

Oct. 15, 1957

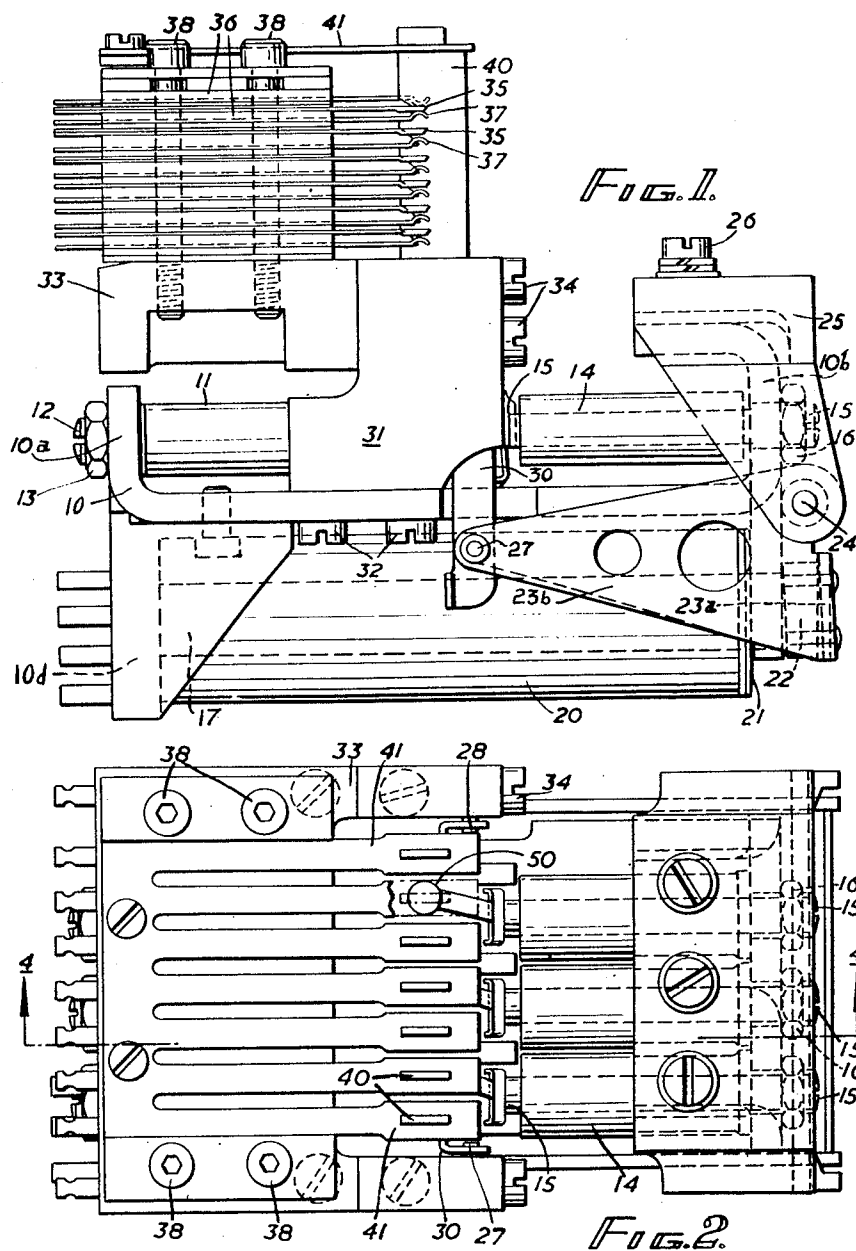
F. E. ROMMEL ET AL

2,810,040

ELECTRIC SWITCHES

Filed Aug. 23, 1954

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

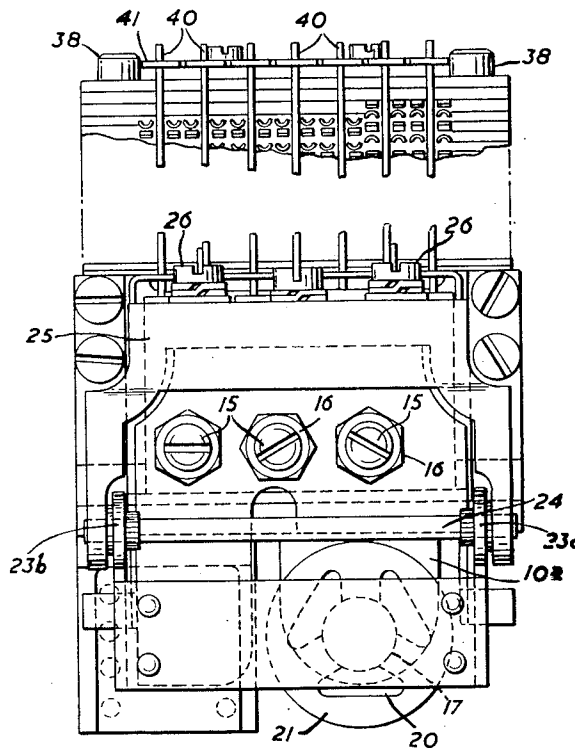


FIG. 3.

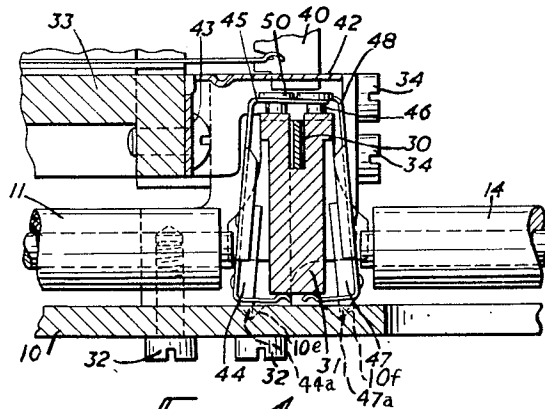


FIG. 4.

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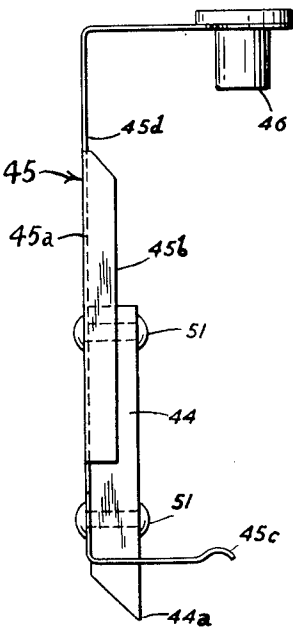


FIG. 5.

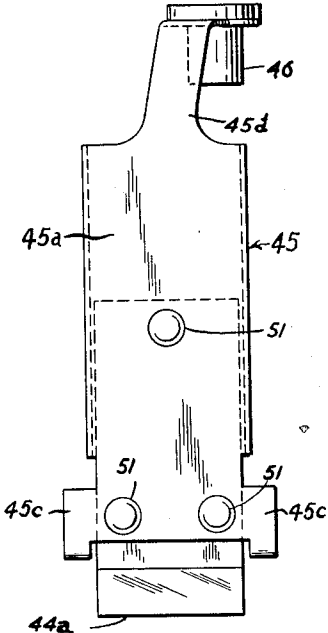


FIG. 6.

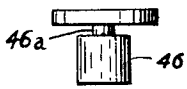


FIG. 7.

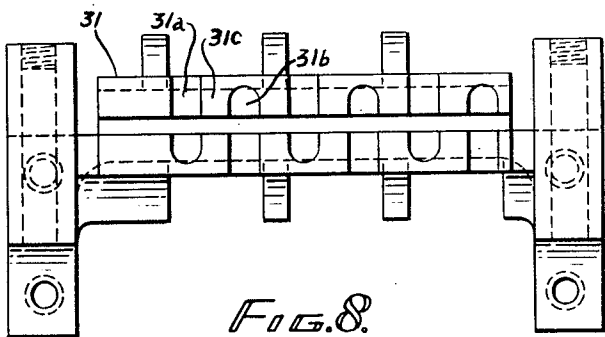


FIG. 8.

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FIG. 11.

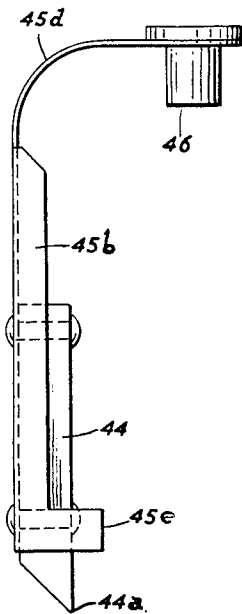
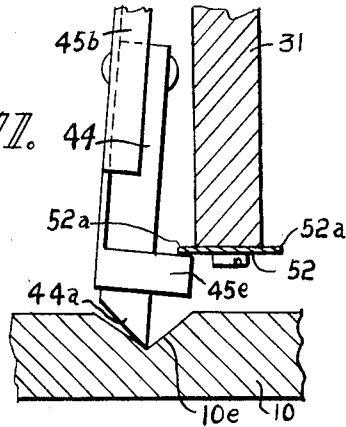


FIG. 9.

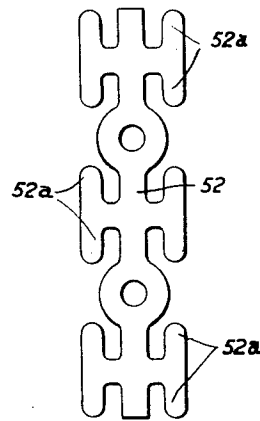


FIG. 10.

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2,810,040

ELECTRIC SWITCHES

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Application August 23, 1954, Serial No. 451,375

Claims priority, application Great Britain August 24, 1953

5 Claims. (Cl. 200—104)

This invention relates to electromagnetic devices in which a plurality of generally similar magnetic armatures are employed. One example of such a device is a switch employing a plurality of contact sets, a preselector or so-called finger magnet pertaining to each contact set, and a main operating magnet. The action is such that upon energisation of a finger magnet a member, which can be identified as an interference piece, is moved into a position such that when the main magnet is energised the contacts of the pertaining set are actuated; the sets of which the finger magnets have not been previously energised, are not actuated. Switches of these types are used in cross-bar telephone systems; one such switch is described in United States Patent No. 2,630,500, and a further example of such a switch is described in a co-pending application No. 451,374, filed August 23, 1954. Since the present invention finds its chief application in switches of this type, the invention will hereinafter be described in relation to such a switch, but it is to be understood that the invention is not limited to this application.

It is very desirable that where a multiplicity of armatures are used in a common switch assembly the armatures should be capable of being manufactured in quantity cheaply, and the invention is concerned with the provision of a construction by which this can be done.

In accordance with the invention there is provided an electromagnetic device including a support member, upon which a plurality of armatures are mounted, said armatures being each provided with a knife edge arranged to enter a recess in said support member, and being there retained by spring means.

In accordance with a further feature of the invention, the spring means serves both to retain the knife edge in the recess, and also to provide the necessary spring bias to restore the armature to the released position.

In a preferred embodiment of the invention, which will be described hereinafter, a single member forming part of the armature not only retains the armature in the recess and provides the restoring force for the armature but also determines the minimum residual air gap in the magnetic circuit of the magnet for the armature. Further, in this embodiment, which is a cross-bar switch of the type referred to above, this same member also provides a flexible mounting for the interference piece.

Other features and advantages of the invention will appear from the following description of one embodiment thereof, given by way of example, in conjunction with the accompanying drawings. The switch shown, and to be described, is of the cross-bar type referred to above.

In the drawings:

Figure 1 is a side elevation of the switch;

Figure 2 is a plan view of the same switch;

Figure 3 is an end elevation of the switch;

Figure 4 is a fragmentary section on the line 4—4 of Figure 2;

Figure 5 is a side view, on an enlarged scale, of one of

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the finger magnet armatures, together with the attached interference piece;

Figure 6 is an end view, on an enlarged scale, of the armature and interference piece of Figure 5;

Figure 7 is a side view of an interference piece before being deformed;

Figure 8 is a plan view of the guide block;

Figure 9 is a side view of an alternative form of armature;

Figure 10 is a view of an alternative form of retaining spring for use with the armature of Figure 9; and

Figure 11 is a view on an enlarged scale similar to part of Fig. 4 but incorporating the armature and spring of Figures 9 and 10.

The switch shown in these drawings is built up on a baseplate 10 of soft iron sheet; "soft" is to be understood as meaning material of high magnetic permeability and low retentivity, such as is suitable for use with electromagnetic devices.

At its one end this baseplate has an upwardly turned flange 10a which supports three finger magnets 11; these magnets have cores 12 which are screwed into and through flange 10a and there held by locknuts 13. As will be seen, these magnets lie with their cores parallel to each other and to the baseplate. At the other end of the baseplate is another flange 10b and three further finger magnets 14 have their cores 15 screwed into the flange, and held by locknuts 16. The upper edge of flange 10b is again turned over, at 10c. The cores of finger magnets 14 are also parallel to each other and to baseplate 10, and the six finger magnets all lie compactly in one layer on the baseplate.

At the same end of the baseplate as flange 10a is a further flange 10d, which serves to carry a main magnet; the main magnet comprises a core 17 which is butt welded to flange 10d, and upon which is the operating coil 20. The coil is held in position on the core by an internally toothed spring clip 21. The armature for the main magnet includes a rectangular element 22 of soft iron mounted upon a carrier 23 having a substantially vertical flat end 23a and two sides 23b, 23c extending at right angles from it, one along each side of the switch. The main armature 23 pivots on shaft 24 secured to a generally inverted U-shaped saddle 25 fixed to the flange 10c by screws 26. To the ends of the sides 23b and 23c at 27 and 28 is pivoted an inverted U-shaped actuator 30, to which further reference will be made.

The movement of actuator 30 in the horizontal direction is limited by arranging the horizontal part of the actuator in a vertical slot in a guide block 31 which lies across the baseplate, between the two rows of finger magnets, and is secured to the baseplate by screws 32. Normally, that is when the main magnet is not energised, the horizontal part of the actuator 30 lies wholly within the slot in the guide block and in particular with its upper edge below the upper surface of the block as shown in Figure 4. When the main magnet is energised, the upper edge of the actuator rises above this surface.

Above the parts of the switch thus so far described is a contact assembly. So far as the construction, support and actuation of the contacts is concerned, this assembly is generally as described in United States Patent No. 2,630,500, to which further attention is directed.

Briefly, however, the assembly includes a mounting block 33 which is secured to the guide block 31 by screws 34, and sets of both stationary and moving contacts carried on this mounting block. The stationary contacts 35 are clamped in a stack of insulating spacers 36 and the moving contacts 37 are carried but not necessarily clamped in this stack. The stack is clamped to the mounting block by screws 38.

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The moving contacts of each set are operated by a card 40; as shown there are seven sets of contacts each with its card. The moving contacts of each set enter slots in the edges of the card, and the cards are guided at their upper ends by means of a tongued spring plate 41, which provides a light downward bias pressure on the cards, and at their lower ends by a relatively rigid plate 42 secured to block 33 by screws 43.

The contact assembly forms a separate unit which can be attached to or removed from the rest of the switch, by means of the screws 34.

When the contact assembly is secured in position, all the cards 40 lie over the upper surface of guide block 31 in the relative lateral position shown in Figure 4. The lower edges of the cards are straight, as shown in Figure 4, and lie parallel to the upper surface of the guide block 31, but in the lowermost position of the cards, corresponding to the non-actuated condition of the contacts, the actuator 30 does not engage the lower edge of the cards of six of the contact sets, even when the main magnet is energised. The exception is the seventh set, which is that shown uppermost in Figure 2. The contacts of this set are the off-normal contacts; they have no finger magnet pertaining to them and they are actuated directly by the actuator 30 upon every energisation of the main magnet. These contacts are required in the circuit of a cross-bar system but hereinafter any reference to the contacts of the relay is to be taken as excluding these off-normal contacts.

So that one vertical set of contacts, pertaining to one finger magnet, can be operated by movement of its card, each finger magnet 11 has an armature which includes an armature element 44 and a spring arm 45, the latter carrying an interference piece 46, while the armatures of finger magnets 14 have correspondingly an element 47 and a spring arm 48, the latter carrying an interference piece 50. Normally, that is with a finger magnet not energised, the interference pieces lie to one side of the actuator 30, as shown in Figure 2, the interference pieces 46 lying to the right and the interference pieces 50 to the left of the actuator. When any finger magnet is energised the corresponding armature moves, and the interference piece is brought into position immediately beneath the card 40 and over actuator 30, so that when the main magnet is energised the actuator raises the card and the contact set corresponding to the energised finger magnet is actuated.

It will be seen that the movement of the interference pieces is limited in the actuating direction, that is, in the vertical direction in Figures 1 and 3; each interference piece is limited in its upward movement by the lower edge of the card 40, and in its downward movement by the surface of the guide block 31 upon which it normally rests.

Additionally, and as shown more clearly in Figure 8, the upper surface of the guide block 31 is provided with a series of recesses 31a, one for each of the interference pieces 46, and corresponding recesses 31b for interference pieces 50. The lower part of the interference pieces is located, at all times, between the side walls of these recesses and so the interference pieces are likewise limited against lateral movement. Since the recesses 31a and 31b have closed ends, the movement of the interference pieces in the interfering direction is also limited.

This aspect of the switch is considered further in the co-pending application No. 451,374. The guide blocks 31 are also formed with webs 31c which lie between the adjacent armatures.

The armature elements of the finger magnet armatures are arranged to provide the necessary pivotal mounting for the armatures. The elements 44 or 47 are identical in construction though transposed in position in assembly and consist of a rectangular strip of soft iron of which one end is machined to a knife edge as shown at 44a and 47a in Figures 4, 5 and 6. To receive these knife edges,

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the baseplate is formed with two series of depressions 10e, 10f, the depressions 10e for knife edges 44a and 10f for 47a. As will be appreciated from Figure 2, the depressions 10e are in line, and 10f are likewise in line, and the two lines are parallel with each other. If desired, each row of depressions can be formed as a single elongated depression, but the separate depressions are preferred. It is convenient to form the depressions by a pressing operation, in which case a hole may be formed in the metal before the pressing operation in order that the metal may flow more easily.

The second parts of the armatures are the spring arms 45 and 48. These are also similar in shape, and are formed as stampings of spring material, such as Phosphor bronze or brass. As shown in Figures 5 and 6, spring 45 has a flat portion 45a which lies against that face of the armature element 44 which is adjacent the core of the finger magnet, and a flange 45b along each edge to increase the stiffness of the spring. The spring is secured to its element by three small rivets 51. From the bottom edge of the flat portion 45a of the spring extend two small fingers 45c at right angles. These fingers, as will be seen from Figure 4, pass beneath the block 31, the centre part of which is cut away to receive the springs, and engage its under surface; thereby these spring fingers retain the armature elements in position in their respective depressions and they provide also the necessary restoring springs for the armatures.

The spring arms are also formed with bent-over extensions 45d or 48d which serve to carry at their extremities the interference pieces 46 or 50. A method found advantageous for attaching the interference pieces to these extensions is to make each interference piece as shown in Figure 7 as a short, flanged cylinder with a narrow, central circumferential groove 46a. The end of each extension has a hole in it, with a slot leading from the hole to the end of the extension. The groove in the cylinder allows the latter to enter the slot and hence the hole, and the cylinder is then deformed endwise to cause it to be firmly and permanently clamped on the extension, and at the same time dimensioned within a close tolerance in the actuating direction.

The simplicity of the armatures, and of the manner in which they are mounted will be apparent. In the first place the construction of the members 45 and 48 is particularly advantageous. These members are similarly shaped, and are formed from a single piece of metal; the metal is thin and can be cut and shaped as desired without difficulty and without the use of any unduly complicated tools. Despite this simplicity of manufacture, the members serve to hold the knife edges of armature elements, and hence the armatures, in position in the recesses in the base plate. They also serve to provide the restoring force for the armatures, to move them away from the cores when the magnets are deenergised. By appropriate choice of the thickness of the metal used for these members, they ensure the correct residual air gap in the magnetic circuit in the operated condition of the magnet, since they are located between the armature elements and the cores. It is a substantial advantage that the correct air gap is obtained without the adjustment or accurate machining necessary in conventional armatures.

The members 45 and 48 also provides the support for the interference pieces 46 and 50, and in doing so giving the desired degree of flexibility necessary to allow the interference pieces to move in the actuating direction. Finally, the members permit the assembly of the armatures on the baseplate in a very simple manner, and without the need for specific securing elements such as screws, rivets or the like, since the two fingers 45c or 48c, as the case may be, have only to be introduced beneath guide block 31, and the knife edge of the armature element located in its recess in the baseplate.

Again, the armature elements 44 and 48 are of very

simple shape, and can be made from standard section strip metal. The only surface machining which is necessary is that by which the knife edge is formed, and this also is a simple operation which can be carried out easily and cheaply to the desired degree of accuracy. Apart from the piercing or drilling of the holes to receive the rivets by which the spring arms 45 and 49 are attached to them, this is all the machining which is necessary. The tolerances on the surfaces other than those defining the knife edge can be relatively large, and this is conducive to cheap production. As the knife edge of each element is in good magnetic contact with the base plate the reluctance of the resulting magnetic circuit of each magnet through its own core, flange 10a or 10b, the main part of base plate 10 and its own armature 36 or 40 is low, so that efficient operation is obtained.

An alternative form of spring member for the armatures and an alternative spring retaining and restoring means for the armature is shown in Figures 9 and 10.

The armature of Figure 9 is generally similar to that shown in Figure 5, except the arms 45c are omitted and the side flanges 45b are each formed with projections 45e. These projections are relatively stiff in the vertical direction. As can be seen more clearly from Figure 11, the armatures are held in the recesses in the base plate by a spring member 52, shown in Figure 10, which has seven opposite pairs of arms 52a pertaining one pair to each armature; this spring member is fastened to the under-surface of the guide block 31 and the arms 52a then project slightly on each side of the guide block. The projections 45e on the member 45 engage the underside of the pertaining pair of arms 52a, to provide both the spring bias to retain the armatures in the recesses and the restoring force for the armatures.

We claim:

1. An electromagnetic relay comprising a plurality of contact sets, an operator for the contacts of each of said contact sets, said operators being arranged in a row, a guide block below said row of operators, said guide block having a plurality of transverse, parallel spaced guide grooves located respectively in alignment with said operators and a second vertical groove extending at a right angle to said guide grooves and intersecting the same, said second groove extending in the direction of said row of operators, a main operating magnet, an actuator member disposed in said second groove of said guide block and movable upwardly upon energization of said main operating magnet, a horizontal row of finger magnets corresponding respectively to said plurality of contact sets and row of operators, a horizontal support plate for said finger magnets, each of said finger magnets having an armature actuated thereby, each said armature including a component of magnetic material having the lower end thereof terminating in a knife edge which is received in a depression in said support plate to constitute a pivotal mounting for the armature, and each said armature further including a relatively thin component of non-magnetic resilient material secured to said pivotally mounted magnetic component, said non-magnetic component including a lower arm portion in contact with a stationary part of said relay for biasing said armature to the non-energized position and an upper arm portion carrying an interference piece slidably guided in the correspondingly located guide groove in said guide block from a position to one side of said guide groove and actuator when the finger magnet is unenergized to a position between said actuator and the corresponding operator when the finger magnet is energized whereby upon energization of said main operating magnet, said actuator will be moved upwardly to engage and effect upward movement of those of said interference pieces which have been brought into alignment with said actuator thereby also effecting up-

ward movement of the corresponding operators to engage and actuate the corresponding contact sets.

2. An electromagnetic relay as defined in claim 1 wherein the said stationary part with which the lower arm portion of the non-magnetic component of each finger magnet armature is in contact is constituted by a plate member of resilient material.

3. An electromagnetic relay as defined in claim 2 wherein said plate member of resilient material includes resilient arm portions contacting the arm portions of the non-magnetic components of the finger magnet armatures.

4. An electromagnetic relay as defined in claim 2 wherein said plate member of resilient material is secured to the under face of said guide block.

5. An electromagnetic relay comprising a plurality of contact sets, an operator for the contacts of each of said contact sets, said operators being arranged in a row, a guide block below said row of operators, said guide block having a plurality of transverse, parallel spaced guide grooves located respectively in alignment with said operators and a second vertical groove extending at a right angle to said guide grooves and intersecting the same, said second groove extending in the direction of said row of operators, a main operating magnet, an actuator member disposed in said second groove of said guide block and movable upwardly upon energization of said main operating magnet, a horizontal row of finger magnets corresponding respectively to said plurality of contact sets and operators, a horizontal support plate for said finger magnets, said support plate extending beneath said guide block and being spaced from the lower end thereof, each of said finger magnets having an armature actuated thereby, each said armature including a component of magnetic material having the lower end thereof terminating in a knife edge which is received in a depression in said support plate to constitute a pivotal mounting for the armature, and each of said armatures further including a relatively thin component of non-magnetic resilient material secured to said pivotally mounted magnetic component, said non-magnetic component including a lower arm portion projecting beneath and engaging the bottom face of said guide block for biasing said armature to the non-energized position and an upper arm portion carrying an interference piece slidably guided in the correspondingly located guide groove in said guide block from a position to one side of said second groove and actuator when the finger magnet is unenergized to a position between said actuator and the corresponding operator when the finger magnet is energized whereby upon energization of said main operating magnet said actuator will be moved upwardly to engage and effect upward movement of those of said interference pieces which have been brought into alignment with said actuator thereby effecting also upward movement of the corresponding operators to engage and actuate the corresponding contact sets.

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