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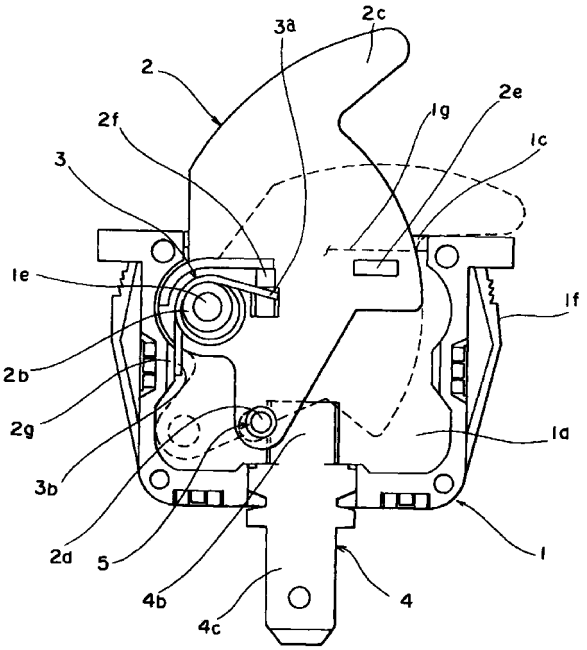
(54) Switch device

(57) A switch device for a refrigerator is disclosed wherein, even in the event of occurrence of an arc in contact portions at the time of switching, contact portions in the initial abutment and contact portions to be kept in a contacted state are made different from each other to prevent an increase of contact resistance and which, due to a sliding motion, can attain a cleaning effect for the surfaces of contact portions, thus permitting the contact resistance to be stabilized, and can therefore be applied even to a switch used with a very small current. The switch device comprises a case having a receptacle portion, an operating lever attached to the case movably, a return spring for urging the operating lever in a return direction, a fixed contact disposed within the case, and a movable contact retained at a free end of the operating lever and adapted to move into contact with and away from the fixed contact, wherein an abutment portion of the movable contact for abutment against the fixed contact is formed using an elastically deformable material, the abutment portion of the movable contact, during return of the operating lever in its return direction with the urging force of the return spring, comes into abutment against the fixed contact and undergoes a further elastic deformation under the urging force of the return spring, while when the operating lever stops, the abutment portion of the movable contact comes into contact with the fixed contact at a position different from the abutment position assumed during the return of the operating lever.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a switch device for turning ON and OFF a cooling motor or turning ON and OFF interior lighting of a refrigerator, in interlock with opening and closing of a door of the refrigerator. Particularly, the invention is concerned with a structure of a switch device provided with a contact structure applicable to both AC and DC.

2. Description of the Prior Art

[0002] As a conventional structure of a switch device for a refrigerator there is known such a structure as shown in Figs. 7 and 8. Fig. 7 is a front view of a switch device for a refrigerator with a case on one side removed and Fig. 8 is an explanatory diagram showing a state of abutment of a movable contact against a fixed contact in the switch device.

[0003] In both figures, a case 11, which is formed of an insulating material such as a synthetic resin, has an opening 11a formed in an upper surface thereof and also has a receptacle portion 11b formed in the interior thereof. A pair of fixed contacts 12a each formed by an electrically conductive metallic plate such as bronze are fixed to an inside bottom of the receptacle portion 11b. On the side opposite to the fixed contacts 12a are formed a pair of fixed terminals 12b projecting outwards of the case 11.

[0004] An operating lever 13 is also formed of an insulating material such as a synthetic resin, and centrally of the operating lever 13 is formed a rotary shaft 13a which is supported by the receptacle portion 11b of the case 11. A return spring 14 constituted by a torsion coiled spring which urges the operating lever 13 in a return direction of the lever is mounted on the rotary shaft 13a. A free end on one end side of the return spring 14 is engaged with one side portion 11c of the case 11, while a free end on the opposite end side of the return spring is engaged with a spring retaining portion 13b of the operating lever 13.

[0005] On one end side of the operating lever 13 is formed an operating portion 13c which projects from the opening 11a of the case and which is operated from the exterior, while on the opposite end side of the operating lever is formed a contact holding portion 13d for holding a movable contact. With an urging force of the return spring 14, the operating portion 13c of the operating lever 13 is normally urged in a projecting direction from the opening 11a.

[0006] A movable contact 15 is formed in the shape of a rod of a round section using an electrically conductive metallic material such as iron or bronze. A middle portion of the movable contact 15 is held by the contact holding portion 13d of the operating lever 13 and both end portions thereof exposed from the contact holding portion 13d serve as abutment portions (contact portions) 15a against the paired fixed contacts 12a.

[0007] The operation of the above conventional switch device will be described below.

[0008] With the door of the refrigerator closed, the operating portion 13c of the operating lever 13 in the switch device is pushed by the door and is urged in a direction not projecting from the opening 11a of the case 11 against the urging force of the return spring 14. In this case, the movable contact 15 held by the free end on the opposite end side of the operating lever 13 is urged in a direction leaving the paired fixed contacts 12a which are fixed to the inside bottom of the receptacle portion 11b of the case 11, with the contacts being OFF.

[0009] Next, when the door of the refrigerator is opened, the operating lever 13 is urged in its projecting direction from the opening 11a of the case 11, so that the movable contact 15 is urged in the direction of its abutment against the paired fixed contacts 12a, with the contacts turning ON upon contact of the movable contact 15 with the paired fixed contacts 12.

[0010] However, in the above conventional switch device structure for a refrigerator, since the cooling motor and the interior lighting of the refrigerator are turned ON and OFF interlockedly with opening and closing motions of the refrigerator door, an arc forms at the time of switching. Consequently, due to the arc generated upon contact of the movable contact 15 with the fixed contact 12a, the surfaces of the contact portions become rough and the thus-roughened contact portions are kept in contact with each other as contact portions, so that the contact resistance of the contact portions becomes larger, causing a poor contact. In addition, the deterioration of the contact portions is marked, thus giving rise to a problem also in point of service life of the contacts.

[0011] Further, because of a large contact resistance of the contact portions, if the above conventional switch device structure is applied to a switch using a relatively very small current such as DC (secondary side) power, the contact becomes unstable and thus such an application has heretofore been difficult.

SUMMARY OF THE INVENTION

[0012] Accordingly, it is an object of the present invention to solve the above-mentioned problems and provide a switch device for a refrigerator wherein, even in the event of occurrence of an arc in contact portions at the time of switching, contact portions in the initial abutment and contact portions to be kept in a contacted state are made different from each other to prevent an increase of contact resistance and which, due to a sliding motion, can attain a cleaning effect for the surfaces of contact portions, thus permitting the contact resist-

ance to be stabilized, and can therefore be applied even to a switch used with a very small current.

[0013] For solving the above-mentioned problems, in the first aspect of the present invention there is provided a switch device comprising a case having a receptacle portion, an operating lever attached to the case movably, a return spring for urging the operating lever in a return direction, a fixed contact disposed within the case, and a movable contact retained at a free end of the operating lever and adapted to move into contact with and away from the fixed contact, wherein an abutment portion of the movable contact for abutment against the fixed contact is formed using an elastically deformable material, the abutment portion of the movable contact comes into abutment against the fixed contact during return of the operating lever in its return direction with the urging force of the return spring and undergoes a further elastic deformation under the urging force of the return spring, while when the operating lever stops, the abutment portion of the movable contact comes into contact with the fixed contact at a position different from the above abutment position assumed during the return of the operating lever.

[0014] In the second aspect of the present invention, the movable contact is formed by a coiled spring, the urging force of the return spring for urging the operating lever is set higher than that of the coiled spring of the movable contact, thereby causing the movable contact to undergo an elastic deformation against the biasing force of the coiled spring.

[0015] In the third aspect of the present invention, a pair of such fixed contacts as mentioned above are disposed opposedly to each other in a winding core direction of the coil of the movable contact, the paired fixed contacts having abutment faces for abutment against the abutment portion of the movable contact, the abutment faces being each formed as a slant face which is concave toward the center between the paired fixed contacts opposed to each other, and the abutment portion of the movable contact moves along the slant face.

[0016] In the fourth aspect of the present invention, a stopper portion is provided between the operating lever and the case, the stopper portion failing to operate while the operating lever stops but operating to prevent the movement of the operating lever when the operating lever moves from its stop condition in a direction in which the contact pressure of the movable contact increases relative to the fixed contact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a front view of a switch device for a refrigerator according to an embodiment of the present invention, with a case on one side removed;

Fig. 2 is an explanatory diagram showing a state of abutment between a movable contact and fixed contacts in the switch device;

Fig. 3 is a plan view showing a fixed terminal used in the switch device;

Fig. 4 is a front view of the fixed terminal;

Fig. 5 is a front view showing a movable contact used in the switch device;

Fig. 6 is a side view of the movable contact;

Fig. 7 is a front view of a conventional switch device for a refrigerator, with a case on one side removed; and

Fig. 8 is an explanatory diagram showing a state of abutment between a movable contact and fixed contacts in the conventional switch device.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0018] An embodiment of the present invention will be described below with reference to Figs. 1 to 6, of which Fig. 1 is a front view of a switch device for a refrigerator, with a case on one side removed, Fig. 2 is an explanatory diagram showing a state of abutment between a movable contact and fixed contacts in the switch device, Fig. 3 is a plan view of a fixed contact, Fig. 4 is a front view of a movable contact, and Fig. 6 is a side view of the movable contact.

[0019] In these figures, a case 1 is formed of an insulating material such as a synthetic resin and has an opening 1c formed in an upper surface thereof. Contiguous to the opening 1c is a receptacle portion 1d in which are accommodated components such as an operating lever to be described later. The case 1 is made up of a left case 1a and a right case 1b which are symmetric right and left. The left and right cases 1a, 1b are put one on the other in such a manner that the respective spaces for the receptacle portion 1d are opposed to each other, thereby forming the case 1 which is in the shape of a box having the receptacle portion 1d in the interior thereof. In the receptacle portion 1d thus formed by the left and right cases 1a, 1b there are provided a pair of pivot shafts 1e opposedly to each other. An operating lever to be described later is supported by the pivot shafts 1e. On both sides of the case 1 are formed a pair of hook portions 1f, whereby the switch device is mounted and fixed to a mounting panel of a refrigerator or the like.

[0020] The operating lever 2 is also formed of an insulating material such as a synthetic resin, and at one end of its middle portion there is disposed a cylindrical rotary shaft 2b having an axial bore 2a which is supported pivotably by the pivot shafts 1e of the case 1. At one free end of the operating lever 2 with respect to the rotary shaft 2b there is formed an operating portion 2c which is projected from the opening 1c of the case 1 and which is turned around the rotary shaft 2 upon abutment thereof against a door of a refrigerator or the like. At an opposite free end of the operating lever 2 is formed a contact holding hole 2d in which a movable contact to

be described later is held for movement into contact with and away from fixed contacts to be described later. At the middle portion of the operating lever 2 and on the side opposite to the rotary shaft 2b are formed lugs 2e projecting outward from both side faces of the operating lever 1. The lugs 2e come into abutment against inner top edges 1g of the opening 1c in the case 1 to stop the turning motion of the operating lever 2. Thus, the lugs 2e serve as stopper portions.

[0021] A return spring 3 is formed by a torsion coiled spring using a wire rod for spring. A central coil portion of the return spring 3 is fitted on the rotary shaft 2b of the operating lever 2 and is supported thereby. An operating end portion 3a as one free end which serves as an urging force operating point is retained by a spring retaining portion 2f of the operating lever 2, while a fulcrum end portion 3b as the other free end which serves as a fulcrum is in abutment against a spring abutment portion 2g formed on an inner side face of the receptacle portion 1d of the case 1. Thus, with the operating lever 2 and the return spring 3 incorporated in the receptacle portion 1d, the operating lever 2 is urged in a projecting direction from the opening 1c of the case 1.

[0022] A fixed terminal 4 is formed of an electrically conductive metallic material such as bronze and the surface thereof is plated with a noble metal such as nickel or silver. A base portion 4a of the fixed terminal is fixed to an inside bottom of the receptacle portion 1d of the case 1 by, for example, press-fitting or caulking. The fixed terminal 4 comprises the base portion 4a, a fixed contact 4b projecting from the base portion 4a into the receptacle portion 1d of the case 1, and a connecting terminal 4c projecting outward of the case 1 from the base portion 4a.

[0023] The fixed terminal 4 is disposed in the inside bottom of the receptacle portion 1d in such a manner that a pair of fixed contacts 4b are opposed to each other. The fixed contacts 4b are each bent in a generally U shape at both end portions. The thus U-bent portions serve as abutment faces 4d for abutment against a movable contact to be described later. The abutment faces 4d are each formed as a slant face which is concave toward the center between the paired fixed contacts 4b opposed to each other, and an abutment portion of a movable contact about to be described moves along the slant face.

[0024] A movable contact 5 is formed of an electrically conductive wire rod such as a wire rod formed using phosphor bronze for spring for example and its surface is plated with a noble metal such as nickel or silver. The movable contact 5 is formed in the shape of a coiled spring as a whole. A central portion of the coiled spring 5 is formed as a holding portion 5a which is held in the contact holding hole 2d formed in a free end of the operating lever 2, and both ends thereof are formed as abutment portions 5b for abutment against the abutment faces 4d of the paired fixed contacts 4b. The abutment portions 5b are formed so that, upon abutment thereof against the abutment faces 4d of the fixed contacts 4b, the abutment portions 5b can deflect with their own elasticity and can thereby move on the abutment faces 4d in sliding contact with the abutment faces.

[0025] The operation of the switch device of this embodiment will be described below.

[0026] When a door of a refrigerator with the switch device attached thereto is closed, the operating portion 2c of the operating lever 2 in the switch device is pushed by the door and is urged in a direction (indicated with a dotted line in Fig. 1) in which the operating portion does not project from the opening 1c of the case 1, against the biasing force of the return spring 3 mounted on the rotary shaft 2b. In this case, the movable contact 5 held by the contact holding hole 2d formed in a free end of the operating lever 2 is urged in a direction away from the paired fixed contacts 4b fixed to the inside bottom of the receptacle portion 1d of the case 1, with the switch device contact being OFF.

[0027] Then, when the refrigerator door is opened by a human hand for example, the operating lever 2 is urged in a projecting direction from the opening 1c of the case 1 with the biasing force of the return spring 3, so that the movable contact 5 held in the contact holding hole 2d of the operating lever 2 is urged in a direction of abutment against the fixed contacts 4b and the abutment portions 5b of the movable contact 5 are brought into abutment against the abutment faces 4d of the paired fixed contacts 4b, whereby the switch device contact is changed over to an ON condition.

[0028] Since the movable contact 5 is formed in the shape of a coiled spring using a wire rod for spring and the urging force of the return spring 3 for the operating lever 3 is set higher than the biasing force of the coiled spring of the movable contact 5, the urging force of the return spring 3 urges the movable contact 5 against the biasing force of the coiled spring after abutment of the abutment portions 5b of the movable contact 5 against the abutment faces 4d of the fixed contacts 4, thus causing the movable contact 5 to be deformed elastically (see Fig. 2).

[0029] Moreover, since the paired fixed contacts 4b are disposed within the case 1 opposedly to each other in the winding core direction of the coil of the movable contact 5 and the abutment faces 4d of the fixed contacts 4b are formed as slat faces which are concave toward the center between the opposed fixed contacts, the abutment portions 5 at both ends of the movable contact 5 move in sliding contact with the slant faces.

[0030] At this time, as shown in Fig. 2, the abutment portions 5b of the movable contact 5 undergoes a further elastic deformation under the urging force of the return spring 3, but when the operating lever 2 stops (i.e., in a balanced state between the spring stress of the return spring 3 and that of the coiled spring of the movable contact 5), each abutment portion 5b of the movable contact comes into contact with the abutment face 4d of the corresponding fixed contact 4b at position

B different from an initial abutment position A (indicated with a dash-double dot line in Fig. 2) in which the movable contact abuts the fixed contact. Therefore, even if an arc forms upon abutment of the movable contact 5 against the fixed contact 4b and the surfaces of the contact portions at the abutment position A is roughened, a stable contact is ensured at the abutment position B which is the final contact abutment position and in which there flows a steady-state current in a switch ON condition. Thus, the occurrence of a poor contact caused by an increase of contact resistance can be prevented and the service life of the contact portions can be improved.

[0031] When the operating lever 2 stop, that is, when the operating lever is in its returned state (contact ON condition) with the urging force of the return spring 3, the lugs 2e as stopper portions of the operating lever do not fulfill their stopper function because they are not in abutment against the case 1. In this state, if the operating lever 2 moves in a direction in which the contact pressure of the movable contact 5 relative to the fixed contacts 4b increases under the action of a certain external force, the lugs 2e come into abutment against the inner top edges 1g of the case 1 and function as stoppers.

[0032] In the switch device according to the present invention, since the contact resistance in switch ON condition can be made small, the switch device is applicable also to a power switch which is used with a relatively very small current such as DC (secondary side) power.

[0033] Although the operating lever 2 described in the above embodiment is a pivotable lever which is pivotable about the rotary shaft 2b, the present invention is not limited thereto. For example, the operating lever 2 may be constituted by a push type operating lever. It goes without saying that also in this case there can be obtained the same effect as above.

[0034] Although the movable contact 5 used in the above embodiment is formed by a coiled spring-like wire rod, a plate-like metallic spring may be used as an alternative thereto.

[0035] In the switch device according to the present invention, as set forth above, abutment portions of the movable contact for abutment against the fixed contacts are formed using an elastically deformable material and, during return of the operating lever with the urging force of the return spring, the abutment portions of the movable contact come into abutment against the fixed contacts and undergo a further elastic deformation under the urging force of the return spring, while when the operating lever stops, the abutment portions of the movable contact come into contact with the fixed contacts at a position different from the abutment position assumed during return of the operating lever. Therefore, even in the event arcing takes place upon abutment of the movable contact against the fixed contacts, with consequent roughening of the surfaces of the contact portions, there is attained a stable contact at the final contact abutment position in which there flows a steady-state current in a switch ON condition, whereby it is possible to prevent the occurrence of a poor contact caused by an increase of contact resistance and hence possible to improve the service life of the contact portions.

[0036] In addition, the movable contact is formed by a coiled spring and the urging force of the return spring for urging the operating lever is set higher than the biasing force of the coiled spring of the movable contact, thereby causing the movable contact to undergo an elastic deformation against the biasing force of the coiled spring. Such a simple structure permits the attainment of a stable contact and improvement in reliability of the contacts.

[0037] Within the case are formed a pair of fixed contacts opposedly to each other in the winding core direction of the coil of the movable contact, the paired fixed contacts are formed with abutment faces for abutment against abutment portions of the movable contact, the abutment faces being formed as slant faces which are concave toward the center between the opposed fixed contacts, and the abutment portions of the movable contact are adapted to move along the slant faces. According to this structure, the position of abutment between the movable contact and the fixed contacts can vary with a sliding motion, so that there is obtained a cleaning effect of removing film and foreign matters deposited on the contact portions and it is possible to diminish the contact resistance when power is ON, thus permitting application of the switch device to a power switch which is used with a relatively very small current such as DC (secondary side) power.

[0038] Further, a stopper portion is provided between the operating lever and the case so as not to operate when the operating lever stops but operate to prevent movement of the operating lever when the same lever moves from the stop condition in a direction in which the contact pressure of the movable contact increases relative to the fixed contacts. Therefore, not only a stable state of contact is maintained while the operating lever stops but also even upon accidental imposition of an external force on the switch device it is possible to prevent an excessive loading on the contact portions and hence possible to avoid damage of the contact portions.

Claims

1. A switch device comprising:

a case having a receptacle portion;
an operating lever attached to the case movably;
a return spring for urging the operating lever for urging the operating lever in a return direction;
a fixed contact disposed within the case; and
a movable contact retained at a free end of the operating lever and adapted to move into con-

tact with and away from the fixed contact, wherein an abutment portion of the movable contact for abutment against the fixed contact is formed using an elastically deformable material, the abutment portion of the movable contact, during return of the operating lever in its return direction with the urging force of the return spring, comes into abutment against the fixed contact and undergoes a further elastic deformation under the urging force of the return spring, while when the operating lever stops, the abutment portion of the movable contact comes into contact with the fixed contact at a position different from the abutment position assumed during the return of the operating lever.

2. A switch device according to claim 1, wherein the movable contact is formed by a coiled spring, the urging force of the return spring for urging the operating lever is set higher than that of the coiled spring of the movable contact, thereby causing the movable contact to undergo an elastic deformation against the biasing force of the coiled spring.

3. A switch device according to claim 1 or 2, wherein a pair of the fixed contacts are disposed opposedly to each other in a winding core direction of the coil of the movable contact, the paired fixed contacts having abutment faces for abutment against the abutment portion of the movable contact, the abutment faces being formed as slant faces which are concave toward the center between the paired fixed contacts opposed to each other, and the abutment portion of the movable contact moves along the slant faces.

4. A switch device according to any of claims 1 to 3, wherein a stopper portion is provided between the operating lever and the case, the stopper portion failing to operate while the operating lever stops but operating to prevent the movement of the operating lever when the operating lever moves from its stop condition in a direction in which the contact pressure of the movable contact increases relative to the fixed contact.

FIG. 1

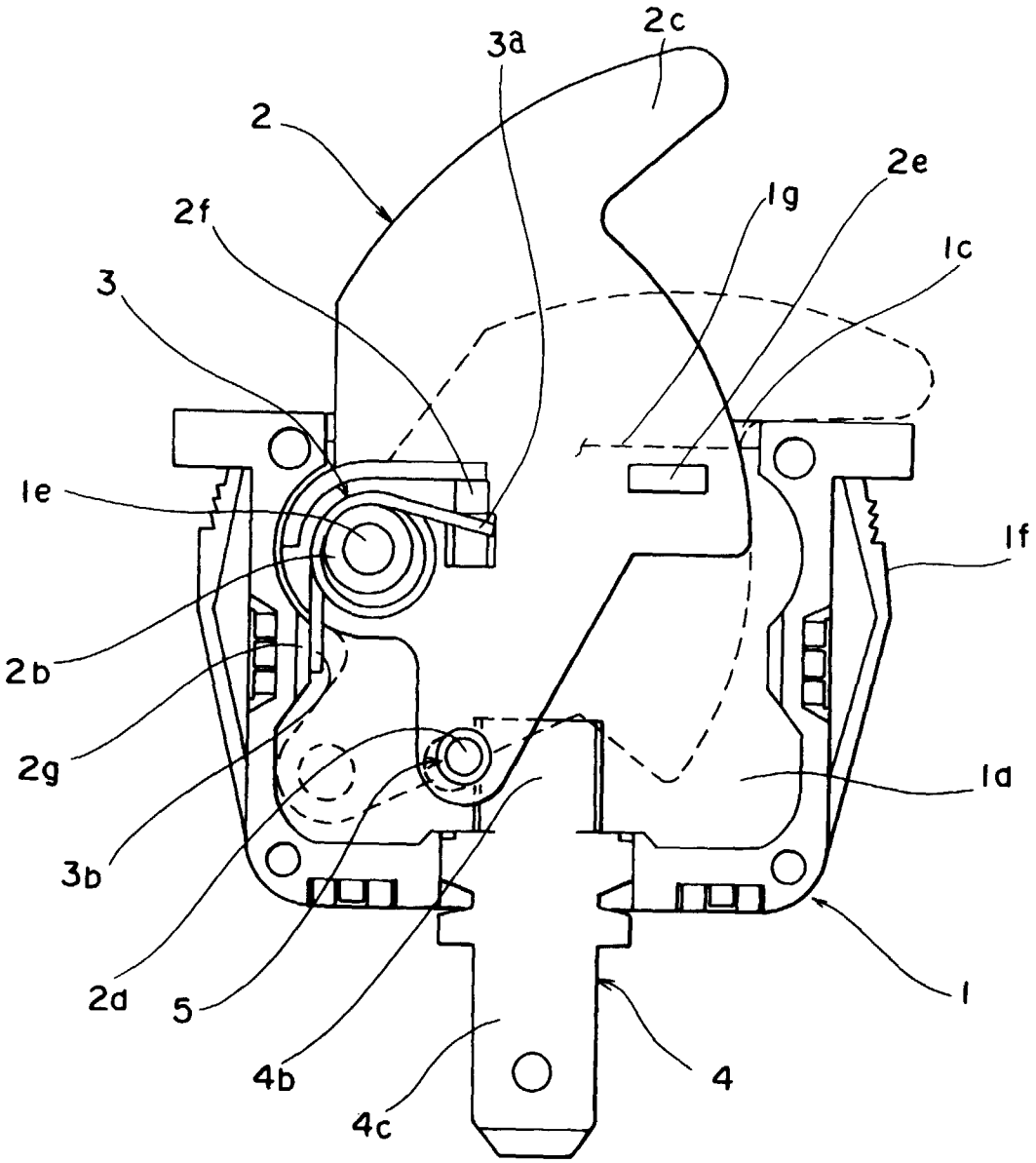


FIG. 2

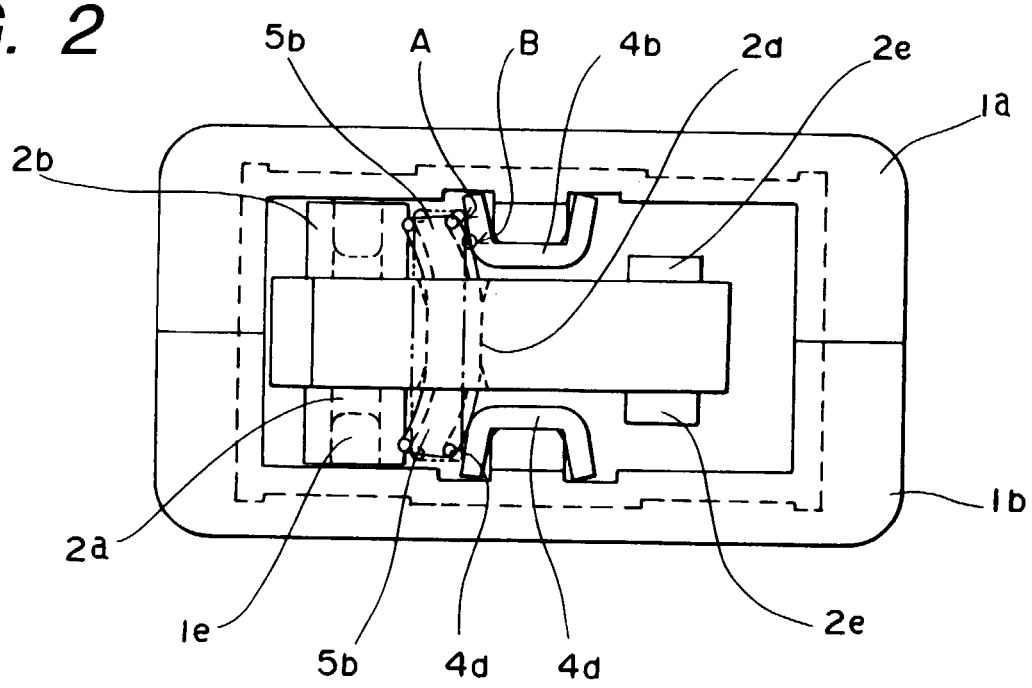


FIG. 3

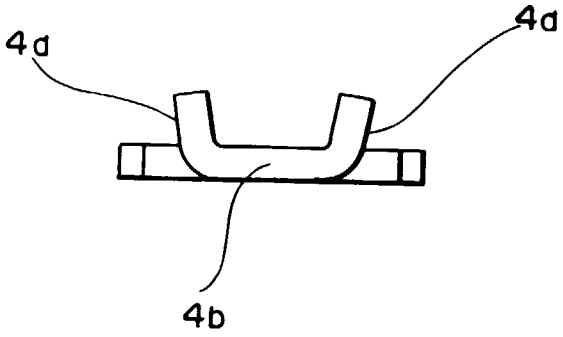


FIG. 4

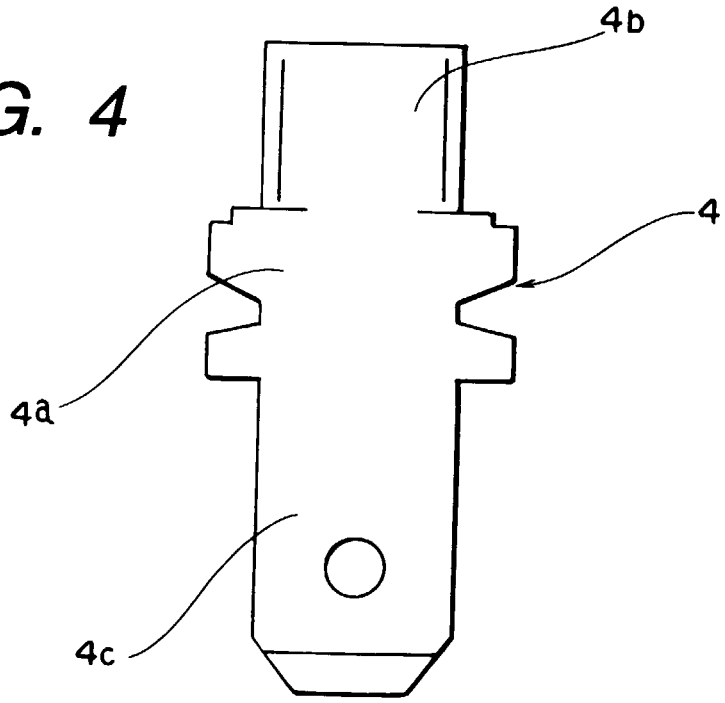


FIG. 5

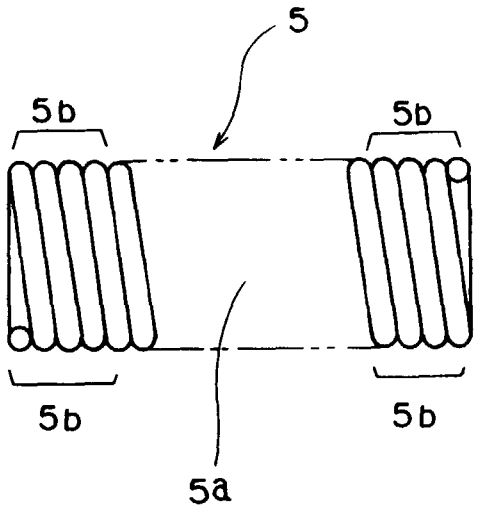


FIG. 6

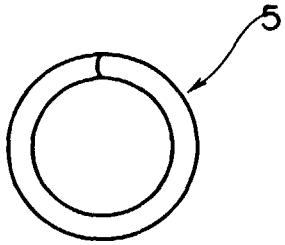


FIG. 8
PRIOR ART

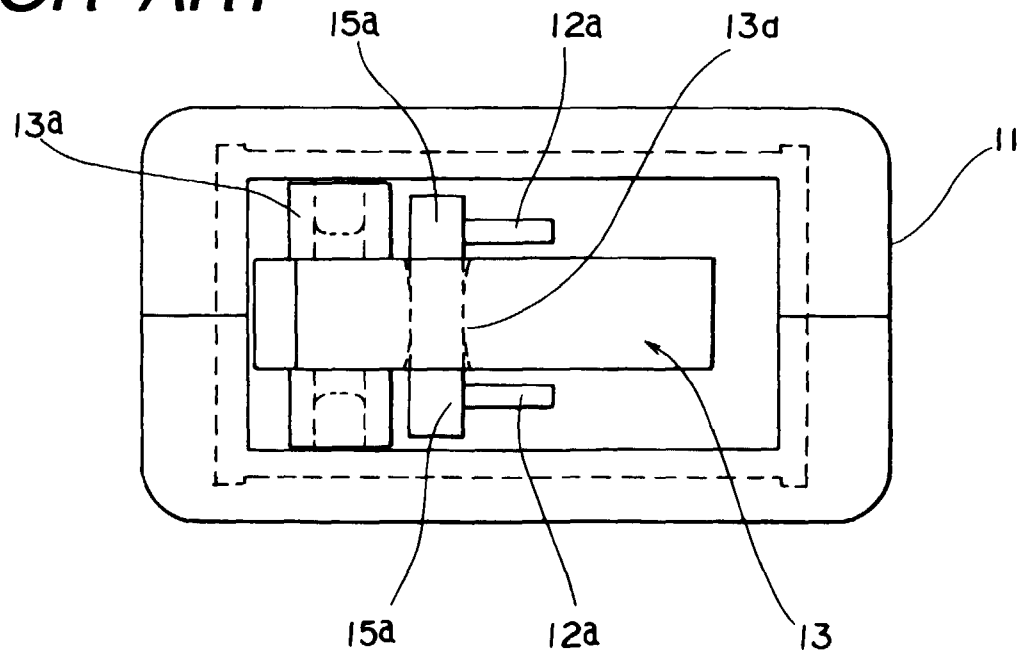
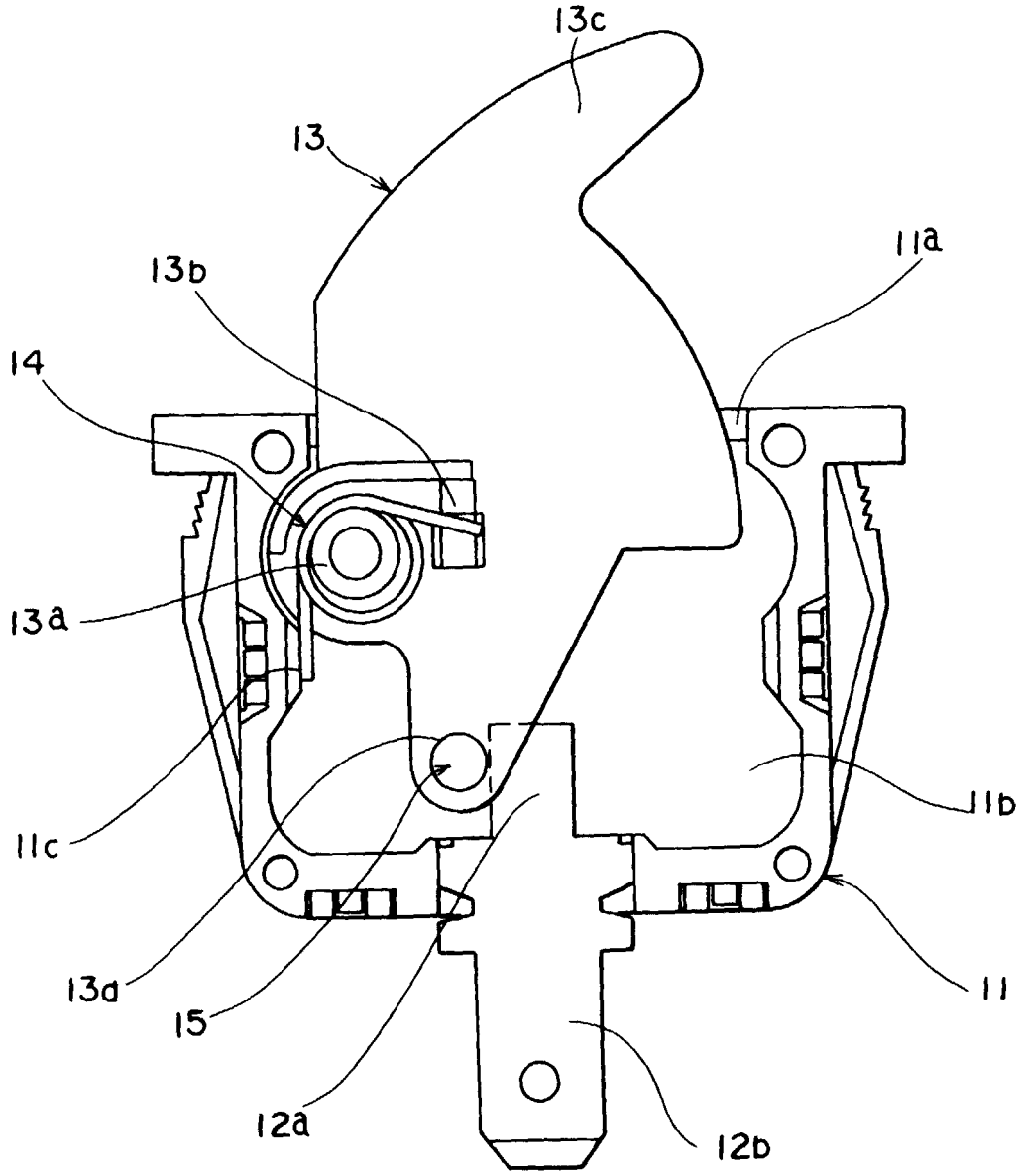


FIG. 7
PRIOR ART



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 11 6031

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)
A	EP 0 908 906 A (ALPS ELECTRIC CO LTD) 14 April 1999 (1999-04-14) * column 6, line 44 - column 7, line 1; figures 8,9 *	1	H01H1/24 H01H13/52
A	US 4 473 727 A (BECK WESLEY H) 25 September 1984 (1984-09-25) * abstract; figures 7,8 *	1-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	10 November 2000	Mausser, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 11 6031

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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10-11-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0908906 A	14-04-1999	JP 11111105 A	23-04-1999
		CN 1213839 A	14-04-1999
US 4473727 A	25-09-1984	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82