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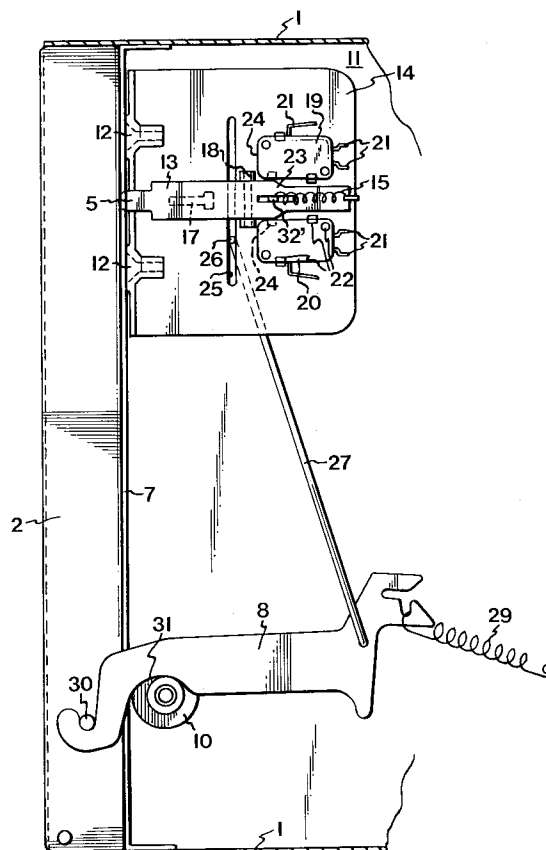
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(54) **Switch device.**

(57) A safety switch device for an apparatus, having a door for sealing the treatment space of the apparatus, has a switching means which returns to a breaking position when the door is opened, thus preventing start or operation of the apparatus. The switch device has an operating means (8) and, cooperating with it, a locking means (26, 27) having a locking position for locking the switching means in the breaking position (Fig. 3). When the door is opened, the locking means is displaced to its locking position and prevents switching the switch device. Also disclosed is a microwave oven equipped with such a safety switch device, as well as the use of one or more such safety switch devices in door-equipped household appliances.

FIG. 2**EP 0 650 311 A1**

The present invention relates to a switch device for use as a safety switch in an apparatus having a door, a protective cover or like means for sealing a treatment space, said switch device being adapted to break a current loop circuit to prevent starting the apparatus when the door is open, and to be switched by a return switching means which during the opening movement of the door returns to a breaking position, in which the current loop circuit is open. The invention also relates to a microwave oven comprising an oven cavity, a microwave source for generating a microwave field in the cavity, a door for sealing the cavity during a cooking process and a safety switch controlled by the position of the door, and to the use of the switch device according to the invention as a safety switch in household appliances having a door for sealing a treatment space.

Present-day household appliances, such as washing machines, tumble-driers, microwave ovens and the like, may involve a risk of injury to the user in case of incorrect handling. To obviate this risk, authorities and consumers place ever higher demands on the reliability of safety devices eliminating undesired conditions of operation of the apparatus concerned. A switch device according to the invention is generally usable in apparatuses having a door for sealing a treatment space to prevent starting and operating the apparatus when the door is not closed. For greater clarity, the invention will however be described in the following with reference to a microwave oven and the particular safety requirements which such an oven should meet.

In general, microwave ovens should provide high safety against microwave leakage. The extent of this leakage must not exceed given limit values, e.g. if the door of the microwave oven is opened more than 2 mm. To achieve this, use is made of safety switches for inactivating the microwave source of the oven when the door is opened. A microwave oven should be equipped with two independent safety switches, at least one of which should be tamper-proof, i.e. not allow manipulation so that the oven can be started when the door is open.

General solutions to this problem reside in using locking and retainer means for the oven door which are adapted to cooperate with the safety switch function. On the whole, there are two basic solutions of this kind. According to the first solution, the safety switch is mounted in a "labyrinth", while the door is provided with movable hooks which slide into corresponding openings in the oven front and which serve to retain the door and to remove a protective element to be able to subsequently act on the safety switch. In this case, any attempt to manipulate the safety switch is prevented by

means of the protective element. According to the second solution, the door is provided with one or two fixed hooks which slide into corresponding openings in the oven front where they operate an unstable rocker device, in turn acting on the safety switch. Any attempt at manipulation means that the rocker device switches to an "inner off-position", which means that the oven cannot be started. To start the oven, the rocker device must be reset, which can only be done by service personnel.

A common drawback of these two approaches is that the door is provided with hooks or like protruding means which are disposed adjacent the free edge of the door and which must have relatively small dimensions to be able, during the rotational movement of the door, to slide into said openings, the dimensions of which must not exceed 3 mm according to current regulations. As a result, the hooks or like means are easily damaged, thus preventing the operation of the oven. The necessity of an accurate fit between the hooks and the openings also places high demands on manufacturing tolerances, which means higher costs. The provision of openings in the oven front, with electric switch devices mounted behind, also involves the risk of access, e.g. with a thin wire, to current-carrying components. To obviate this risk, special protective sleeves must be mounted in the openings.

Examples of the above-described and similar solutions are disclosed in US Patents Nos 4,749,835, 4,542,269, 4,321,445 and 3,898,412, as well as in DE-A1-38 39 404 and SE Patent No. 7811624-1. In addition to the shortcomings described above, all the constructions disclosed in these publications comprise a relatively large number of mechanical components requiring accurate fit for mounting, and sometimes subsequent adjustment as well. This makes these constructions expensive and less suited for mass production.

The object of the invention is to provide a switch device which does not suffer from the drawbacks inherent in the known devices, and which is of a simple and robust design well suited for mass production.

According to the invention, this object is achieved by means of a switch device of the type described by way of introduction, which is characterised by an operating means associated with the door and adapted to be displaced by the opening movement of the door, and a locking means cooperating with the operating means and having a locking position for locking the switching means in the breaking position when the door is open, the displacement of the operating means, during the initial opening movement of the door, bringing about a displacement of the locking means to the locking position, so as to prevent switching the

switch device.

An advantage achieved by the invention is that the locking of the switching means of the switch device in a breaking position is directly controlled by the movement of the door, thus preventing any displacement of the switching means by manipulation. Moreover, the invention confers the advantage of a completely smooth engagement surface without any protruding parts on the oven door for its engagement against the oven front, which also facilitates cleaning the oven door.

A preferred embodiment of the switch device according to the invention, in which the switching means comprises a slide device with a transverse locking groove and the locking means comprises a locking member insertable in the locking groove, and in which a switch holder is provided adjacent the opening plane of the treatment space and the slide device has an engagement portion which in the breaking position projects through an opening in a front portion of the apparatus cooperating with the door, and which in a closing position is inserted in the front portion by direct action of the door, is characterised in that the slide device is adapted to slide along the switch holder, that the locking means comprises a locking arm which, at one end, is rotatably connected to said operating means and, at the other end, carries said locking member, and that the switch holder has a guide groove which is provided transverse to the path of movement of the slide device and in which the locking member of the locking arm slides during the opening movement of the door, the locking member being inserted in the locking groove when this comes to a position in registry with the guide groove.

Since the slide device is thus provided with a projecting engagement portion which, when the door is opened, is locked in an extended position, any problem relating to an opening in the front portion of the apparatus that may allow manipulation of the switch device, as well as the risk of providing access through the opening to current-carrying parts of the apparatus are eliminated without necessitating the use of special protective sleeves.

Other preferred embodiments of the switch device according to the invention will appear from the appended claims.

A microwave oven according to the invention, comprising an oven cavity, a microwave source for generating a microwave field in the cavity, a door for sealing the cavity during a cooking process, and a door switch serving as a safety switch for closing and breaking an activating current loop circuit for the microwave source, said door switch comprising a returning switching means which can be set in a breaking position or in a closing posi-

tion depending on the position of the door, said switching means returning to the breaking position to break the current loop circuit and preventing or interrupting the activation of the microwave source when the door is opened, while the switching means occupies the closing position to close the current loop circuit and allows activation of the microwave source when the door is being closed, is characterised by an operating means associated with the door and adapted to be displaced by the opening movement of the door, and a locking means cooperating with the operating means and having a locking position for locking the switching means in the breaking position when the door is open, said displacement of the operating means during the initial opening movement of the door bringing about a displacement of the locking means to the locking position, whereby to prevent switching the door switch.

Other features of a microwave oven according to the invention will appear from the appended claims.

To meet the demands set out above in respect of two independent safety switches, such a microwave oven may preferably comprise two switch devices of the type described, which are designed as two door switches.

According to the invention, the switch device can be used in different types of household appliances equipped with a door for sealing a treatment space, e.g. washing machines and tumble-driers, to eliminate the risk of injuries in case of incorrect handling.

The invention will be described in more detail hereinbelow when used in a microwave oven with reference to the accompanying drawings, in which:

Fig. 1 shows a microwave oven according to the invention,

Fig. 2 is a detailed side view of the oven in Fig. 1 with the oven casing removed and with the door in closed position, illustrating the switch device according to the invention,

Fig. 3 is a view similar to that of Fig. 2, but with the door in a slightly open position,

Fig. 4 is a side view of the switch holder in Figs 2 and 3,

Figs 5a, 5b is a top plan view and a side view, respectively, of the switching slide included in the switch device, and

Fig. 6 is a front view of the locking arm in Figs 2 and 3.

Like parts in the Figures have like reference numerals.

The microwave oven shown in Fig. 1 has a casing 1 enclosing a treatment space in the form of a cavity 6. The cavity can be sealed by the front folding door 2, which in closed position engages the oven front 7. The control panel 3 of the micro-

wave oven is provided below the opening of the cavity. The oven door 2 is pivoted at its lower edge and balanced by two balancing arms 8, 9 extending through corresponding openings in the oven front 7 into a space between the cavity wall and the casing 1. Adjacent the upper edge of the cavity opening, engagement portions 4, 5 project through corresponding openings in the oven front 7. The engagement portions 4, 5 each pertain to a switching slide means in two switch devices according to the invention which are integrated in the above-mentioned space defined between the cavity wall and the casing. In the illustrated open position of the door, the respective engagement portions are locked in the illustrated, extended position, as will appear from the following.

Fig. 2 is a detailed side view of the oven in Fig. 1 with the oven casing 1 removed. The Figure shows a switch holder 11 mounted by screw joints 12 in the oven front 7 at the upper edge of the cavity opening. The switch holder 11 carries a slide device 13 which is displaceable along the base plate 14 of the switch holder when its engagement portion 5 is acted on by the oven door 2 in a direction against the force of a tension spring 15 tending to displace the slide device to the illustrated extended position with the engagement portion 5 projecting through the oven front 7. The movement of the slide device 13 on the base plate is controlled by guide means 16 (see Fig. 5) running in a groove 17 in the base plate, as indicated by dashed lines. Similar guide means and guide grooves are provided at both ends of the slide device. As appears more clearly from Figs 5a and 5b, the slide device 13 has a transverse locking groove 18.

The base plate of the switch holder is provided with two switches 19, 20 having electric connection legs 21. The switches 19, 20 are retained on the switch holder by fixing means 22. The slide device 13 has two cam surfaces 23 which in the present case are slightly offset with respect to each other in the longitudinal direction of the slide device. The cam surfaces 23 cooperate with return switching studs 24 on the respective switch.

The base plate 14 has a vertical guide groove or slot 25, in which runs a locking member 26 mounted in one end of a locking arm 27. The locking member 26 is maintained in the guide groove 25 by a guide yoke 28 (see Fig. 4) on the base plate 11, through which the locking arm 27 extends. The other end of the locking arm 27 is mounted at one end of a balancing arm 8 which is loaded by a tension spring 29 and whose other end is rotatably anchored in the oven door 2 by means of a bearing pin 30. The balancing arm 8 has a cam curve 31 passing over a guide wheel 10. The balancing arm 8, the wheel 10 and the tension

spring 29 ensure retention of the door 2 against the oven front 7 while pressing the engagement portion 5 of the slide device 13 against the force exerted by the tension spring 15.

Fig. 3 is a view similar to that of Fig. 2, but differs therefrom by the door 2 having been slightly opened, whereby the slide device 13 has occupied its extended position with the engagement portion 5 projecting through the oven front 7. The balancing arm 8 occupies a slightly raised position and, hence, has displaced the locking member 26 of the locking arm 27 upwards in its guide groove 25. In this manner, the locking member 26 has been brought into engagement with the locking groove 18 of the slide device 13.

In the illustrated extended position, the slide device 13 occupies its breaking position in that the studs 24 of the switches have left the cam surfaces 24, whereby the switches have returned to a position preventing the oven from being started, or interrupting a cooking process already in progress. In the position of the door 2 shown in Fig. 3, the slide device 13 is thus locked in its forwardly extended position by the locking member 26 being in engagement with the locking groove 18. The locking of the slide device in this position prevents activation of the microwave source of the oven with the door in the illustrated position, by manipulating the switch device.

The side view in Fig. 4 shows the switch holder 11 with the switches 19, 20 and the slide device 13 removed. One side of the base plate carries the fixing means 22 for the switches, and the other side carries the guide yoke 28 for the locking arm 27.

Fig. 5a shows the slide device 13 from above in accordance with Figs 2 and 3, while Fig. 5b shows the slide device from the side. As appears from these Figures, the slide device has a transverse locking groove 18 on its underside facing the base plate 14. This underside is also provided with two T-shaped guide means 16 insertable in a respective widened portion of the guide grooves 17 to be brought into engagement, thanks to their T shape, with the narrow portion of the guide grooves. The slide device is provided at its front end with the engagement portion 5 and at its rear end with a fixing means for the tension spring 15. A corresponding fixing means 32' is provided on the base plate 14 (see Fig. 2). The slide device has an open groove or slot 33, in which the fixing means 32' moves when the slide device is displaced in its longitudinal direction.

Fig. 6 shows the locking arm 27 in more detail. The locking arm consists of a rigid metal wire provided at one end with a locking member 26 consisting of an angled portion of the locking arm. At its other end, the locking arm has a bent portion

34 to be inserted in the mounting hole provided for the locking arm in the balancing arm 8. At 35, the locking arm has a slight bend allowing the displacement of the locking arm in the space between the switch holder and the wall of the cavity 6 without engaging either one.

With reference to Figs 2 and 3, the switch device operates as follows. When the door 2 is opened, the slide device 13 is successively pulled forwards by the tension spring 15. At the same time, the locking member 26 is moved upwards in the guide groove 25 by the locking arm 27 and the balancing arm 8 when the cam curve 31 is pulled over the guide wheel 10 by the opening movement of the door. When this opening movement continues, the slide device 13 reaches its extended breaking position shown in Fig. 2, and the locking groove 18 of the slide device 13 at the same time comes to a position in registry with the guide groove 25, whereby the locking member 26 is inserted in the locking groove 18 so as to lock the slide device. When the door is again closed, the locking member 26 is pulled out of the locking groove 18 and releases the slide device 13, while the door 2 at the same time enters into engagement with the engagement portion 5 and urges the slide device 13 rearwards to its closing position against the force exerted by the spring 15. The balancing arm is retracted by the spring 29, and the cam curve 31 enters into engagement with the guide wheel 10 so as to retain the door 2 against the oven front 7.

It is understood that those skilled in the art may perceive alternative detail solutions within the scope defined by the appended claims. The application as described above and shown in the drawings should therefore be regarded as a non-restrictive embodiment of the invention.

Claims

1. A switch device for use as a safety switch in an apparatus having a door (2), a protective cover or like means for sealing a treatment space (6), said switch device being adapted to break a current loop circuit to prevent the apparatus from being started when the door is open, and to be switched by a return switching means (5, 13) which during the opening movement of the door returns to a breaking position, in which the current loop circuit is open, **characterised by**

an operating means (8) associated with the door and adapted to be displaced by the opening movement thereof, and

a locking means (26, 27) cooperating with said operating means and having a locking position for locking the switching means in said

breaking position when the door is open, said displacement of the operating means, during the initial opening movement of the door, bringing about a displacement of the locking means to said locking position, to prevent switching the switch device.

2. A switch device as claimed in claim 1, in which said switching means comprises a slide device (13) which during the switching operation is displaced along a path of movement, **characterised in**

that the slide device has a locking groove (18) which is transverse to said path of movement, and

that said locking means comprises a locking member (26) insertable in the locking groove,

said locking position being attained by inserting the locking member in the locking groove during the initial opening movement of the door, whereby to lock the slide device in said breaking position (Fig. 3).

3. A switch device as claimed in claim 2, in which said safety switch comprises a switch holder (11) arranged adjacent the opening plane of the treatment space, said slide device having an engagement portion (5) which in said breaking position projects through an opening in a front portion (7) of the apparatus cooperating with the door, and which in the closing position is inserted in said front portion by direct action of the door, **characterised in**

that the slide device is adapted to slide along the switch holder,

that the locking means has a locking arm (27) which, at one end, is rotatably connected to said operating means (8) and, at the other end, carries said locking member (26), and

that the switch holder has a guide groove (25) which is arranged transverse to the path of movement of the slide device and in which the locking member (26) of the locking arm (27) slides during the opening movement of the door,

the locking member being inserted in the locking groove (18) when this comes to a position in registry with the guide groove (25).

4. A switch device as claimed in claim 3, **characterised in**

that the switch holder comprises a base plate (14),

that the slide device is arranged on one side of the base plate with the locking groove (18) facing the base plate,

that the guide groove (25) consists of a

slot through the base plate, and

that the locking element is an angled portion (26, Fig. 6) of the locking arm extending through the guide groove from the other side of the base plate.

5. A microwave oven comprising an oven cavity (6), a microwave source for generating a microwave field in the cavity, a door (2) for sealing the cavity during a cooking process, and a door switch serving as a safety switch for closing and breaking an activating current loop circuit for the microwave source, said door switch comprising a return switching means (5, 13) which can be set in a breaking position (Fig. 3) or in a closing position (Fig. 2) depending on the position of the door, said switching means returning to the breaking position to break the current loop circuit and preventing or interrupting the activation of the microwave source when the door is opened, while the switching means occupies the closing position to close the current loop circuit and allow activation of the microwave source when the door is being closed, **characterised** by

an operating means (8) associated with the door and adapted to be displaced by the opening movement of the door, and

a locking means (26, 27) cooperating with the operating means and having a locking position for locking the switching means in the breaking position when the door is open, said displacement of the operating means, during the initial opening movement of the door, bringing about a displacement of the locking means to the locking position, whereby to prevent switching the door switch.

6. A microwave oven as claimed in claim 5, in which said switching means comprises a slide device (13) which during the switching operation is displaced along a path of movement, **characterised** in

that the slide device has a locking groove (18) transverse to said path of movement, and

that the locking means comprises a locking member (26) insertable in said locking groove,

said locking position being obtained by the insertion of the locking member in the locking groove when the slide device returns to the breaking position during the initial opening movement of the door, whereby to lock the slide device in this position.

7. A microwave oven as claimed in claim 6, in which the door switch comprises a switch hold-

er (11) having a base plate (14) arranged adjacent to the opening plane of the treatment space, the slide device (13) having an engagement portion (5) which in the breaking position projects through an opening in a front portion (7) of the oven cooperating with the door, and which in the closing position is inserted in said front portion by direct action of the door, **characterised** in

that the slide device is adapted to slide in its path of movement along one side of the base plate with its locking groove facing the base plate,

that the locking means comprises a locking arm (27) which, at one end, is rotatably connected to said operating means (8) and, at the other end, has an angled portion (26, Fig. 6) forming said locking member, and

that the base plate has, extending through it, a guide groove or slot (25) which is transverse to the path of movement of the slide device and in which the angled portion of the locking arm slides during the opening movement of the door,

the angled portion of the locking arm extending from the other side of the base plate through the guide groove therein to be inserted in the locking groove when this comes to a position in registry with the guide groove.

8. A microwave oven as claimed in claim 7, comprising a casing (1) enclosing the cavity (6) and defining a space between the cavity wall and the casing, the switch holder (11) being mounted in said space with the engagement portion (5) of the slide device provided for cooperating with the free edge side of the door, **characterised** in

that the locking arm (27) is adapted to extend between the cavity wall and the base plate (14) of the switch holder, and

that the switch holder is provided with a guide means (28) detaching the locking arm from the cavity wall and retaining its angled portion in the guide groove.

9. A microwave oven as claimed in any one of claims 5-8, comprising a spring-biased balancing arm (8, 29) for balancing the weight of the door and damping its opening movement, said balancing arm having a cam curve (31) passing over a support member (10) and retaining the door in closed position, **characterised** in

that the balancing arm (8) is adapted also to act as said operating means by one end of the balancing arm being rotatably connected to the locking means (26, 27) and by its other end being rotatably connected to the door (2,

30), while the cam curve, combined with the length of the balancing arm, is adapted to move the locking means to an adequate extent even upon a small opening movement of the door.

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10. The use of a switch device as claimed in any one of claims 1-4 as a safety switch, alternatively two or more such switch devices as independently operating safety switches, in a microwave oven, a washing machine, a tumble-drier or other household appliance provided with a door or like means for sealing a treatment space, to prevent intentional or unintentional start or operation of the apparatus when the door is not closed.

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FIG.1

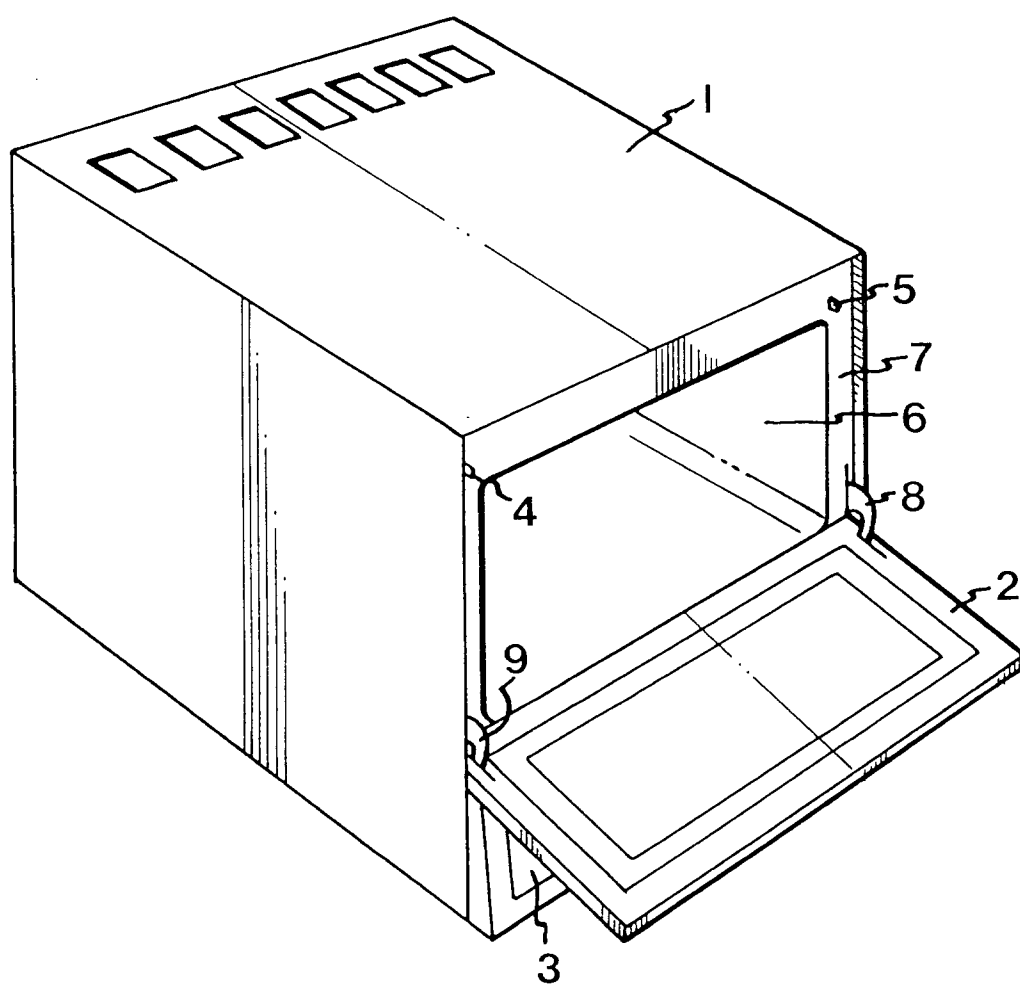


FIG. 2

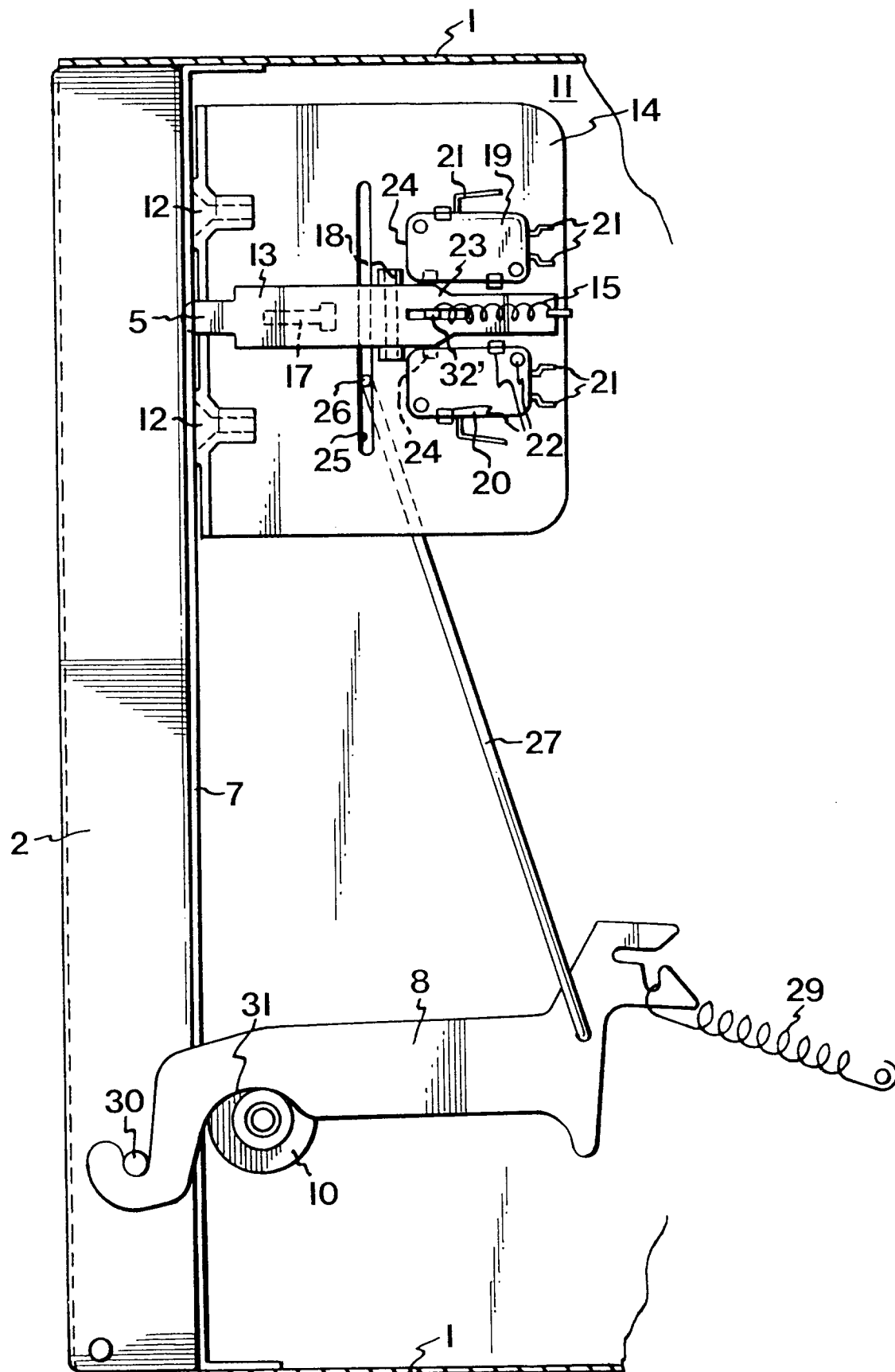


FIG.3

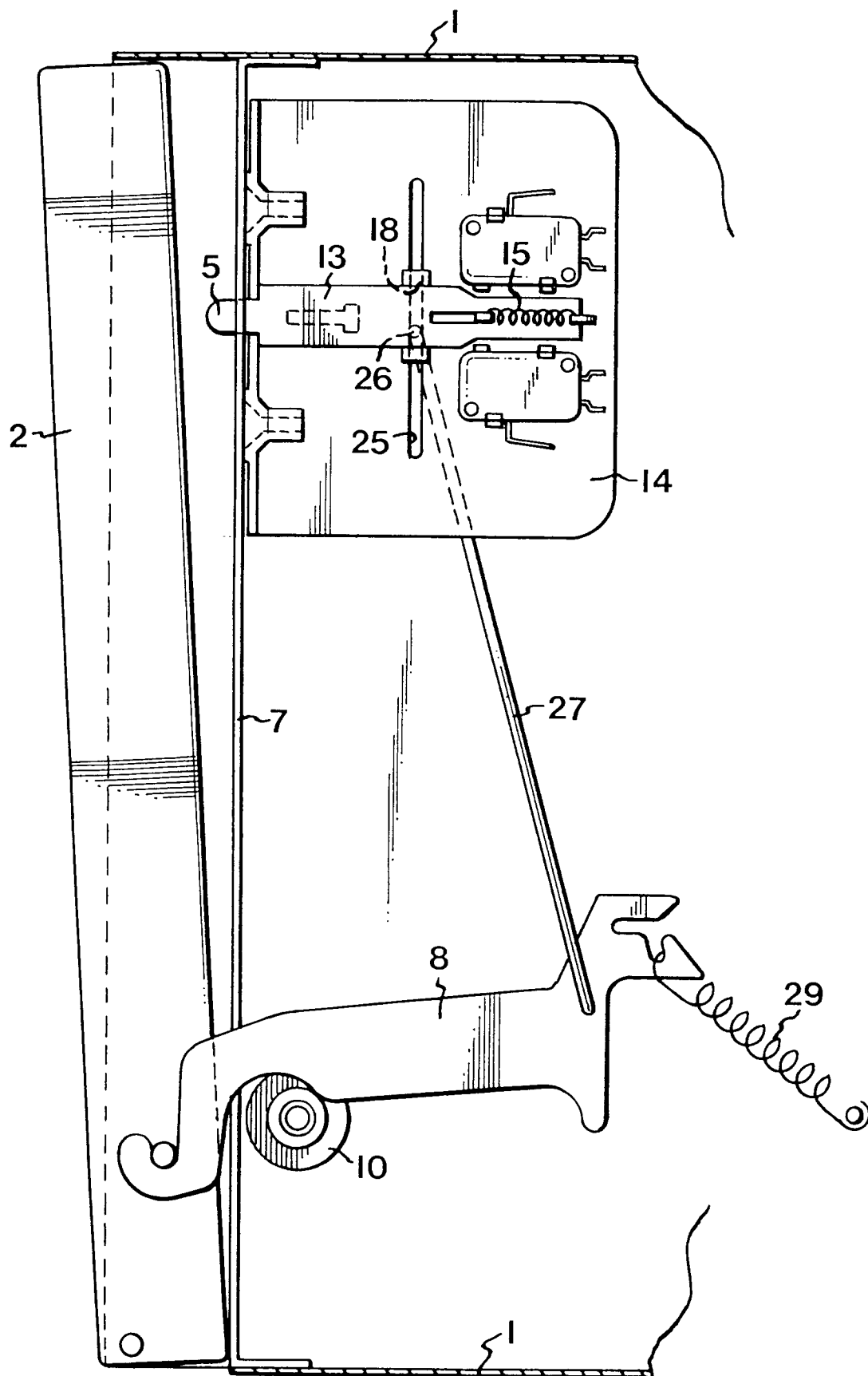


FIG.4

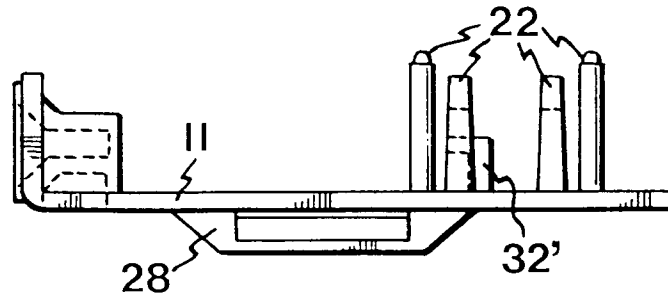


FIG.5a

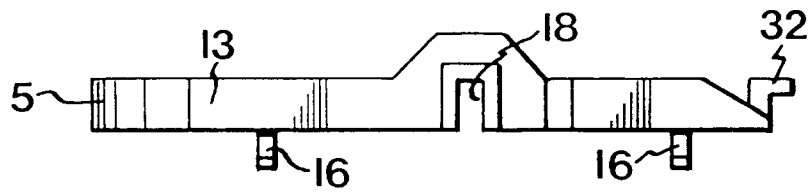


FIG.5b

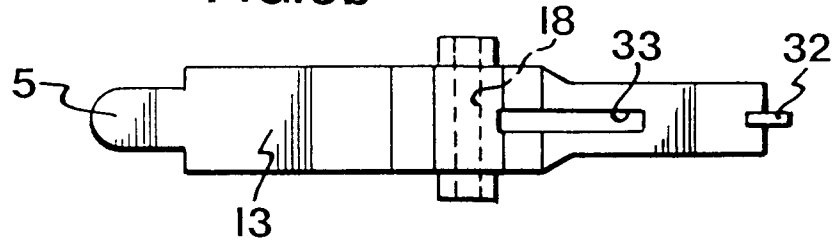
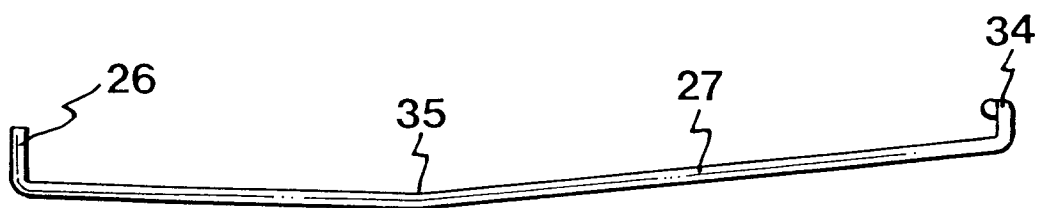


FIG.6





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EUROPEAN SEARCH REPORT

Application Number
EP 93 11 7138

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.6)
X	EP-A-0 058 207 (MATSUSHITA ELECTRIC INDUSTRIAL CO.) * page 7, line 24 - page 10, line 22; figures 1-7 *	1,5,10	H05B6/76
A	---	2,3,6,7	
X	US-I-B549964 (C.M. TIPPY ET AL) * column 2, line 56 - column 4, line 52; figures 1-5 *	1,5,10	
A	---		
A	US-A-4 201 901 (B.O. SCHUCHERT) * figures 1-4 *	9	
A	---		
A	GB-A-2 010 954 (SHARP K.K.) ---		
D,A	US-A-3 898 412 (E.W. ROBINSON ET AL.) -----		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H05B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 4 March 1994	Examiner Albertsson, E
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	