit of the electric household appliance causes (for example) two successive excitation pulses to be sent to the coil 26 of the actuator 25. As a result of this, the toothed wheel 21 is rotated through an angle corresponding to the extent of two of its saw teeth 22. This rotation brings about the engagement of the radial appendage 11a of the locking member by a new trapezoidal tooth or cam 23 of the wheel. The locking member 11 is thus brought back to the retracted or release position shown in Figure 4 in which it allows the retaining member or slide 6 to return to the position in which the door P is allowed to open.

[0044] When the locking member 11 is returned to the retracted, release position in the manner described, at the same time, the plate 18, which is no longer opposed by the rocker 60, returns the contact 17 to the raised, inoperative position and thus opens the switch 12.

[0045] Should the movable locking member 11 shear, then - as shown in Figure 9 - its remaining portion connected to the plate 14 would no longer be able to engage the arm 60a of the rocker 60. The plate 18 would be free to return, owing to its own resilience, to the raised condition in which it keeps the contact 17 in a position which cannot be reached by the movable contact 13 carried by the plate 14. The switch 12 would thus open, immediately providing an indication of the fact that the door was no longer locked.

[0046] The method of operation is similar if a locking and unlocking device 1 is installed without a locking member 11; in that case, the operating switch 12 remains open in the very first cycle, providing the control unit of the electric household appliance with the information that the door is in fact not locked.

[0047] Naturally, the principle of the invention remaining the same, the forms of embodiment and details of construction may be varied widely with respect to those described and illustrated purely by way of non-limiting example, without thereby departing from the scope of the invention as defined in the appended claims.

Claims

1. A device (1) for locking and unlocking the door (P) of an electric household appliance, comprising:

a support housing (2) with an opening (5) for the introduction of a hook member (A) connected to the door (P),

retaining and locking means (6, 11, 21-34) comprising:

a retaining member (6) which is mounted so as to be movable relative to the housing (2) between a rest position in which it allows the hook member (A) to be introduced into the opening (5) and a working position in which it can restrain the hook member (A) which has been introduced into the opening (5),

a locking member (11) which is movable in the housing (2) between a release position and an engagement position in which it can allow and prevent the movement of the retaining member (6) from the working position to the rest position, respectively, and

control means (21 to 34) which can be activated electrically and can control the position of the locking member (11), and

a switch (12) including a first electrical contact and a second electrical contact (13, 17), the first electrical contact (13) being carried by a first flexible plate (14) made of electrically-conductive material, mounted in the housing (2) and connected to the locking member (11) in a manner such that the plate (14) can move the first contact (13) towards the second electrical contact (17) when the locking member (11) moves to the engagement position in which it prevents opening of the door (P),

the device being **characterized in that** the second contact (17) of the switch (12) is mounted so as to be movable in the housing (2) between an operative position and an inoperative position in which it can be reached and cannot be reached by the first contact (13) carried by the first plate (14), respectively, and is connected to the retaining and locking means (6, 11, 21-34) in a manner such that it can adopt the operative position solely when the locking member (11) is restrained in its working position, and can be arranged in the inopera-

tive position when the retaining member (6) returns to the rest position.

2. A device according to Claim 1 in which the second contact (17) of the switch (12) is carried by a second plate (18) which is made of electrically-conductive material, is mounted so as to be movable in the support housing (2), and is associated with a control member (60) which can control its position in dependence on the position of the retaining member (6). 5 10
3. A device according to Claim 2 in which the control member (60) is a rocker (60) mounted pivotably in the support housing (2, 4) and having a first arm (60a) which can cooperate with the locking member (11) and a second arm (60b) cooperating with the second plate (18). 15
4. A device according to Claim 3 in which the rocker (60) also has a third arm (60c) extending in the same direction as the first arm (60a) and cooperating with the retaining member (6). 20

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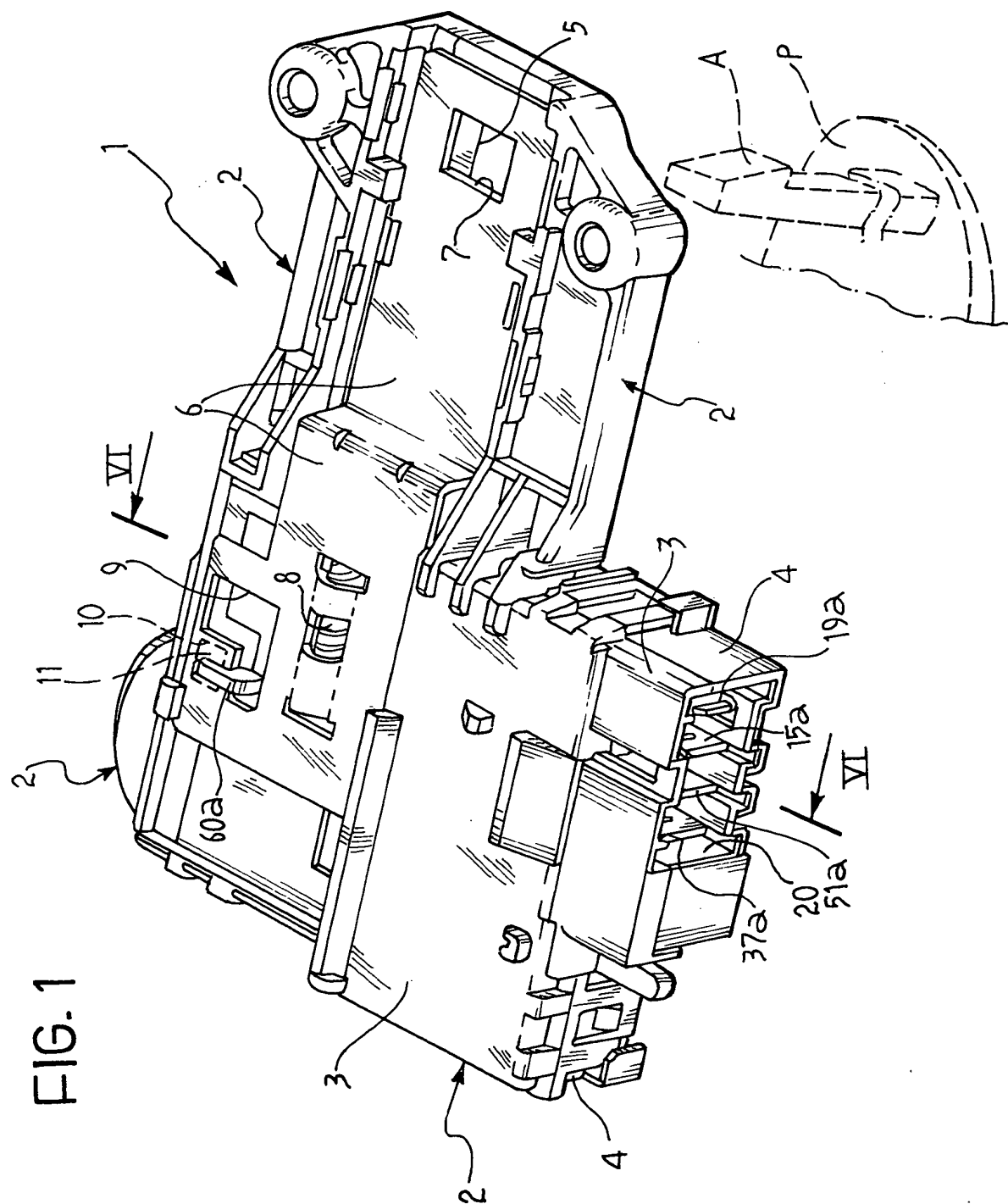


FIG. 2

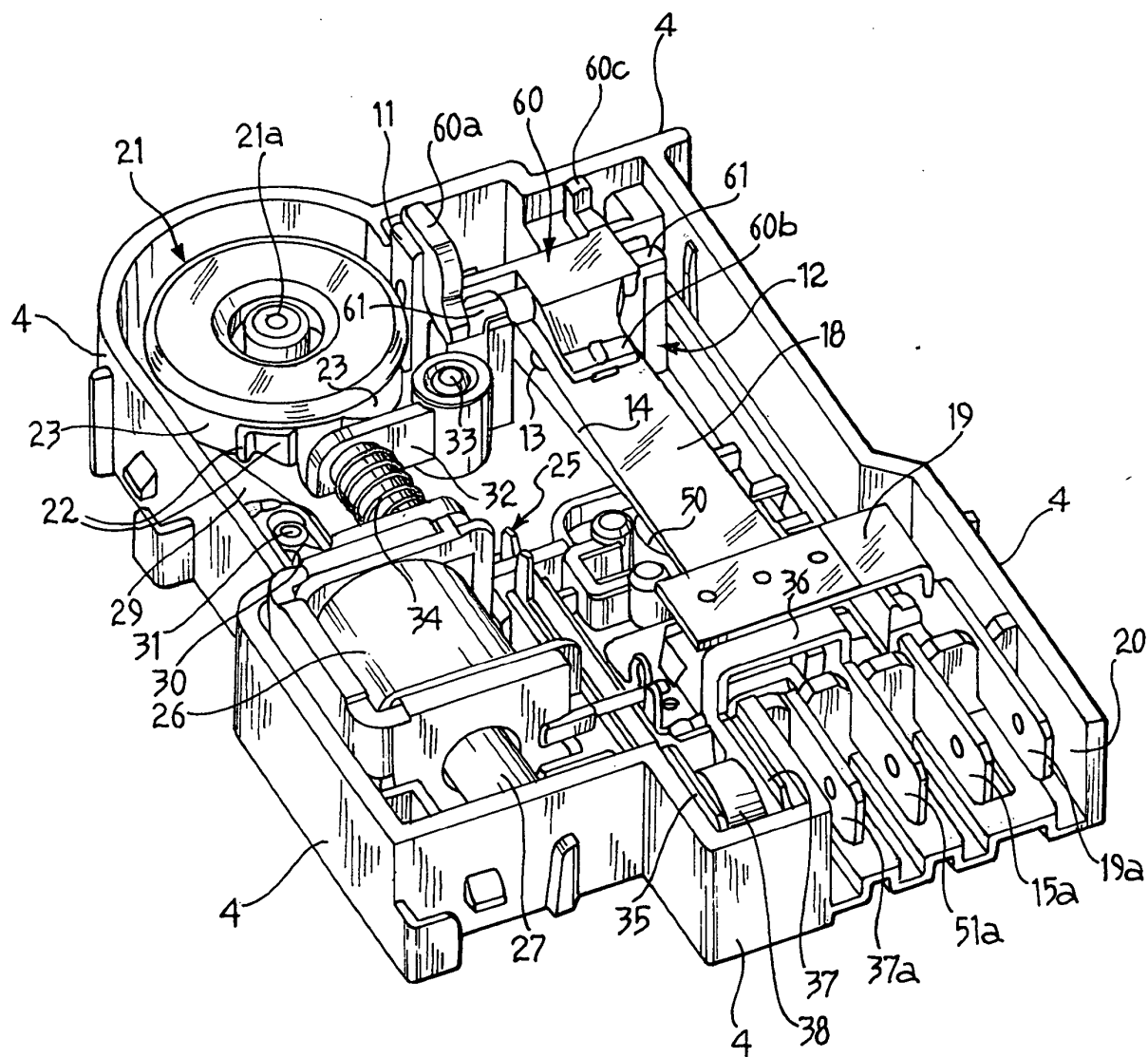


FIG. 3

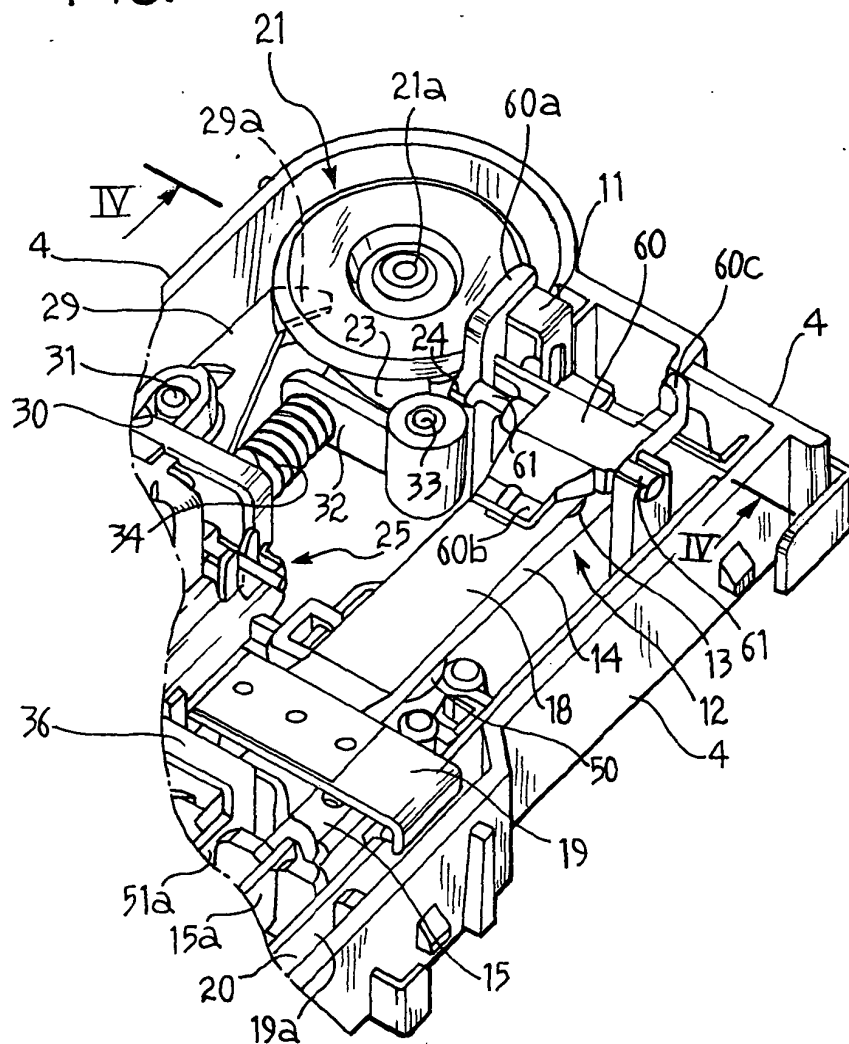


FIG. 4

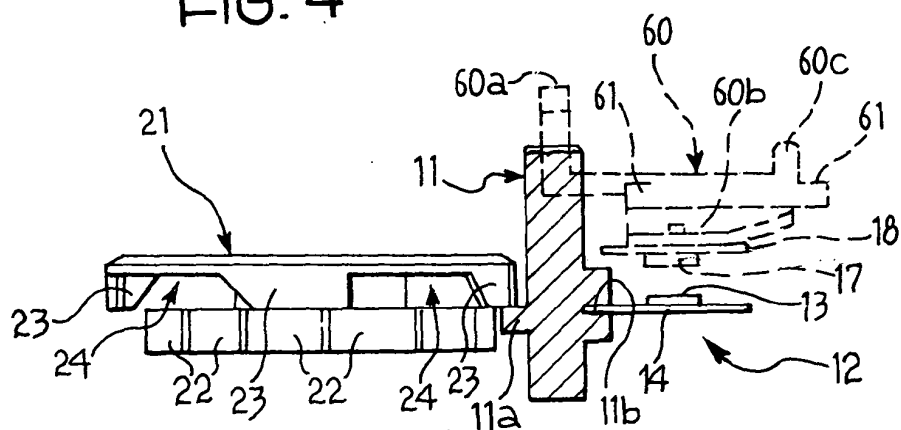


FIG. 5

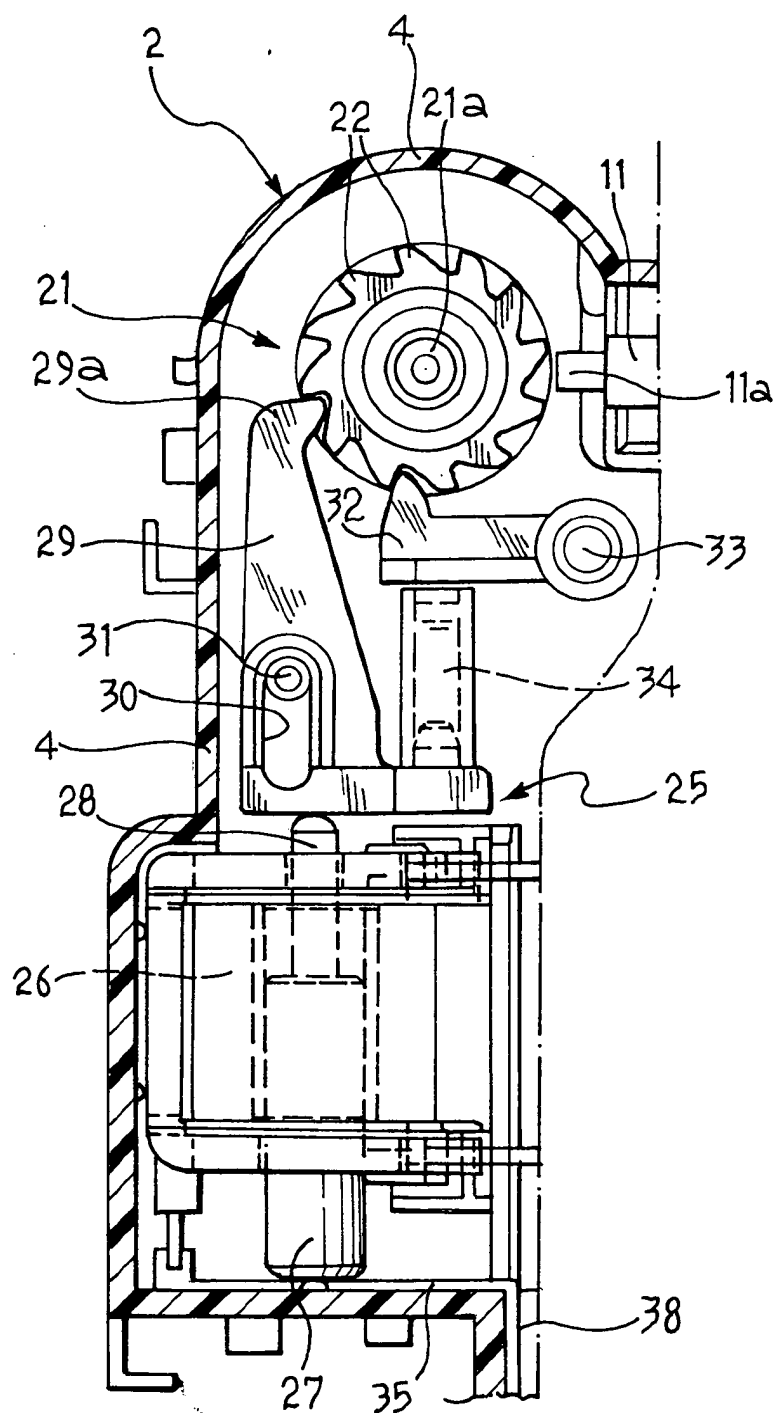


FIG. 6

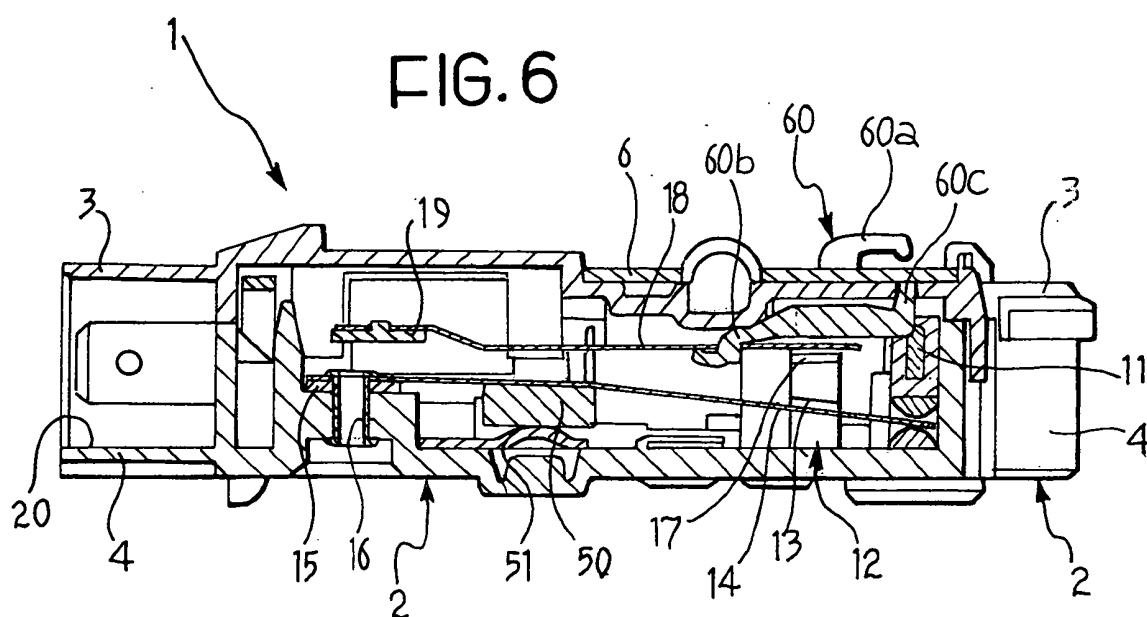
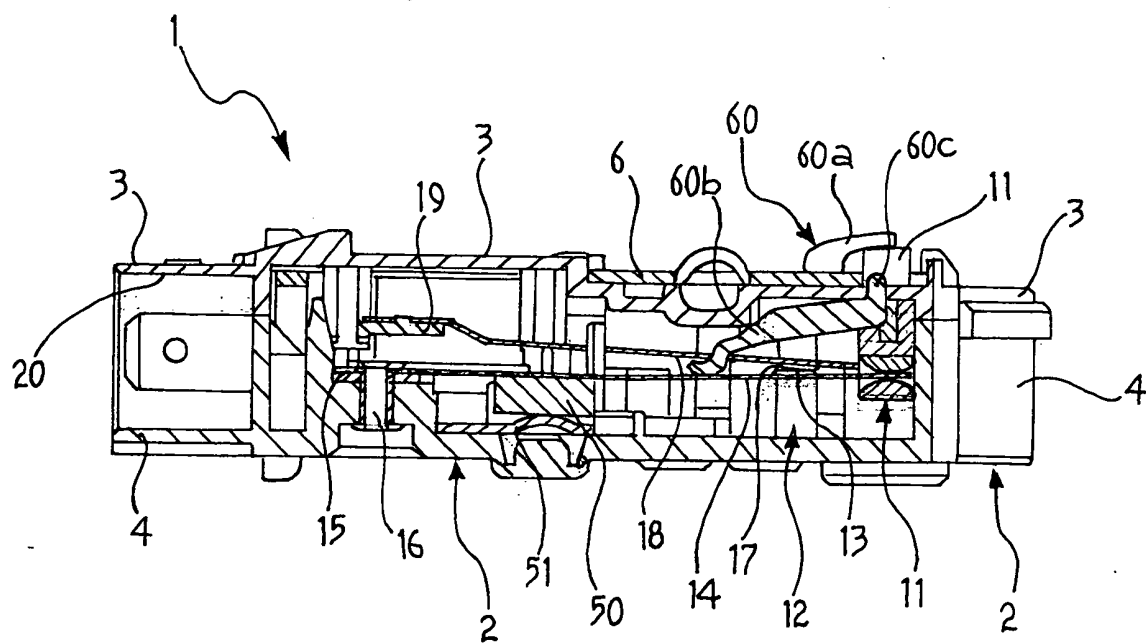


FIG. 8



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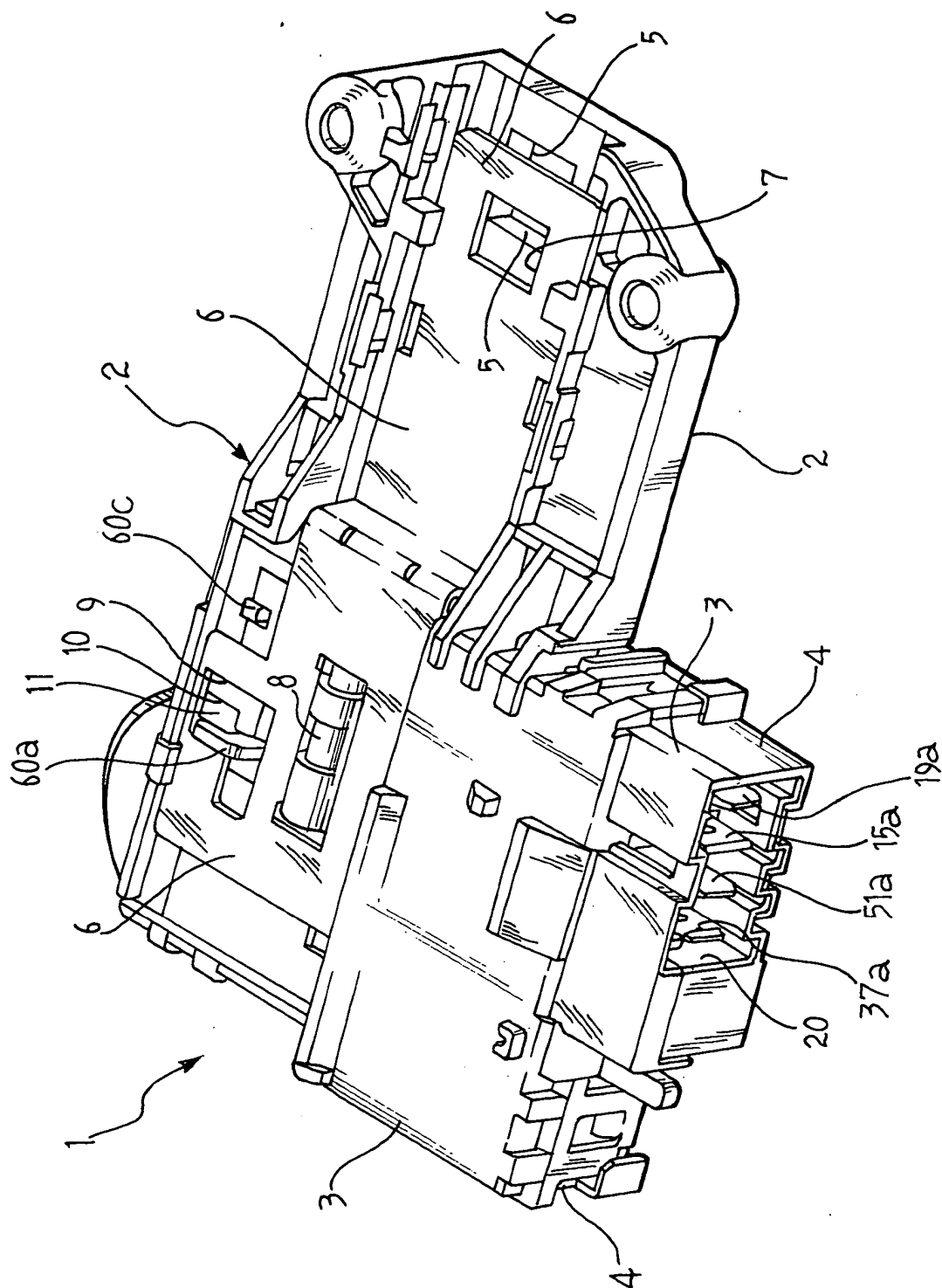
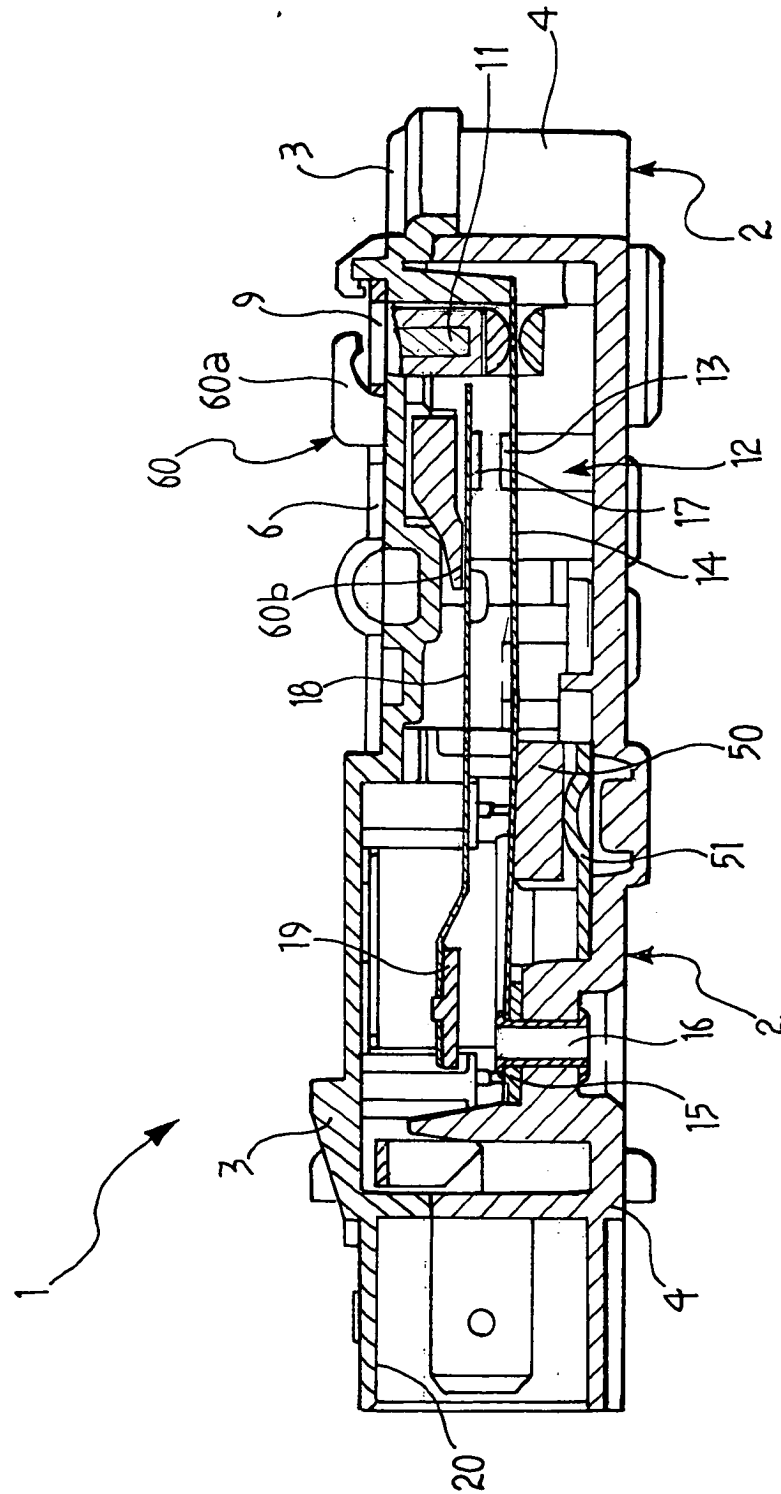


FIG. 9





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 04 00 8426

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 July 2004	Examiner Spitzer, B
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