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Meyer

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[54] SWITCHING RELAY WITH A MAKE-AND-BREAK CONTACT MEMBER

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[52] **U.S. Cl.**.....**335/196,** 200/166 J, 335/200

[51] **Int. Cl.**.....**H01h 1/18**

[58] **Field of Search**.....335/196, 200; 200/166 J

[56] **References Cited**

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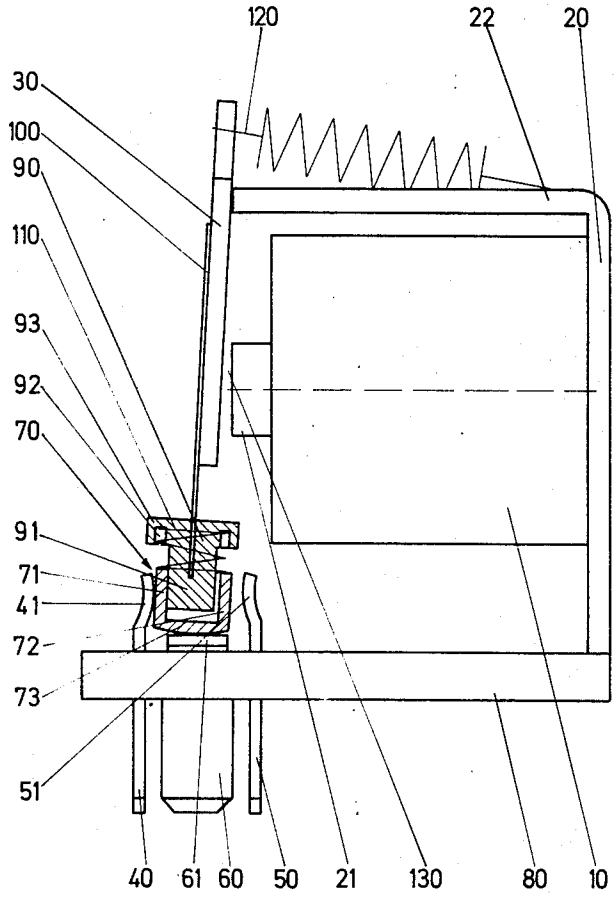
[57] **ABSTRACT**

Switching relay with an electromagnet actuating an armature which armature actuates a contact member acting as bridging contact which in two end positions electrically connects to one another the center one and one of the outer ones of three stationary contact members arranged next to each other, the contact member consisting of a cup of contact material elastically connected with the said armature, the center one of the stationary contacts being arranged so that the bottom of the said cup is in slidable contact with the said stationary center contact, the two other stationary contacts being arranged so that the side wall of the said cup is in contact with one of the said stationary contacts in the end positions of the said cup contacting at the same time the said stationary center contact.

13 Claims, 4 Drawing Figures



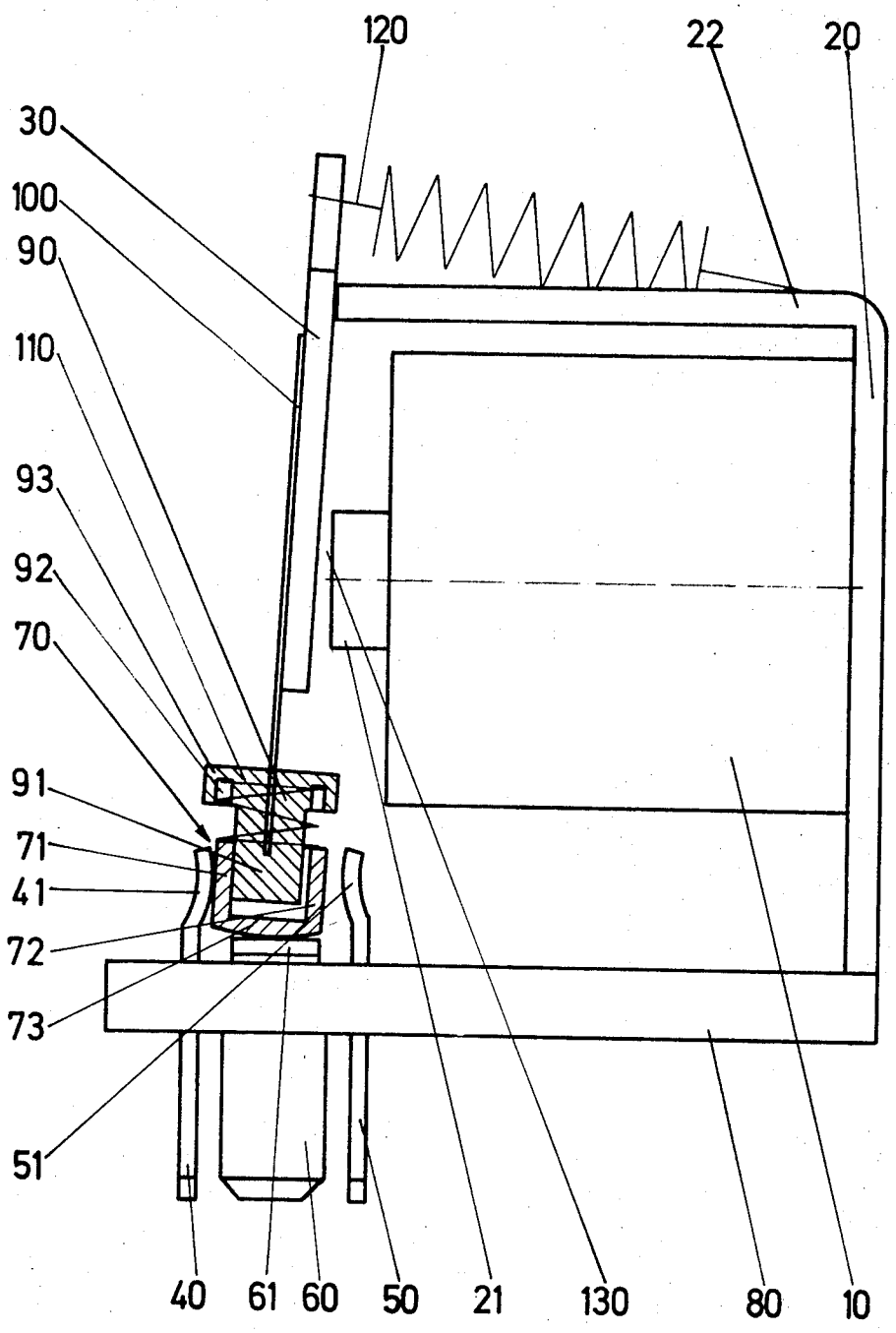

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Fig. 1

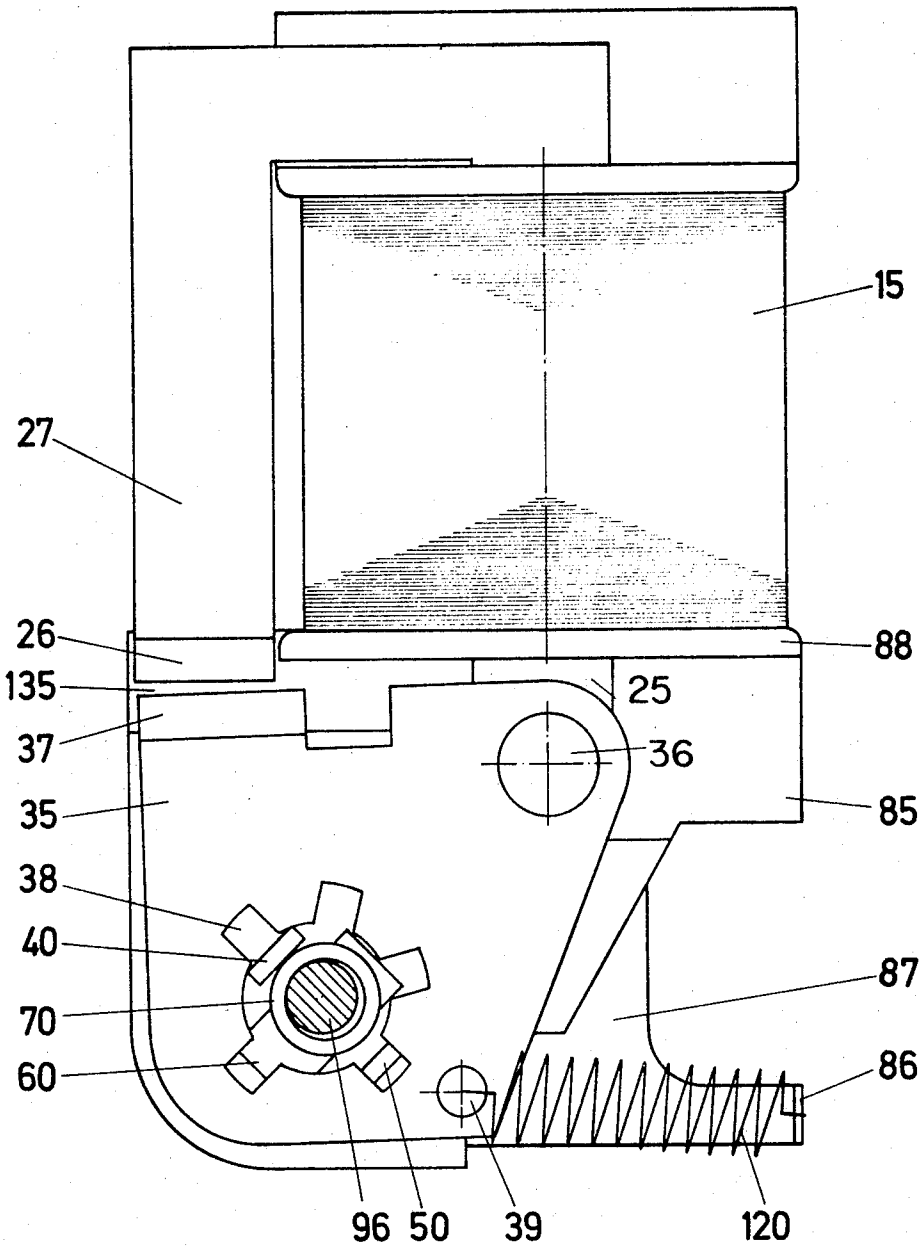

Fig. 2

Fig.4

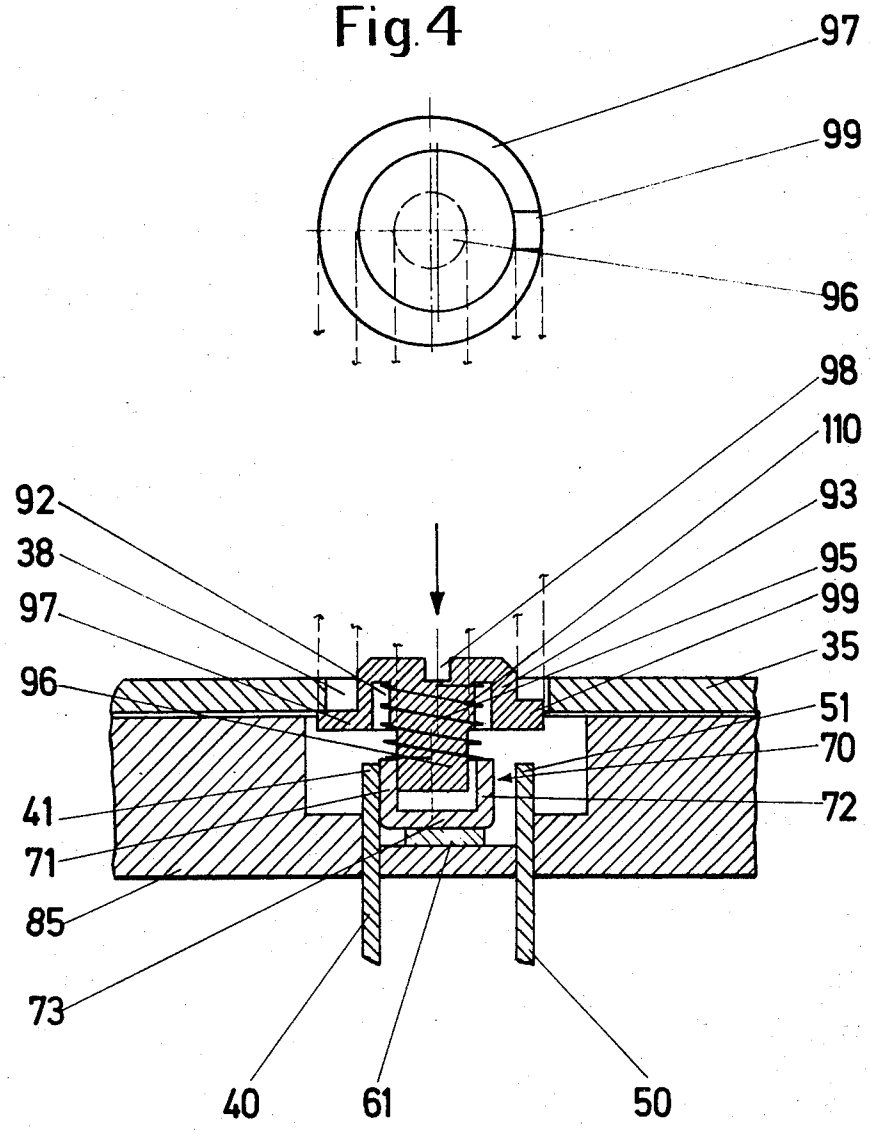

Fig.3

SWITCHING RELAY WITH A MAKE-AND-BREAK CONTACT MEMBER

The present invention relates to a switching relay with a make-and-break contact member acting as a bridging contact which, in two end positions, electrically connects to one another the center one and one of the outer ones of three stationary contact members arranged next to each other, and which is resiliently supported on an electrically non-conducting switching member which, in turn, is mounted to the armature and, together therewith, is capable of being moved into either one of the two end positions. The invention is particularly needed in the case of heavy current relays performing the switching functions of a make-and-break contact member.

In one conventional type of switching relay employing a make-and-break contact member acting as the bridging contact, the latter is designed as a resilient, tiltable ball or roller contact carried by an electrically non-conducting switching member cooperating with a lever arm arranged on the armature, thus permitting the switching member to swing into two end positions (German Printed application (DAS) 1 251 437). This conventional type of switching relay, owing to the employed tilting mechanism, is relatively expensive in manufacture. This is especially due to the required fork-shaped and angled-off parts, to the use of a swingably and tiltably supported switching member, and to the use of stops for restricting the swivel range. Moreover, such a tilting mechanism often requires an unwanted high excitation for operating the armature.

It is the object of the present invention to provide a switching relay avoiding these disadvantages as caused by the tilting mechanism. In a switching relay of the type mentioned hereinbefore, this problem is solved in accordance with the present invention, in that the make-and-break contact member comprises at least two oppositely arranged contact walls as well as a third contact wall extending vertically in relation thereto and which, in every position of the switching member, is resiliently applied to the center one of the stationary contact members, while in the end positions of the switching member one of the oppositely arranged contact walls is pressed against one of the outer stationary contact parts which simultaneously restrict the swivel range of the switching member.

The switching relay according to the invention offers various advantages. As regards the manufacture, it combines all that is required for a quick and inexpensive mass production because only a small number and simple parts are used which, in addition thereto, can be assembled in the most simple way on the finished relay. Upon actuating the switching member in the switching relay according to the invention, unlike in the conventional type of embodiment, the make-and-break contact member is displaced in one plane almost parallel in relation to the contacting part of the center one of the contact members, thus resulting in a particularly small armature actuating force.

The most simple adjustment and the omission of electrically conducting parts to the armature are further advantages to be mentioned in connection with the switching relay according to the invention. A further advantage results from the omission of special stops for limiting the swivel range of the make-and-break contact member, because this limitation in the switching relay according to the invention is simultaneously effected by the two outer stationary contact members. Owing to the fact that in the switching relay according to the invention the make-and-break contact member performs a sliding movement on the stationary contact members during actuation of the switching member, the invention also achieves a self-cleaning of the contact parts.

Further details and advantages of the invention will now be explained with reference to FIGS. **1** to **4** of the accompanying drawings showing preferred examples of embodiment of the invention, and in which:

FIG. **1**, partly in a sectional view, shows a switching relay according to the invention,

FIG.**2**, in a top view, shows the armature with the bridging contact of a switching relay according to the invention which is modified with respect to the one shown in FIG.**1**,

FIG.**3**, in a sectional view, shows details of the bridging contact shown in FIG.**2**, and

FIG.**4**, in a top view, shows the bridging contact of FIG.**3**.

In the switching relay shown in FIG.**1**, the driving system consists of the excitation coil **10**, the magnet **20**, and the armature **30** while the contact system is composed of the stationary contact members **40**, **50**, **60** and of the movable contact part, i.e. the make-and-break contact member **70**. Both of the these systems are combined mechanically and functionally. For the mechanical connection there is used a baseplate **80** of an insulating material consisting of hard paper or appropriately of injection-pressed or injection-molded plastics with coilforms shaped thereto for taking up the excitation coil or operating winding **10**, and with insertion openings shaped thereto, for receiving the stationary contact members **40**, **50**, **60**, as well as hold means shaped thereto, for the magnet **20**. The stationary contact members **40**, **50**, **60** together with the make-and-break contact member **70** form a make-and-break or switching contact. These, as well as the connecting parts of the excitation coil **10** are advantageously pressed in a self-retarding manner into insertion holes provided in the baseplate **80**, or are firmly connected to the baseplate by means of a subsequent deformation. The portions of the stationary contact members **40**, **50**, **60** as projecting out of the baseplate **80** and the (not shown) connecting parts of the excitation coil **10** are appropriately designed as connector terminals for mating with a printed circuit board.

For establishing the functional connection between the driving and the contact system there is used an actuating system consisting of an electrically non-conducting switching member **90** and of a spring element **100** as mounted to the armature **30**. To this end the switching member **90** is firmly connected at one end to a straight-lined flat or wire spring **100** while the free end of the switching member is in an operational connection with the make-and-break contact member **70**.

As make-and-break contact member **70** there is used a contact cup consisting at least on its outside of contact material, with this cup being engaged by the switching member **90** swingable with the armature **30**, together with a loosely fitting plug-shaped member **91** in such a way that the contact cup, upon actuation of

the switching member, is swiveled in direction towards one of the outer stationary contact members 40,50. In the end positions of the contact cup 70 respectively one outer cup wall 71, 72 is in contact with one of the two oppositely arranged stationary contact members 40 or 50 while the bottom 73 of the contact cup is permanently and resiliently pressed against the center one of the stationary contact members (60). This is effected by a helical compression spring 110 acting in the direction of the centerline of the contact cup and surrounding the switch plug 91, with the one end of the spring 110 abutting on the edge of the cup and the other end thereof being arranged within a recess 92 provided in a flange 93 of the switching member 90. By means of this helical compression spring there is produced the contact pressure between the contact cup 70 and the center one of the stationary contact parts (61). Owing to the fact that the contact cup 70 is loosely supported at the plug-shaped member 91 of the switching member 90 and is acted upon by a helical compression spring 110, tolerances of the contact cup and of the central contact part 61, to which the bottom of the cup 73 is to be applied permanently, are compensated.

It is not absolutely necessary for the make-and-break contact member to consist of a contact cup 70. In fact, it is sufficient to provide two oppositely arranged contact walls 71, 72 and a third contact wall 73 extending vertically in relation thereto, which is permanently and resiliently pressed against the center one of the stationary contact members 60 or the contacting part 61 thereof respectively, whereas in the end positions of the switching member 90 one of the oppositely arranged contact walls 71, 72 is applied to one of the outer stationary contact members 40, 50 or the contacting parts 41, 51 thereof respectively. In the sense of the foregoing the make-and-break contact member 70 may consist of a bracket having a U-shaped cross section whose U-shaped limbs 71, 72 are appropriately rounded in the transverse direction and whose U-shaped strap especially is arched towards the outside. Moreover, instead of a contact cup or a U-shaped contact bridge it is possible, in general, to use a make-and-break contact member 70 at least two oppositely arranged contact walls 71, 72 as well as a third contact wall 73 extending vertically in relation thereto. This may also be accomplished in that there is used a body of insulating material having an almost U-shaped or rectangular cross section, hence a hollow or solid body of insulating material provided with contacting areas at the desired points, i.e. on two opposite sides and one side vertical in relation thereto. In cases where a make-and-break contact member 70 of a solid material is used, special driving elements will have to be provided for in order to establish an operational connection between the switching member 90 and the make-and-break contact member.

For directly restricting or limiting the swivel range of the switching member 90 or of the make-and-break contact member 70 there are used the contact parts 41, 51 of the outer stationary contact members 40, 50, so that to this end special stops may be omitted. In order to safeguard an unobjectionable contact connection between the contact parts 41, 51 of the stationary contact members 40, 50 and the make-and-break contact member 70, the contact members are convexly arched with respect to the outside wall 71, 72 of the make-and-break contact member.

It is the object of the magnet armature 20 to establish the contact pressure between the contact parts 41, 51 of the oppositely arranged stationary contact members 40,50 and the contacting walls 71, 72 of the contact cup 70. In the non-excited state of the switching relay, this is effected by means of a reset spring element 120 for the armature which, with its one end, is mounted to a stationary part of the relay and, with its other end, to the armature. In the excited or energized condition of the relay, establishment of the respective contact pressure is safeguarded by the attractive force of the magnetic core. By using a wire- or tape-shaped spring element 100 and a reset spring element 120 having a relatively small stiffness with respect to the armature loading pressure, it is no longer necessary for the armature to be adjusted.

In the switching relay shown in FIGS.1 to 4, the contact cup 70, upon actuation of the switching member 90, 95 is moved about an axis extending vertically in relation to the centerline of the excitation coil 10, 15 and in relation to the plane of the magnetic core 21 or the magnet yoke 27 respectively. In this way it is possible to achieve a particularly flat construction in which practically only the winding arrangement of the excitation coil 10, 15 is determinative of the overall height of the relay.

Whereas in the switching relay shown in FIG.1, the armature 30 is movably mounted to the freely exposed end of the outer yoke limb 22 it will be seen that in the switching relay shown in FIGS.2 to 4 the armature 35 is hinged to the point 36 at the free end of the magnetic core 25. In both of these cases, however, the (operating) airgap 130, 135 is lying in a plane extending almost vertically in relation to the centerline of the excitation coil 10, 15 and in relation to the plane of the magnetic core 21 or the magnet yoke 27 respectively. In the switching relay according to FIGS.2 to 4 the airgap 135 is respectively restricted by each time one free end piece 26, 37 of the outer yoke limb 27 or of the armature 35 respectively which is bent vertically in relation to the centerline of the excitation coil. In this way the airgap 135 has a relatively large cross-sectional area compared to its length, this having a reducing effect of rapid variations of the magnetic attractive force upon the armature during its movement.

The switching relay shown in FIGS.2 to 4, however, chiefly differs from the design according to FIG.1 in that the plug-shaped portion 96 of the switching member 95, by means of a flange-shaped hold member 97, is rotatably supported in the armature and eccentrically in relation to the centerline of the plug. In this way it is safeguarded that by turning the hold member 97 which, for this purpose, is provided with a slot 98 for inserting a tool similar to a screw-driver, the airgap 135 can be varied; this is of particular importance in the case of burnings of the contact. The size of the airgap 135 can be changed continuously when taking care that the hold member 97 of the switching plug 96 is tightly seated in a recess of the armature 35. However, for eliminating unavoidable manufacturing tolerances, it is still more favorable to provide the armature 35 within the receiving range of the rotatable hold member 97

with an engaging contour 38 coacting with an engaging portion 99 of the hold member similar to a click-stop device, or the like. Otherwise, the switching member 95 is designed in the same way as the switching member 90 so that it does not need to be described in detail herein. It should merely be pointed out that the abutment for the hold member 97 of the switching member 95 is formed by a helical compression spring 110 likewise guided in a recess 92 of the switching member, with this spring resting with one end on the edge of the contact cup 70 under spring tension. Since also the contact cup 70 of the switching relay shown in FIGS. 2 to 4 is designed in almost the same way as the one in the type of embodiment according to FIG.1, a further detailed explanation may also be omitted in this case.

Also in the switching relay according to FIGS.2 to 4 there is provided as the supporting means for the stationary contact members 40, 50, 60, for the armature 35 and the electromagnet (15, 25, 27), a common baseplate 85 which, however, is designed in accordance with the arrangement of the driving system, the contact system, and the actuating system. It may in particular, have the shape shown in FIG.2. From this drawing it may be taken that for the reset spring element there are provided two spring seats of which the one is designed as a hole 39 and is arranged in the armature 35, while the other spring seat consists of an angled-off end piece 86 of either the baseplate 85 or a hold member 87 mounted thereto. Otherwise, the baseplate may consist of injection-pressed or injection-molded plastics material with insertion holes shaped thereto for the stationary contact members 40, 50, 60 and a coil form 88 shaped thereto for taking up the excitation coil 15.

From FIGS.1, 2 and 3 it will be taken that upon actuation of the switching member 90, 95, the contact cup 70 is swiveled about an axis extending vertically in relation to the excitation coil 10, 15 and vertically in relation to the plane of the magnet 20, 21, 22 or 25, 27, from the one stationary contact member 40 or 50 to the other stationary contact member 50 or 40 respectively, so as to effect a sliding movement of the contact cup on the stationary contact parts 41, 51, 61 thus causing self-cleaning of all contacting areas. This self-cleaning effect is till assisted in that the plug 91, 96 of the switching member 90, 95 immerses into the contact cup 70 with a certain clearance and, on the other hand, in that the contact parts 41, 51 of the oppositely arranged stationary contact members 40, 50 are convexly arched with respect to the walls 71, 72 of the contact cup.

I claim:

1. A switching relay including an electromagnet and an armature actuated thereby to move from a first position to a second position comprising in combination:

first and second contacts disposed opposite each other,

an intermediate contact positioned transversely between said first and second contacts,

a make-and-break bridging contact including a pair of side contact walls and a connecting contact wall positioned transversely between said pair of side contact walls,

means for positioning said bridging contact so that said connecting contact wall is slidably positioned against said intermediate contact and said side contact walls are juxtaposed between said first and second contacts, and

means for coupling said bridging contact to said armature so that in said first position of said armature one of said side contact walls abuts said first contact and when said electromagnet is actuated to move said armature to said second position, said bridging contact slides away from said first contact so that said other side contact wall abuts said second contact.

2. The combination in accordance with claim 1, wherein said side contact walls and said connecting contact wall of said bridging contact are coupled to each other to be substantially U-shaped.

3. The combination in accordance with claim 2, wherein said U-shaped bridging contact comprises a cup.

4. The combination in accordance with claim 3, wherein said cup bridging contact is resiliently coupled to said armature.

5. The combination in accordance with claim 4, wherein said resilient mounting means comprises:

a non-conductive plug member attached to one end of said armature, and

a coil spring positioned between said plug member and said cup to bias said cup against said intermediate contact.

6. The combination in accordance with claim 5, wherein said connecting contact wall of said cup is substantially arch-shaped so that said bridging contact slides across said intermediate contact when said electromagnet is actuated.

7. The combination in accordance with claim 6, wherein said first and second contacts lie in planes substantially parallel to each other.

8. The combination in accordance with claim 7, wherein said intermediate contact lies in a plane substantially transverse to said planes of said first and second contacts.

9. The combination in accordance with claim 8, wherein said relay includes a bifurcated magnet and an excitation coil wound around a first one of said bifurcations of said magnet and said armature is pivotally connected to the second bifurcation to swivel about an axis extending vertically in relation to the centerline of said excitation coil.

10. The combination in accordance with claim 9, wherein said armature and said first bifurcation of said electromagnet create an air gap therebetween in said first position of said armature such that said air gap lies in a plane which is almost vertical in relation to the centerline of said excitation coil.

11. The combination in accordance with claim 10, wherein said first contact defines a stop for said armature in said first position.

12. The combination in accordance with claim 11 that further includes a biasing spring coupled to said armature and said first bifurcation of said magnet to bias said armature into said first position.

13. The combination in accordance with claim 12, wherein said second contact provides a stop position for said bridging contact when said electromagnet is actuated to pivot said armature against said biasing spring.

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