July 21, 1970 P. OULIANOFF 3,521,017

ELECTRICAL SWITCH MECHANISM

Filed May 22, 1968 4 Sheets-Sheet 1

Fig 1.

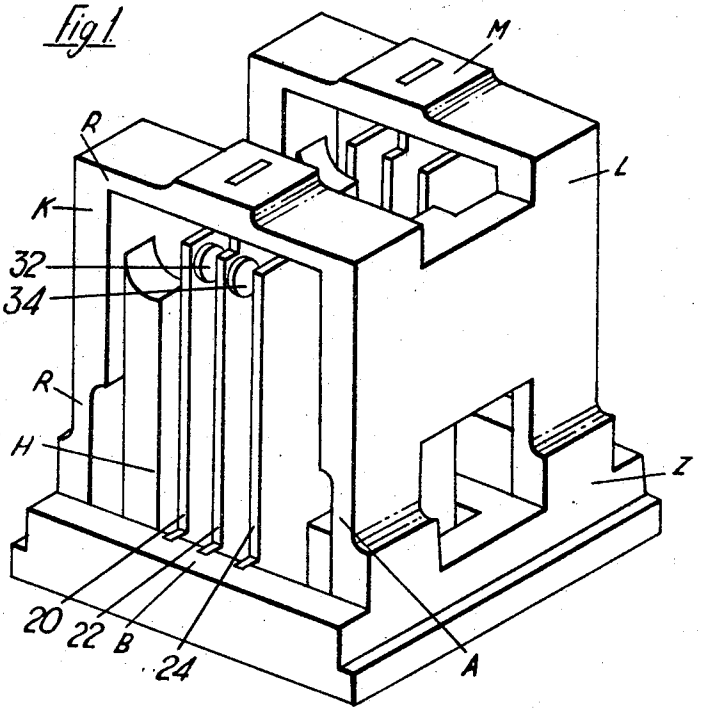

Fig 2.

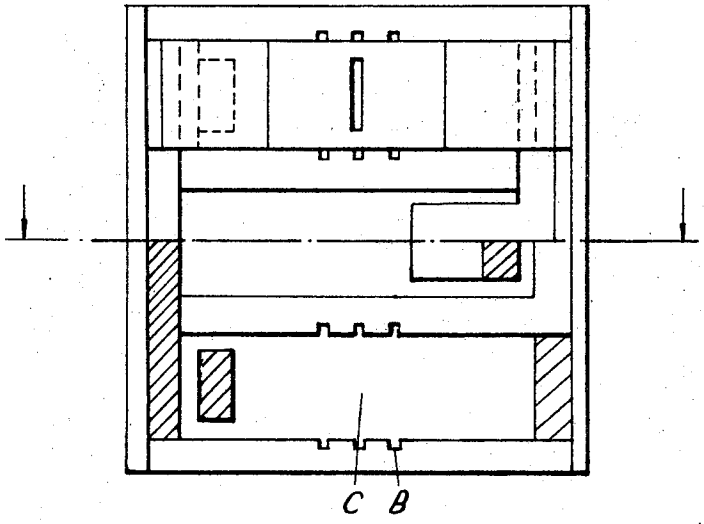

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Fig. 4

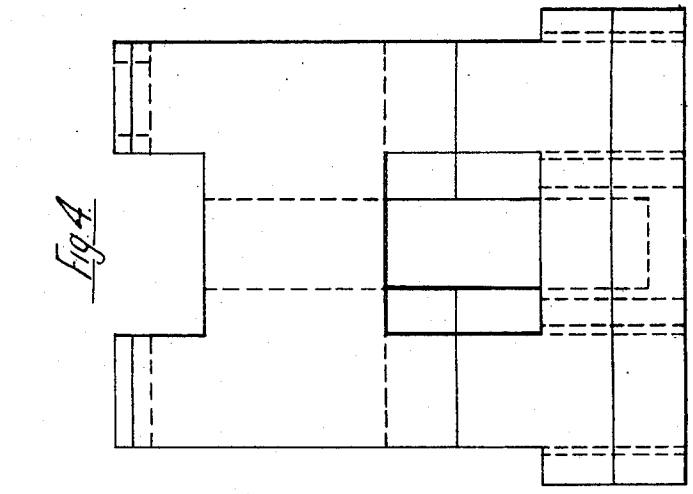


Fig. 3

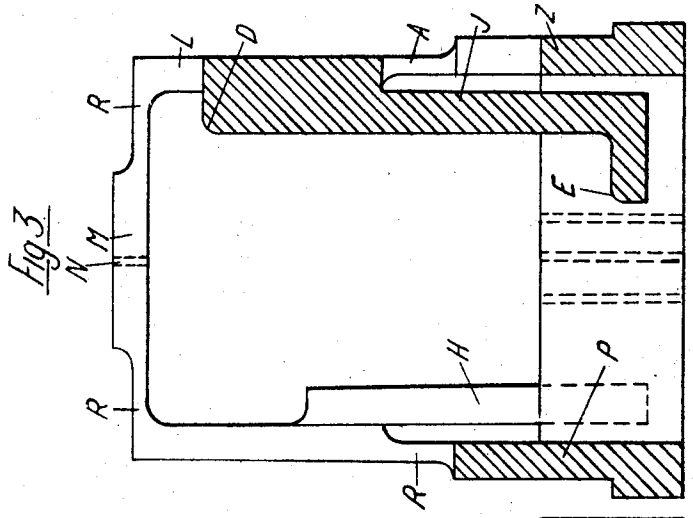
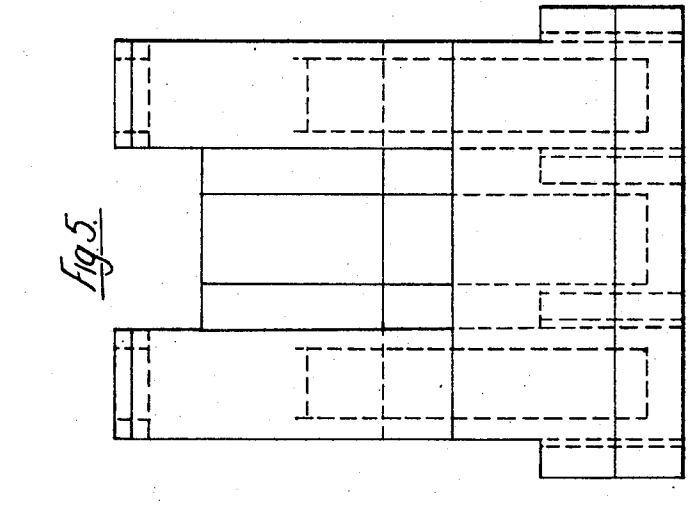


Fig. 5



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ELECTRICAL SWITCH MECHANISM

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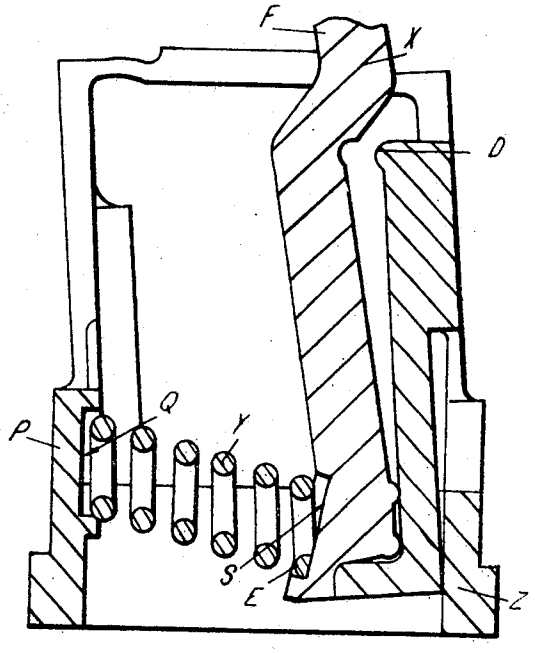
Fig 6.



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ELECTRICAL SWITCH MECHANISM

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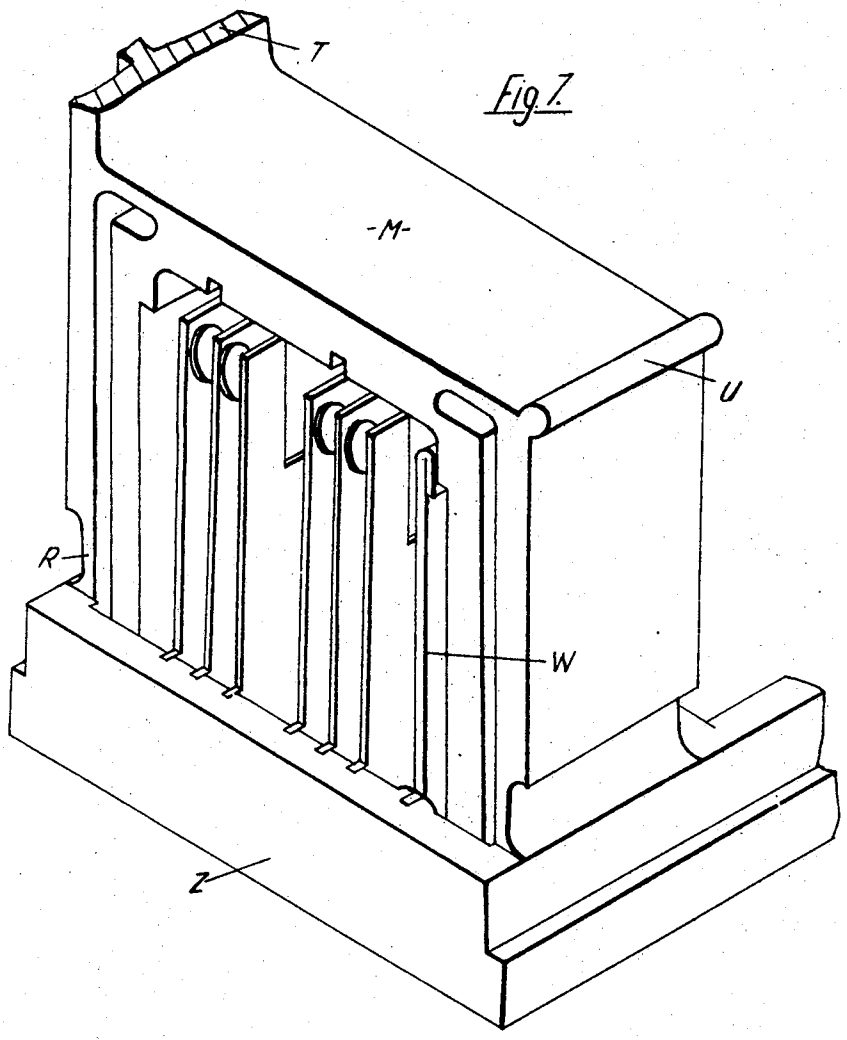
Fig. 7.



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ELECTRICAL SWITCH MECHANISM

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Int. Cl. H01h 9/02
U.S. Cl. 200—168 11 Claims

ABSTRACT OF THE DISCLOSURE

The switch mechanism comprises a flexible frame with a substantially inflexible base portion in which are mounted electrical contact members. Means are provided for distorting the frame whereby the electrical contacts are moved by means actuated by distortion of the frame. There are no mechanical bearings and the switch may be designed to operate bistably or monostably.

The invention relates to switch mechanisms. The switch of this invention is primarily intended, though not exclusively, for use as an electrical contact maker and/or breaker in the telephone or telecommunication industry.

Generally, prior art switches suited for the above application consist of spring piles supported by insulators and clamped or attached to a base or frame and operated by means of mechanical linkages. Such spring and contact piles usually require extensive adjustment operation performance on the individual switches to set contact sequences and gaps. These adjustments require relatively skilled assembly techniques and represent large proportion of the assembly time. Disadvantages encountered with the mechanical linkages used to operate such switches have been shown to be inherent in relation to pivots and bearings for the operation of the switches, these pivots and bearings being subjected to wear and are thus often the cause of final breakdown. Further, the forces required to operate the system of springs are in direct relation to the number of contact springs operated unless complicated linkages and lever systems are used.

These force X distance factors are often very large in relation to the operating force—distance factors available for actuation of the spring set, e.g. relay armature travel, etc. A relatively simple solution to this problem can be found in some micro-switch systems whereby one of the contact springs is pre-stressed against anchor points on two different levels. The contact spring acts as a toggle spring creating two stable positions for the contact points. Under these conditions the operating and contact pressures are low whereas the pressures exerted on the pivots are extremely high with the disadvantage of considerable wear and fatigue effects occurring at these points. The careful design required involves relatively tight toleranceing of the individual parts, expensive moulding techniques and close control of the moulding materials and processes. In addition, multiple contact systems will require individual tooling for each separate application, that is, for small batch production or individual application, the cost of manufacture tending to become prohibitively high. This is especially so if electrical requirements such as make-before-break in conjunction with normal make or break in specific sequences were to be imposed.

The main object of the invention is to provide a switch mechanism which is subsantially free from the above disadvantages.

In general terms the invention may be considered as a switch mechanism comprising a hollow frame having at least a part of flexible material, a substantially inflexible base portion on the frame, electrical contact members mounted with respect to the base portion, means for distorting the frame, and means actuated by distortion of the frame to move the electrical contact members.

According to a specific embodiment the frame is in the shape of a parallelogram flexible at its corners in such a way that one of the parallel sides is fixed as a base and serves as an anchor for the electrical contacts. The contacts are closed or opened by the movemen of the other three sides in relation to the base. A feature of the frame is that is can be designed and constructed free from mechanical bearings, relying on the elastic properties of flextural material in a distorting frame for its operation. Stops can be incorporated in the frame to limit and control the travel of the parallel sides adjacent the base, thus, affording protection to the contacts from excessive pressures. Distortion of the frame may be actuated directly by pressure on one of its sides or by a lever being an extension of a side or by a separate lever and springs acting on one or both of the sides adjacent the base. The last method allows indirect actuation of the switch and incorporates protection against overstressing of the frame.

The invention will be better understood from the following description with reference to the accompanying drawings, in which:

FIG. 1 is a general isometric view of the switching mechanism according to a preferred embodiment of the invention;

FIG. 2 shows a half section plan view of the frame of FIG. 1;

FIG. 3 shows a half section of the side elevation of the frame;

FIG. 4 shows a front elevation of the frame;

FIG. 5 shows a rear elevation of the frame;

FIG. 6 shows a half section of the side elevation of the frame and lever assembly; and

FIG. 7 shows another embodiment within the spirit of the invention.

With reference to the accompanying drawings and particularly to FIG. 1, the switch comprises a middle frame L of suitable material (preferably a thermoplastic material with suitable properties, e.g. an acetal resin known as "Delrin") (registered trademark) suitably weakened at the points A, R. Contact springs **20**, **22** and **24** may be either inserted individually in slots B in the base Z or sub-assembled as a separate unit and then inserted and locked into position in cavity C (see FIG. 2). The contact springs in the illustrated frame (FIG. 1) would, for example, be cantilevered leaves, extending from the base to the top M, the middle spring **22** acting as a lever which engages in the slot N and the moves with the top M as described below. Each of contact springs **20** and **24** have secured thereon contacts **32**, which, when the switch is actuated, electrically connect to a contact **34** on contact spring **22**.

The spring pile may be actuated through the parallel side wall members K and L by the application of suitable forces along an extension (not shown) of these members K and L. In the switch illustrated, over-travel facilities have been incorporated to provide additional protection for the contact springs. Switching is performed by a separate lever (see FIG. 6) resting against two fulcrums D and E and held in position by a spring Y under compression in sockets Q and S in the wall P and end of lever X, respectively. This spring Y delivers a measured force against the fulcrums D or E which becomes a pivot point for the lever in the event of the actuating force F becoming excessive. Thus, the lever may be subjected to overtravel without damaging effect to either frame or contact springs.

To provide the necessary switching characteristics, the actuating spring Y may act on the lever X at any chosen point as may be required from case to case, i.e. the switch may be monostable in one or the other direction depending on the axis of action of the spring Y forces, or, if the neutral axis of the spring Y crosses the centre of the pivot A the switch may be operated bistably. The distance of travel of the member M may be controlled by the stops H and J and the gaps between these members and the side wall members K and L of the case.

The characteristics of the switch may be determined by the following:

(a) The type of contacts, e.g. simple cantilevered contact springs, prestressed cantilevered contact springs, Reed contacts, contact bars, sliding contacts, pivoting contacts or any combination of these.

(b) The location of the contacts in the frame.

(c) The location of the frame fulcrums D and E and of the stops H and J, if any.

(d) The method of acuation and/or the line of action of the actuating force, e.g. on the side wall members K and L on an extension T of the side wall members K and L crossing the centre of rotation of a side wall member, etc.

FIG. 7 illustrates a second embodiment of the same principle wherein the stops H and J are integral with and depend from the top member M parallel with the base Z. A pre-tensioned spring W is incorporated to determine the direction of action of the switching lever X (not shown). The contacts are thus closed under the action of spring W and opened when the actuating lever is operated. Provision is made by the extension T of one side wall member for a direct actuating lever, and a pivoting fulcrum U is provided for an over-travel safety lever (not shown). FIG. 7 shows only one set of contacts the switch being intended to be mounted in parallel banks in the manner shown by the broken section to the right of the drawing and on one common base Z. The spring Y of FIG. 6 (not shown in FIG. 7) which retains the actuating lever X will be mounted between two banks of the contacts.

Two preferred embodiments have been described above but it should be understood that other forms besides these are feasible within the scope of the invention. One form of the switch as described above utilizes the material "Delrin" which is a plastic material having suitable properties to permit frame flexural action with constructional rigidity. However, it is conceivable that an identically designed switch may be produced from non-plastic material, even metal, with the flexure points A and R being fabricated from suitable elastic material, e.g. spring steel. Furthermore, particular types of switches according to this invention may be constructed other than with an integral frame as illustrated in FIG. 1.

It should also be understood that the foregoing disclosure relates only to preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples in the invention herein

chosen for the purposes of the disclosure and which do not constitute departure from the spirit and scope of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A switch mechanism comprising: a rigid base member, a flexible frame member secured to said rigid base member, a plurality of electrical contact members mounted on said rigid base member and extending away from said rigid base member in planes parallel to a portion of said flexible frame member, means for distorting said flexible frame member so as to cause said flexible frame member to directly contact at least one of said electrical contact members and cause the electrical contact member to move.

2. A switch mechanism in accordance with claim **1** wherein at least one of said electrical contact members is also secured to said flexible frame member.

3. A switch mechanism in accordance with claim **1** wherein stops are secured to said switch mechanism to limit the travel of said flexible frame member.

4. A switch mechanism in accordance with claim **3** wherein said stops are integral with and depend from said flexible frame member.

5. A switch mechanism in accordance with claim **1** wherein distortion of said flexible frame member is actuated directly by pressure to said flexible frame member.

6. A switch mechanism in accordance with claim **1** wherein distortion of the flexible frame member may be actuated by a lever forming one side of said flexible frame member.

7. A switch mechanism in accordance with claim **1** wherein the sides of said flexible frame member adjacent to said rigid base member are distorted by means of a lever and springs secured to said rigid base member.

8. A switch mechanism in accordance with claim **6** wherein said switch mechanism operation is monostable.

9. A switch mechanism in accordance with claim **8** wherein said switch mechanism operation is bistable.

10. A switch mechanism in accordance with claim **1** wherein at least a portion of said flexible frame member is composed of a thermoplastic material.

11. An electrical contact maker comprising a frame having a parallelogram shape, said frame being flexible at its corners, one of the sides of said parallelogram being fixed and serving as a base portion, electrical contacts secured to said base portion, said contacts being opened or closed by movement of the other three sides of said parallelogram in relation to said base portion.

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