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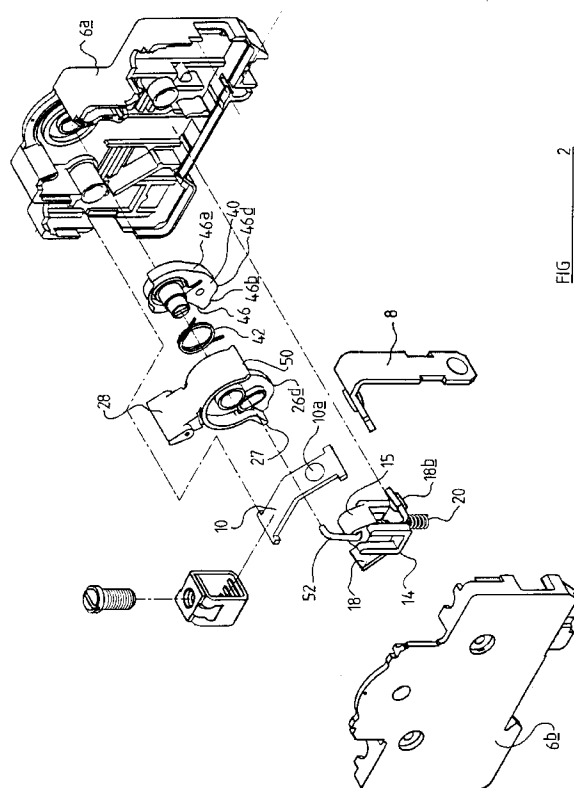
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(54) **Electric switches.**

(57) An electric switch comprises a housing (6) within which is mounted a first contact assembly (8, 10) and a movable contact assembly (12) which is urged into a first position, shown in Figure 1a, by a spring (20). The housing (6) also carries a switch operating mechanism (24) comprising an operating member afforded by a primary cam (26), from which a switch handle (28) extends. The cam (26) comprises an operating surface comprising portions (26a, 26b, 26c and 26d), whereby the contact assembly (18) may be moved against the action of the spring (20). Mounted for rotation with the cam (26) is a restraining means in the form of a second cam (40), urged by a spring (40) into a position in which the two cams are generally in alignment. Upon movement of the switch handle (28) to its "off" position, the second cam (40) retains the movable contact assembly in its closed position, until completion of initial movement of the switch handle, whereupon a shoulder (50) of the primary cam engages the secondary cam, allowing the switch to open at a relatively high speed.

The movable contact assembly (12) comprises a contact member (18) which is mounted for limited rotational movement, so that on completion of linear movement of approach between the movable contact assembly (12) and the fixed contact assembly, relative rotational movement occurs after engagement between the contact elements (8a, 18b), and similarly on separative movement between the contact elements rotational movement occurs prior to separative movement therebetween.



## Description of Invention

This invention is concerned with improvements relating to electric switches, particularly those carrying high current and/or those carrying direct current.

The problem of arcing of switch contacts is ongoing, and numerous attempts have been made to reduce arcing, and/or the effect of arcing on the switch contacts.

Arcing occurs primarily on opening of a circuit. On closing an arc is not established until the contacts are in very close proximity. However on opening an arc is formed and stretched at the moment the contacts separate, creating an ionised region in the vicinity of the contacts, allowing the arc to be maintained for a longer period. Thus, it is desirable for contact opening movement of the switch to be as fast as possible. This is especially so in DC switches where the current wave form has no zero point to allow the arc to extinguish.

According to this invention there is provided an electric switch comprising means to urge the moving contacts towards an open position, and retaining means to prevent such movement of the moving contacts upon initial opening movement of the switch.

According to this invention there is also provided an electric switch comprising:-

- a) a housing;
- b) a fixed contact assembly in the housing;
- c) a movable contact assembly movable in the housing between a first, contact closed position and a second, contact open position;
- d) a switch member movable between an "on" position and an "off" position; and
- e) operating mechanism to cause the movable contact assembly to move to the first position on movement of the switch member to its "on" position and to cause the movable contact assembly to move to its second position on movement of the switch member to its "off" position;

characterised in that the switch comprises restraining means to restrain the movable contact assembly in its first position during initial movement of the switch member from its "on" position towards its "off" position, and means to render the restraining means inoperative subsequent to completion of such initial movement.

Thus, in closing the switch, the switch member may be moved from its "off" to its "on" position in a normal manner. However on opening the switch, on initial movement of the switch member the movable contact assembly is retained in its first, contact closed position, by the restraining means. After further travel of the switch member towards its "off" position, the restraining means is rendered inoperative, and the movable contact assembly may be moved from its contact closed position without any significant restraint, allowing high speed of contact separation to

be attained.

Conveniently the operating mechanism comprises a cam member to move the movable contact assembly from its second to its first position, and preferably the restraining means comprises a latch member to hold the movable contact assembly in its contact closed position. Conveniently the latch member is moved to a retracted position by a trailing surface of the cam member.

Preferably the latch member is mounted on the cam member of the operating mechanism, and is preferably spring urged into a rest position in relation to said cam member. Thus when the switch member is moved to its "on" position and the movable contact assembly is moved to its contact closed position, engagement between the latch member and the cam member retains the latch member in a position to prevent the movable contact assembly moving from its contact closed position, preferably by a means which includes an over centre mechanism.

Thus when the switch member is moved towards its "off" position, the latch member retains the movable contact assembly in its first position, until the cam member has moved some distance towards the "off" position, whereupon the latch member is rendered inoperative, being moved into an out-of-the-way position, allowing the movable contact assembly to move quickly from its first to its second position.

Conveniently the latch member is in the form of a second cam member mounted alongside the primary cam member, preferably having a somewhat similar cam profile.

Advantageously the latch member (secondary cam) may be omitted to enable the switch to be utilised in a normal mode, when a fast break is not required.

Another problem is that arcing will cause erosion of the surfaces of the contact elements, which may increase the resistance at the interface of the contact elements, creating hot spots.

According to another aspect of this invention there is provided an electric switch comprising:-

- a) a first contact comprising a first contact element;
- b) a second contact comprising a second contact element;
- c) means to cause said contact elements to move towards and away from one another; and
- d) means to cause relative rotational movement between the contact elements.

Preferably the movement of approach and separation between the contact elements is linear, preferably rectilinear, and preferably the rotational movement occurs whilst the contact elements are in engagement, and is preferably about an axis extending at right angles to the direction of approach between the two contact elements.

Thus preferably on separative movement be-

tween the contact elements relative rotational movement occurs prior to separative movement, and preferably also on movement of approach between the contact elements relative rotational movement occurs after engagement between the contact elements.

In this manner the areas of engagement between the contact elements when fully closed, through which current flows in use, are not the areas of the contact elements which approach and initially engage one another, and/or are not the areas which move from engagement and separate from one another, between which areas arcing occurs. Thus, surface damage caused to the contact elements by arcing will not be effective to impair the interface between the contact elements, through which current flows during use of the switch, or at least such impairment will be reduced.

Thus preferably one of the contact elements is provided by a contact member which is inclined to the plane of approach and separation, and which is permitted to "roll" into such plane from said inclined position on engagement between the two contact elements, e.g. against the action of a restraint such as a spring.

Another problem occurs in electrical devices such as switches, particularly of the kind adapted to be mounted on a mounting rail of the kind known as a "din-rail", and which comprise contact members which are moved into conductive engagement with a bus-bar mounted alongside such a mounting rail in pursuance of the mounting of the electrical device on the mounting rail. Such a system is disclosed in the specification of our co-pending European Patent Application EP-A-472409, to which reference should be made for details not described herein.

In the specification of said co-pending application, conductive engagement between the contact member and the bus-bar relies primarily on face-to-face contact, and on occasion such contact may be of lower quality than is desirable.

Thus according to a further aspect of this invention there is provided an electrical device for use with a mounting rail providing a flat surface against which the electrical device may be located, a supply assembly comprising a supply member for the supply of electricity to the electrical device mounted on the mounting rail, the electrical device comprising a recess which may be located over the mounting rail and the supply member providing a contact surface and the supply assembly comprising means to urge a contact member of the electrical device against said contact surface,

wherein the contact member is deformed from one side so as to present to the supply member a protrusion for the improvement of electrical contact between the contact member and the supply member.

The protrusion may be elongate in the direction of movement of the contact member into engagement

with the supply member, but may be circular in profile, to cater for misalignment in mutually perpendicular directions.

It is to be appreciated that whilst the invention set out in the last preceding paragraph is of particular advantage in application to electrical devices such as electric switches, and will be described hereinafter in detail in relation to use as part of an electric switch, the invention may be utilised with other electrical devices of the type concerned, including circuit breakers, transformers, RCDs, etc.

The above and other of the various aspects of this invention will become more clear from the following detailed description, to be read with reference to the accompanying drawings, of an electric switch which is the preferred embodiment of the invention, and which has been selected for the purposes of illustrating the invention by way of example.

In the accompanying drawings:-

Figure 1a is a side elevation of the preferred embodiment, a cover thereof having been removed for clarity, the switch being in circuit-open condition;

Figure 1b is a view similar to Figure 1a, showing the switch in circuit-closed condition;

Figure 2 is an exploded perspective view of the preferred embodiment, showing internal components thereof;

Figures 3, 4 and 5 are views showing a movable contact assembly of the preferred embodiment; and

Figures 6 and 7 are views showing a contact member of one embodiment.

The switch which is the preferred embodiment of the invention comprises a housing 6 made up of a base part 6a and a cover 6b, the cover having been removed from Figure 1.

Mounted in the base 6a is a fixed contact assembly comprising a first fixed contact member 8 and a second fixed contact member 10, each of said contact members comprising a contact element 8a, 10a respectively.

Mounted between the contact members of the fixed contact assembly is a movable contact assembly 12 comprising a moulded housing 14 mounted for linear sliding movement within channels (only one, 16, being shown) provided on the base 6a, said housing 14 being generally open-sided, and through which extends a movable contact member 18, said movable contact member 18 comprising contact elements 18a, 18b positioned opposite the fixed contact elements 10a, 8a respectively.

The movable contact assembly 12 is urged to a first position, shown in Figure 1a by a spring 20 acting between the housing 6 and the housing 14.

The housing 6 also carries switch operating mechanism 24 comprising an operating member afforded by a primary cam 26, from which a switch

member or handle 28, located for manual operation, extends.

The cam 26 comprises a cam surface having a central, convex portion 26a located between two concave portions 26b and 26c, the portion 26b being radially further spaced from the axis of the cam than the portion 26c.

Mounted for rotation with the cam 26, about a common axis, is restraining means in the form of a second cam 40, a coil spring 42 being operative between the cam 40 and the cam 26. The cam 40 has a cam face similar to that of the cam 26, over the portions 26a, 26b and 26c thereof, although the cam 40 has a cam surface portion 46d of greater radius than the corresponding portion 26d of the cam 26. The spring 42 urges the cam 40 into a position in which said cam surfaces are in alignment, an end face 46 of the cam 40 abutting against a flange 27 of the cam 26.

In the position shown in Figure 1a, a nose portion 15 of the housing 14 is seated against the concave portion 26c of the cam 26. On movement of the switch member 28 in the direction of the arrow A, from the "off" position towards the "on" position, the two cams move as one, the nose 15 of the housing 14 being engaged progressively by the cam surface 26c, 26a, 26d and 26b, and simultaneously by corresponding surface portions 40c, 40a, 40d and 40b of the cam 40 (see Figure 1b). Thus the portion 26a of the cam surface depresses the housing 14 against the action of the spring 20, moving the contact elements 18a and 18b into engagement with the contact elements 10a and 8a. On final movement of the switch member 28 into its "on" position, as the nose 15 moves over a high point 26d of the cam face 26 between the portions 26a and 26b, and over a corresponding, but higher, point 46d of the cam face 46, the contact elements engage, residual movement being accommodated by movement of the contact member 18 relative to the housing 14 against the action of a compression spring 19.

Thus the switch is stable with the movable contact assembly in either of its first, contact closed position or its second, contact open position.

However on movement of the switch member 28 in the direction of the arrow B, towards its "off" position, the shoulder 27 separates from the face 46, and because of the over-centre position caused by the surface portion 46d, engagement between the nose 15 under the action of the spring 20 prevents movement of the cam 40, and instead relative rotational movement occurs between the two cams. After perhaps rotation of 30°, by which time a large portion of the cam face 26 will have been separated from the nose 15 of the housing 14, and in particular the high point 26d thereof, a flange 50 of the cam 26 moves into contact with the cam 40, causing the cam 40 to rotate and causing the nose 15 to move from engage-

ment with the portion 46b thereof to the portion 46d. At this point, there is nothing to restrain rotation of the cam 40 back into its rest position under the action of the spring 42, and in consequence nothing to prevent movement of the movable contact assembly 12 under the action of the spring 20 at high speed from its contact closed to its contact open position.

Theoretically if it is desired to utilise the switch in a situation where a fast break is not required, the second cam member 40 could be removed, and movement of the movable contact assembly achieved under the action of the cam member 26 alone.

A link 52 is provided between the cam 26 and the movable contact assembly, so that in the event of the contacts welding together, it is not possible to move the switch member to its open position, whilst the contacts remain closed. In general, either the positive drive which is effected by the link 52 will break the weld, or the switch member is prevented from being moved fully to its "off" position.

The contact member 18 of the moving contact assembly 12 is in the form of a flat strip having terminal portions bent up, as illustrated. However the contact member is mounted in the housing 14, and is seated on a lower surface 14a of the housing which is inclined to the direction of movement of the contact assembly between its open and closed positions (see Figure 4). Thus on movement of the moving contact assembly into its circuit closed position, each of the fixed contacts 10a, 8a will be engaged initially by an edge portion of the one of the moving contact elements 18a, 18b (Figure 5), and when such engagement has taken place, and on terminal movement of the switch member 28 the moving contact member 18 moves relative to the housing 12 against the action of the spring 19, the seating 14a moves away from the contact member 18, allowing the contact member to roll around to its normal, flat position in the direction indicated in Figure 5 and causing the contact element 18a, 18b to roll over the surfaces of the contact elements 10a, 8a to the normal working position.

On opening movement of the switch, as the contact member 18 is initially engaged by the surface 14a, and initially rolling movement of the contact member 18 is produced, prior to rectilinear separation.

In this manner the points of engagement and disengagement between the two pairs of contacts is an edge portion, and the normal operating position involves central face-to-face contact, so the interface between the two pairs of contacts remains relatively undamaged by any arcing which takes place, this being limited to the edge regions at which engagement and disengagement takes place.

The switch assembly which is the preferred embodiment of this invention is for use in an electricity supply assembly of the kind illustrated in said co-pending application, and is provided on its underside

with a recess 60 adapted to be located over a mounting rail of the "din-rail" type, indicated by the numeral 62 in Figure 1, with the contact member 8 being brought into face-to-face engagement with a contact surface 64a of a bus-bar 64, to which a supply of electricity is connected.

To improve conductive engagement between the contact member 8 and the bus-bar 64, under the action of the spring 65, the contact member 8 is provided with a protrusion 8a, formed by causing an indentation 8b from the opposite side (see Figures 6 and 7) to ensure good contact between the contact member 8 and the bus-bar 64.

As shown in Figure 6, the projection 8a may be elongate, in the direction of insertion of the contact member into engagement with the bus-bar, but if desired the protrusion may be in the form of a circular pimple (or dimple as seen from the other side).

Whilst in the description of the preferred embodiment given above those aspects which relate to operation of the switch mechanism are specific to a switch mechanism, the provision of the protrusion 8a on the contact member 8 may be utilised in similar or analogous circumstances, such as miniature circuit breakers, residual current devices, transformers, timers and the like, when these are intended to be used in a manner similar to that of the preferred embodiment.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

## Claims

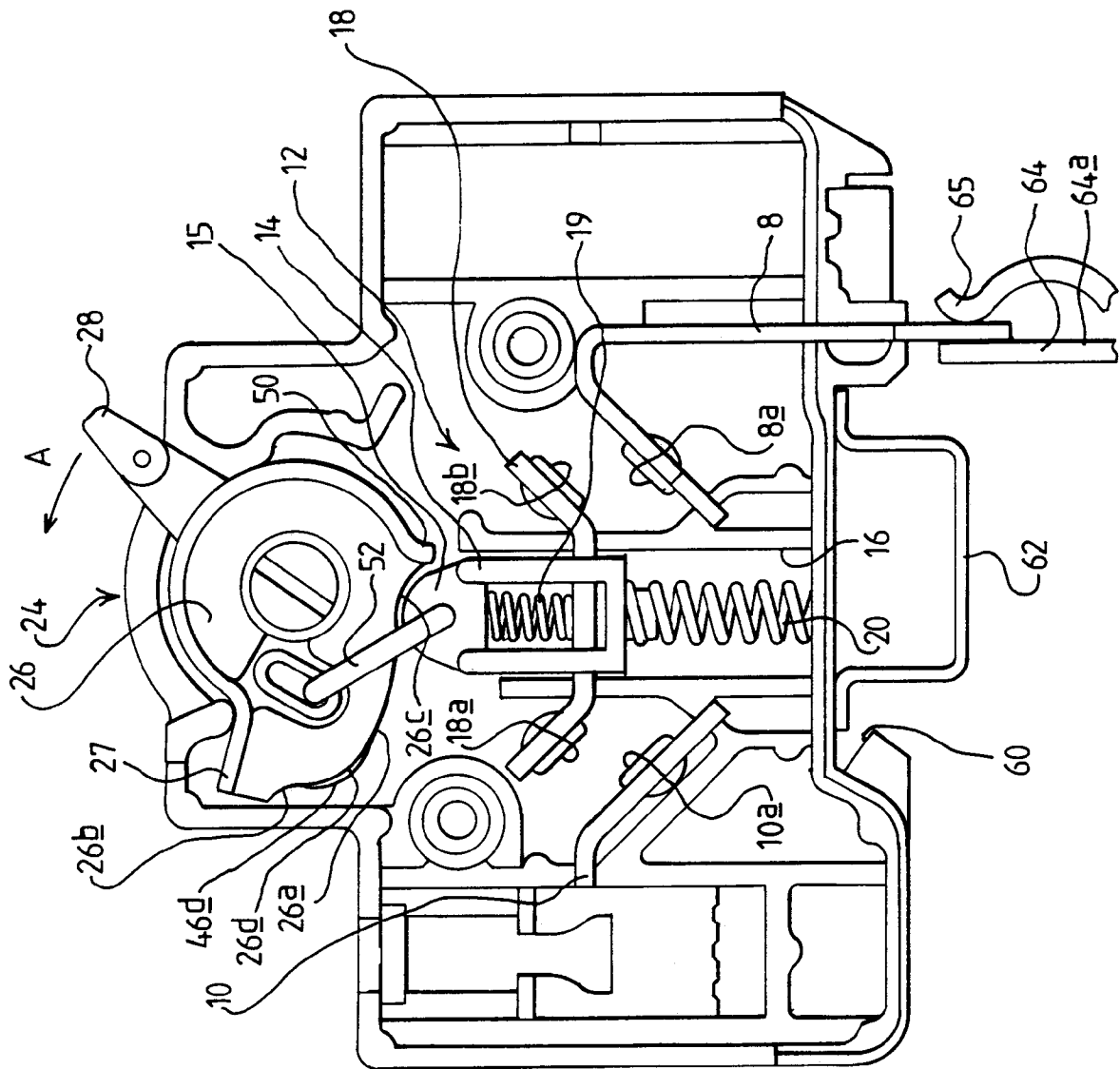
1. An electric switch comprising means (20) to urge the moving contacts (18a, 18b) towards an open position, and retaining means (40) to prevent such movement of the moving contacts upon initial opening movement of the switch.
2. An electric switch comprising
  - a) a housing;
  - b) a fixed contact assembly (8, 10) in the housing;
  - c) a movable contact assembly (12) movable in the housing between a first, contact closed position and a second, contact open position;
  - d) a switch member (28) movable between an "on" position and an "off" position; and
  - e) operating mechanism (15, 19, 20, 26, 28, 40) to cause the movable contact assembly (14) to move to the first position on movement

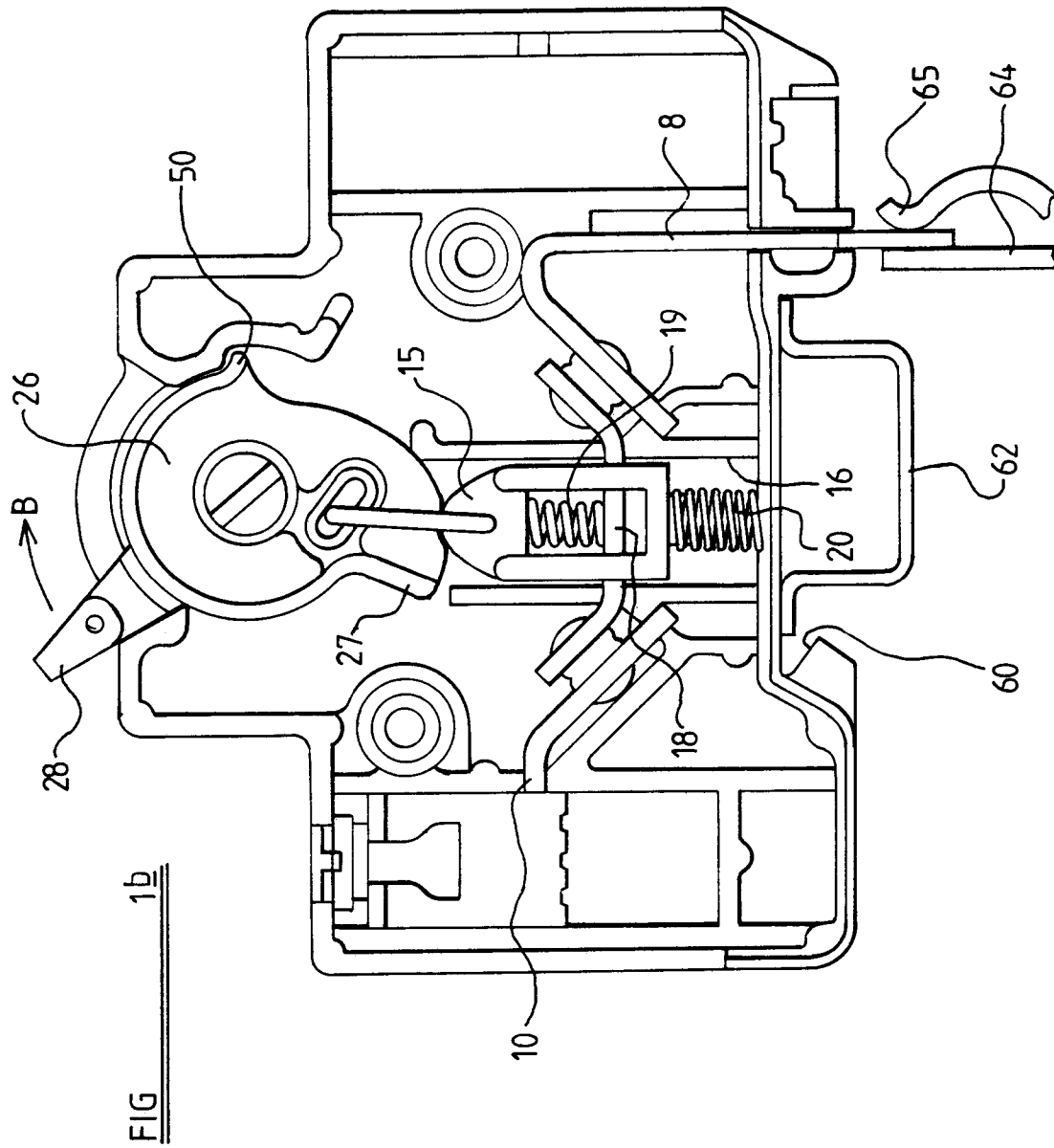
of the switch member (28) to its "on" position and to cause the movable contact assembly (14) to move to its second position on movement of the switch member to its "off" position; characterised in that the switch comprises restraining means (46) to restrain the movable contact assembly in its first position during initial movement of the switch member (28) from its "on" position towards its "off" position, and means (50) to render the restraining means inoperative subsequent to completion of such initial movement.

3. An electric switch according to Claim 2 wherein the operating mechanism comprises a cam member (26) to move the movable contact assembly (14) from its second to its first position, and the restraining means comprises a latch member (46) to hold the movable contact assembly in its contact closed position.
4. An electric switch according to Claim 3 wherein the latch member is moved to a retracted position by a trailing surface (50) of the cam member (26).
5. An electric switch according to one of Claims 3 and 4 wherein the latch member (46) is mounted on the cam member (26) of the operating mechanism, and is preferably urged by spring means (42) from a rest position in relation to said cam member.
6. An electric switch according to one of Claims 4 and 5 wherein the latch member (46) is in the form of a second cam member mounted alongside the primary cam member (26).
7. An electric switch comprising
  - a) a first contact (8) comprising a first contact element (8a);
  - b) a second contact (18) comprising a second contact element (18b);
  - c) means (15, 19, 20) to cause said contact elements (8a, 18b) to move towards and away from one another; and
  - d) means (14, 14a, 18, 19) to cause relative rotational movement between the contact elements (8a, 18b).
8. An electric switch according to Claim 7 wherein the movement of approach and separation between the contact elements (8a, 18b) is linear, preferably rectilinear.
9. An electric switch according to one of Claims 7 and 8 wherein the rotational movement occurs whilst the contact elements (8a, 18b) are in engagement, and is preferably about an axis extending at right angles to the direction of ap-

proach between the two contact elements.

- 10.** An electric switch according to Claim 9 wherein on separative movement between the contact elements relative rotational movement occurs prior to separative movement, and on movement of approach between the contact elements relative rotational movement occurs after engagement between the contact elements. 5 10
- 11.** An electric switch according to any one of Claims 7, 8, 9 and 10 wherein one of the contact elements is provided by a contact member 18 which is inclined to the plane of approach and separation, and which is permitted to roll into such plane from said inclined position on engagement between the two contact elements against the action of a restraint (19). 15 20
- 12.** An electrical device for use with a mounting rail (62) providing a flat surface against which the electrical device may be located, a supply assembly comprising a supply member (64) for the supply of electricity to the electrical device mounted on the mounting rail (62), the electrical device comprising a recess (60) which may be located over the mounting rail (62) and the supply member providing a contact surface (64a) and the supply assembly comprising means (65) to urge a contact member (8) of the electrical device against said contact surface (64), characterised in that the contact member (8) is deformed from one side so as to present to the supply member (64) a protrusion (8a) for the improvement of electrical contact between the contact member (8) and the supply member (64). 25 30 35
- 13.** An electrical device according to Claim 12 wherein the protrusion (8a) is elongate in the direction of movement of the contact member (8) into engagement with the supply member (64). 40 45 50 55







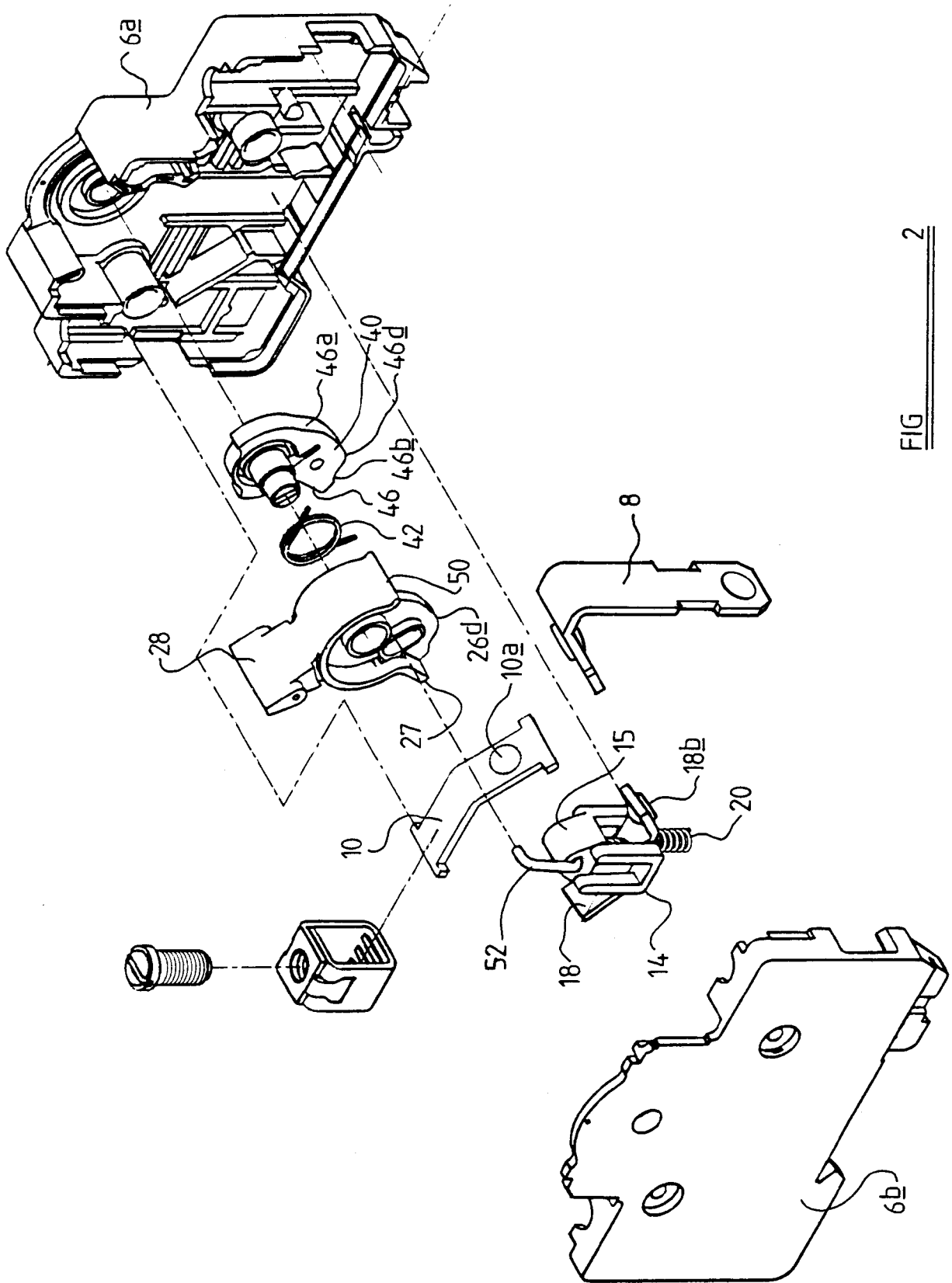


FIG 2

FIG 3

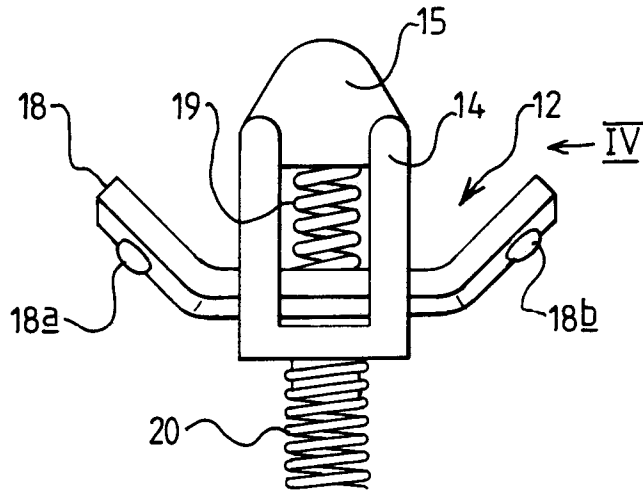


FIG 4

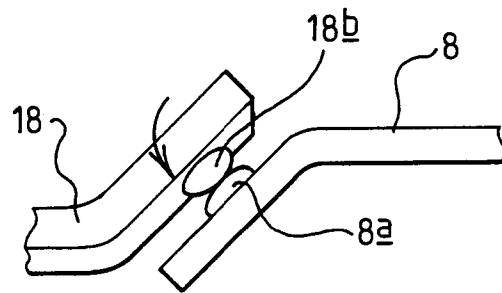
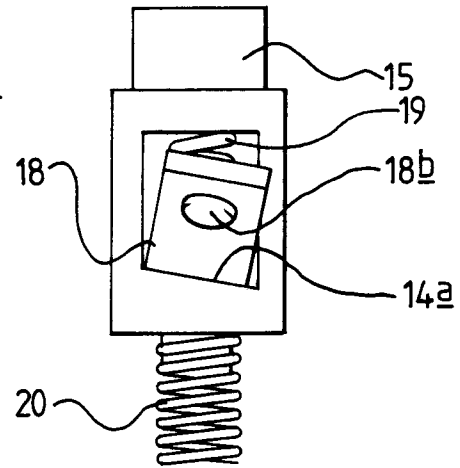


FIG 5

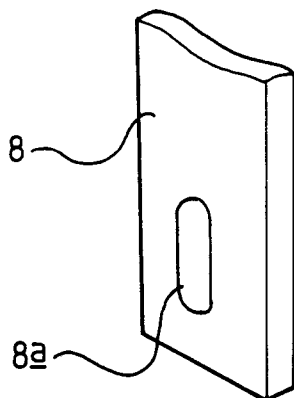


FIG 6

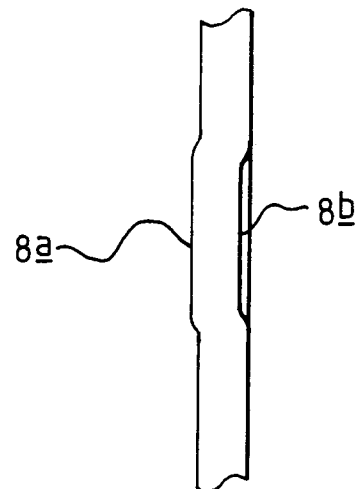


FIG 7