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(54) MINIATURE ELECTRICAL RELAY MECHANISM

(71) We, NORTHERN TELECOM LIMITED, a Canadian company of 1600 Dorchester Blvd., West, Montreal, Canada H3H 1R1, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to electrical relay mechanisms and in particular to electrical relay mechanisms for telecommunications systems.

The need to conserve space, to improve reliability and reduce manufacturing costs has resulted in considerable redesign of the normal telephone switching relay particularly to miniaturize it. Reduced material costs and increased density are two advantages. There is also a reduction in operating power, of considerable importance in large switching offices.

Essentially a relay comprises one or more sets of contacts, an electro-magnetically actuated armature which actuates the contacts—breaking one set and making the other, and mounting means for the armature. Generally, although not always, the mounting means for the armature acts to return the armature to its inactive position and yet permits easy pivoting of the armature on actuation of the electro-magnetic system.

One source of trouble is the connection of the armature to the hinge spring. Conventionally the armature is brazed or staked to the spring and breakage as a result of fatigue often occurs after a period of service.

The present invention provides a miniature electrical relay mechanism comprising an E-shaped core having a bridge portion, a central leg positioned within a coil, and two outer legs, a U-shaped armature having a bridge portion and two legs, and a U-shaped hinge spring having a bridge portion and two legs, the hinge spring bridge portion being clamped to the core bridge portion and the armature bridge portion engaging an operating card for operating a series of contact springs, the hinge spring legs overlapping respective armature legs and interengaging formations on the ends of the legs releasably hingeably attaching the armature to the hinge spring for pivotal movement of the armature towards and away from the core outer legs. An embodiment of the invention will now be described by way of example, in conjunction with the accompanying drawings, in which:

Figure 1 is a perspective view of a relay viewed from the base;

Figure 2 is a bottom plan view of the relay of Figure 1 with the base plate mostly removed;

Figure 3 is a cross-section on the line III–III of Figure 2;

Figure 4 is an exploded perspective view of the spring contact pile-up and actuating mechanism;

Figure 5 is an enlarged view of the hinge attachment between armature and hinge spring;

Figure 6 is a cross-section on the line V–V of Figure 2 to an enlarged scale to illustrate the cooperation between operating card and spring contacts;

Figure 7 is an end view on Figure 6 in the direction of the arrow A.

As illustrated in Figures 1, 2 and 3, a relay comprises a housing 10 and a base plate 11, forming an enclosure for the relay mechanism. The relay mechanism comprises a coil 12 on a centre leg of a core 13, an armature 14 with hinge spring 15, an assemblage of springs and contacts including break contact springs 16, transfer springs 17, make contact spring 18, return spring 19 and card 20. Various insulators are positioned between various items, as indicated at 21, 22, 23, 24 and 25. The whole assemblage is held together by screws passing through holes in insulators and springs and screwing into threaded holes in the core 13. The various springs and insulators 22, 23 and 24 have oversize holes relative to the holes in the insulators, and hollow bosses 26 formed on the bottom insulator 25 pass through the various holes to avoid electrical shorting between springs via the screws.

The various individual items are seen more clearly and in more detail in Figure 4. The coil is formed by a winding on a molded former 30. The molded former has a hollow spool part, on which are wound the windings, and an end extension 31. The end extension has two arms 32 extending normal to the axis of the coil and also normal to the major plane of the core 13. In the arms 32 are positioned two contact strips 33, the ends remote from the core axis eventually passing through the base 11 of the relay, as indicated at 34 in Figure 1. Other ends of the contact strips 33 initially extend outwards from the coil axis, as indicated by dotted outline 35. After connection of the winding ends to the ends 35 they are bent to lie parallel to the coil axis, at 35a. This ensures some slack in the connections to the ends 35. The core has two side legs 13*a* extending from the bottom part of the core, spaced from and extending parallel to the centre leg of the core 13.

Positioned next to the core 13 is the armature 14 and hinge spring 15. Previously, the hinge spring was permanently attached to the armature, as by brazing, spot welding, or similar, and as a fatigue sensitive position was set up at the region of attachment, where cracking could occur. In Figure 3 the relay is shown as energised, that is the coil is connected to an electrical supply and the core 13 has attracted the armature 14 against the action of the contact springs. Contacts have been actuated as will be described.

The hinge spring is U-shaped having a base portion attached to the bottom part of the core 13 and two parallel spaced apart legs 15*a* positioned over the side legs 13*a* of the core. The connection of the armature to the hinge spring, in the present invention avoids the formation of fatigue sensitive regions. As seen in Figure 4 and also in larger scale in Figure 5, the ends of the legs 14*a* of the armature 14 are chamfered at 36 and a recess 37 is formed at the side of each leg. The end of each leg 15*a* of the hinge spring is inclined and a pair of tangs 38 are struck out of the inclined end. Seen in side view, as in Figure 5, the pair of tangs present a somewhat C-shaped configuration, the mouth of the C facing down. Each C-shaped configuration is a fairly close fit in a recess 37. In assembly, the coil 12 and core 13, hinge spring 15, and springs and insulators are first assembled and screwed together. The armature 14 is then assembled on the hinge spring by sliding the armature along the core, with the legs 14*a* of the armature sliding on the core. When the legs 14*a* of the armature 14 meet the legs 15*a* of the hinge spring 15, the chamfers 36 act on the tangs and lift the legs 15*a* of the hinge spring up. The C-shaped formations slide over the ends of the legs 14*a* of the armature and drop into the recesses 37 to hingeably and releasably attach the armature to the hinge spring. Assembly is very easy and cheap, being cheaper than brazing of staking and avoiding fatigue problems. Some care is needed in providing acceptable dimensions. Thus the chamfers 36 must be such that the ends of the legs 14*a* will lift up the legs of the hinge spring. The distance between the end of the chamfer and the wall of the recess nearest the chamfer must be slightly larger than the distance across the mouth of the C shape—i.e. between the ends of the tangs 38. As can be seen in Figure 4, the C-shaped tangs occupy approximately half the width of the hinge spring leg and the legs 14*a* and 15*a* are of approximately equal width.

Once the armature is assembled on the hinge spring it is quite firmly attached and will stand up to heavy mishandling of the relay, such as by dropping. The hingeable connection permits pivotal movement of the armature towards and away from the legs of the core 13.

The operating card 20 is arranged to act on the contact springs 16 and 18 as close to the contacts as possible. Thus the amount of movement of the contacts is substantially the same as the movement of the card. Conventionally the card engages the contact springs a short distance away from the contacts and there is some movement differential—the movement of the card being slightly more than that of the contacts. While the differences may be small, in very small relays, with which the present invention is particularly concerned, even small reductions in armature movement are extremely important.

The card 20 is provided with an extension —seen more clearly in Figure 6. The extension 51, is positioned between the ends of the contact springs 16 and 18, and is very close to the contacts 52 and 53 on the contact springs 16 and 18 respectively. Corresponding contacts 54 are on each side of the transfer spring 17. The operating card 20 is carried on the ends of the legs 19*a* of return spring 19. Two small recesses 55 are formed near the outer ends of the legs 19*a*. The legs 19*a* pass through apertures 56 in the card 20 with the recessed parts of the legs 19*a* engaging in the apertures. This can be seen in Figure 7. The extension 51 is carried by a central bar 57.

The card 20 is also carried on the end of the armature 14. The outer end of the armature is provided with a small channel or undercut 58 (Figure 4) at each edge. The card has a further aperture 59 through which the end of the armature 14 passes, and small protrusions 60 (Figure 4) at two corners of the aperture 59 engage with the channels 58. Thus movement of the armature 14 is transmitted via the operating card 20 to the contact springs 16 and 18.

With the very small movements of the armature, and small clearances, sticking of the armature to the core, as a result of residual magnetism, can be a problem. While such a problem has been reduced considerably by the use of special alloys, it can still occur, particularly if manufacturing tolerances happen to build up in a particular manner to reduce clearances, etc. In this relay, additional protection against armature sticking can be provided.

Two features can be provided to ensure correct armature operation. Firstly, the surface 62 of the side legs 13*a* of the core 13, which the armature 14 engages on actuation, is knurled to provide a slightly roughened surface as indicated in Figure 4. Secondly, the side legs 13*a* are bent slightly out of the plane of the major part of the core. In particular, in the present example, the legs are bent upward as viewed in Figure 4. The bending is extremely small, typically about ·005 inch. Both these provisions create a localized air gap between armature and core, when the core is energized and armature actuated, thus avoiding sticking.

The base plate 11 is of molded form and small depressions are formed during manufacture in what will be the inner surface of the base plate. The depressions extend part way through the base plate.

The various contact springs, that is contact springs 16 and 18 and transfer spring 17, have terminals 70, 71 and 72 respectively which extend from the base plate. The outer ends of the terminals are pointed, and after assembly of the relay into the case 10, the base plate is pushed on over the terminals. The ends of the terminals locate in the depressions on the inner surface of the base plate and cut their way through the remaining thickness. This provides a good seal around the terminals.

For optimum operation of the contacts 52, 53 and 54 it is desirable that the transfer spring 17 be completely rigid while the contact springs 16 and 18 be infinitely flexible. For manufacturing reasons, some compromise must be made, and the transfer spring does have some flexibility. To increase the rigidity of the transfer spring 17 the insulators 22 and 23 are made longer than usual and extend further along the transfer spring, as shown in Figure 3. This extension of the insulators 22 and 23 does not interefere with the spring contacts 16 and 18, and is an aid towards reducing chatter at the contacts.

It is desirable to control the amount of movement of the armature, and in particular it is at least preferable that the disengaged or released position of the armature be controlled. Conventionally this is obtained by a separate part which is adjustable after assembly to give the correct positioning. However, this control can be obtained as shown in Figure 3 by a stop 75 molded as part of the coil bobbin or former 30. Stop 75 comprises a protrusion and serves to locate the outer end of the armature in the released or disengaged position. This in turn controls the movement of the aperture card and locates the card also when in the inoperative position.

It will also be seen, particularly from Figure 1, that the housing protects the contacts and other moving parts of the relay from physical damage, but any contaminants can escape. Thus there is no gas build up as a result of operation of the relay.

WHAT WE CLAIM IS:

1. A miniature electrical relay mechanism comprising an E-shaped core having a bridge portion, a central leg positioned within a coil, and two outer legs, a U-shaped armature having a bridge portion and two legs, and a U-shaped hinge spring having a bridge portion and two legs, the hinge spring portion being clamped to the core bridge portion and the armature bridge portion engaging an operating card for operating a series of contact springs, the hinge spring legs overlapping respective armature legs and interengaging formations on the ends of the legs releasably hingeably attaching the armature to the hinge spring for pivotal movement of the armature towards and away from the core outer legs.

2. A relay mechanism as claimed in claim 1, the interengaging formations comprising a recess in each leg of the armature, and a tang formation at the end of each leg of the hinge spring, the tang formations engaging in the recesses.

3. A relay mechanism as claimed in claim 2, the legs of the hinge spring being planar and the ends thereof being inclined out of the plane of the legs.

4. A relay mechanism as claimed in claim 3, the tangs being struck from the ends of the hinge spring legs in a direction in which the ends are inclined.

5. A relay mechanism as claimed in any of claims 2 to 4, the tangs being C-form, extremities thereof being struck out of the legs and central portions thereof acting to support the tangs from respective legs.

6. A relay mechanism as claimed in any of claims 2 to 5, each tang occupying approximately half the width of a hinge spring leg.

7. A relay mechanism as claimed in any preceding claim wherein the width of the

spring legs and the width of the armature legs are equal.

8. A relay mechanism as claimed in any of the preceding claims wherein the ends of the armature legs are bevelled.

9. A relay mechanism as claimed in any of the preceding claims wherein the contact springs each include contacts at a free end thereof, the contact springs being mounted from the core bridge portion at their other ends with an insulating member positioned between each adjacent pair of contact springs.

10. A relay mechanism as claimed in claim 9 wherein the contact spring include a central transfer contact spring and an outer contact spring on each side thereof, the insulating members on each side of the transfer contact spring extending for a substantial distance along the transfer contact spring to increase the rigidity thereof.

11. A relay mechanism as claimed in claim 10 wherein the free ends of the outer contact spring extend a short distance beyond the central transfer contact spring, the operating card extending over the free ends of said outer contact springs and including an extension extending between the free ends of said outer contact springs and in contact therewith, immediately adjacent to the contacts on said outer contact springs.

12. A relay mechanism as claimed in any preceding claim, the core outer legs having surfaces contacted by the armature on energization of the coil, the contact surface being of roughened formation to reduce the contact area between the armature and the core.

13. A miniature electrical relay including a hollow housing, a base plate closing the housing and a relay mechanism as claimed in any of the previous claims within the housing.

14. A relay substantially as described herein, and illustrated in the accompanying drawings.

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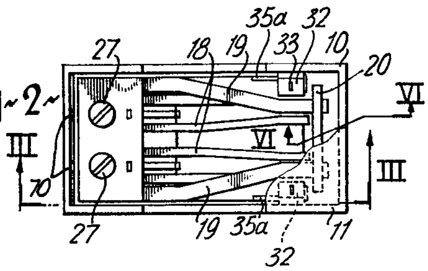
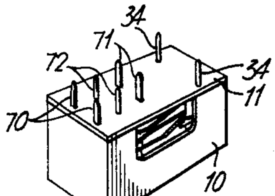
1568693 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

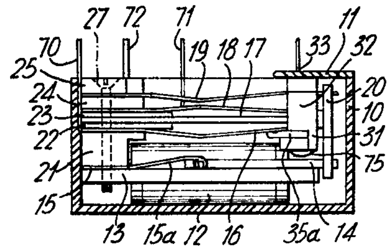
Sheet 1

-Fig-2-

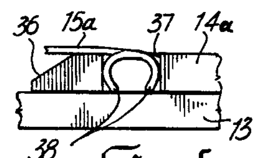




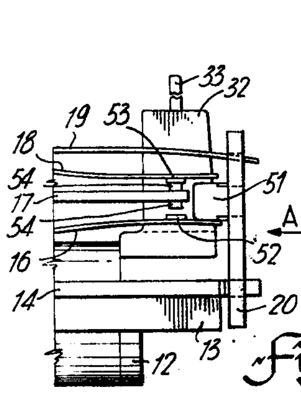
-Fig-1-



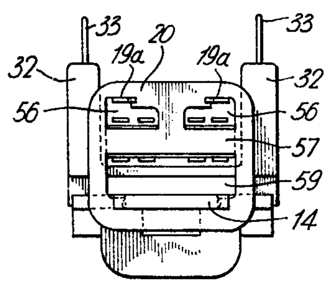
-Fig-3-



-Fig-5-



-Fig-6-



-Fig-7-

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

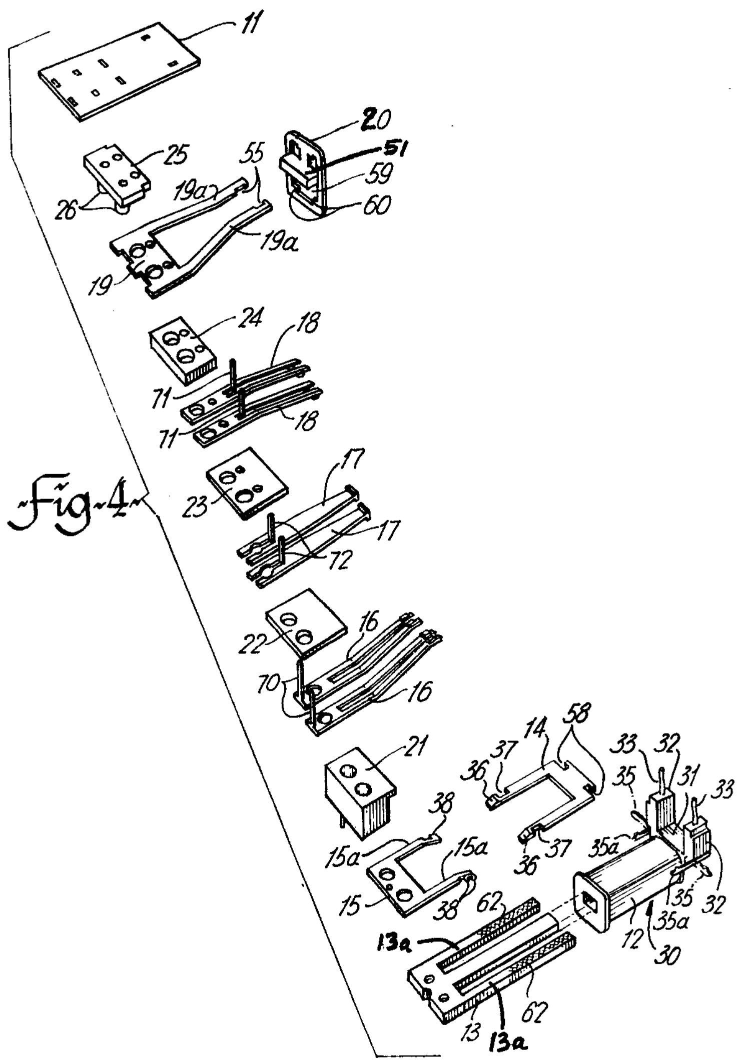

Fig-4