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C. H. MCGUIRE ET AL

2,969,434

SWITCHING DEVICE

Filed Jan. 30, 1958

FIG. 1

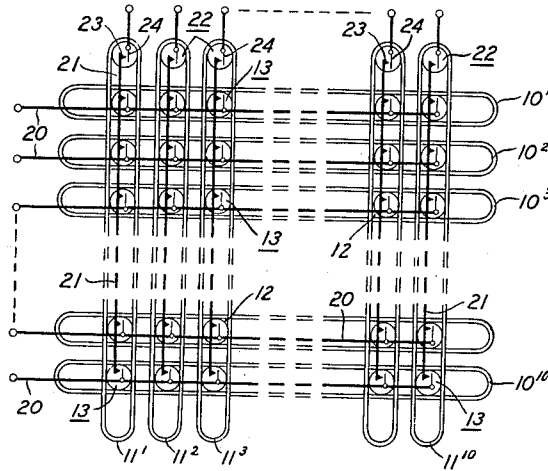


FIG. 2

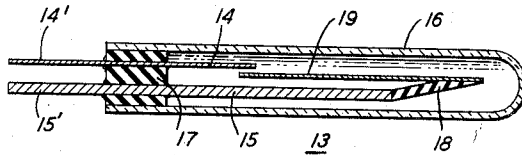
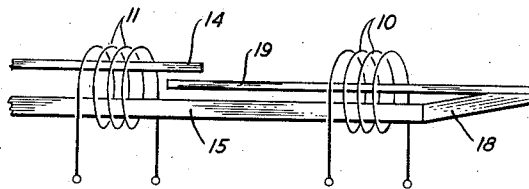


FIG. 3



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SWITCHING DEVICE

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6 Claims. (Cl. 179—27.54)

This invention relates to circuit controlling devices, and more particularly to coordinate or crosspoint switching devices of the general class illustrated by Patent 2,187,115, granted January 16, 1940, to W. B. Ellwood and W. H. T. Holden.

In brief, switching devices of the type disclosed in the above-identified patent comprise two groups of energizing coils mounted in coordinate relation, thereby defining a plurality of crosspoints disposed in columns and rows. A switching unit is located at each of the crosspoints and adapted for control by energization of the two coils corresponding to or defining the crosspoint. Advantageously, in the interests of speedy and trouble-free operation, among other factors, the switching units are of the sealed reed type.

One general object of this invention is to improve the operation and structure of coordinate switching devices.

A more specific object of this invention is to realize positive non-marginal operation of high speed crosspoint switches.

Another object of the present invention is to prevent false operation of reed type switching units, particularly in switching devices of the coordinate or crosspoint type.

One feature of this invention relates to the cooperative association of the switching units and the energizing coils or windings so that any unit can be placed in locked operated condition only upon energization of its associated coils in prescribed sequence. More particularly, in accordance with this feature the elements mentioned are so constructed and arranged that if the two coils associated with any switching unit are energized in the prescribed order, the unit will be operated to locked operated condition and will so remain despite subsequent release or reenergization of the first coil operated, whereas if the two coils are energized in the inverse order, the unit will be placed in locked open condition and so remain until at least the first operated coil is deenergized.

A related feature of this invention resides in the combination, in a coordinate device, of switching units and coils associated in the manner above described, whereby upon operation of any switching unit in one column all other units in that column are locked in open condition but any other unit in the same row may be operated by energization of the two coils associated therewith in the proper order.

The invention and the above-noted and other objects and features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing, in which:

Fig. 1 is an elevational view of a coordinate switching device illustrative of one embodiment of this invention;

Fig. 2 is a sectional view of one of the switching units included in the device of Fig. 1; and

Fig. 3 is a diagrammatic representation depicting the functional association of the reeds in each of the switching units and the respective select and hold coils.

Referring now to the drawing, in the specific and illustrative embodiment of this invention portrayed in Fig. 1,

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the switching device comprises a group of select coils 10¹ to 10¹⁰, inclusive, and a group of hold coils 11¹ to 11¹⁰, inclusive, the coils being generally rectangular and those of the two groups being in adjacent and orthogonal relation, thereby defining, in effect, a plurality, 100 in the particular embodiment represented, of apertures 12 in coordinate array. Each of the apertures constitutes a crosspoint at which a respective switching unit 13 is positioned.

For clarity of illustration, only a single unit 13 is shown at each crosspoint, but it is to be understood that there may be, and, in typical transmission circuit switching configurations embodying the principles of this invention, there usually will be, two or more such units at each crosspoint. In such an arrangement, all the units 13 at a crosspoint operate together in the manner described below for the illustrative case of one unit per crosspoint.

Each unit 13, as illustrated in Fig. 2, comprises a pair of fixed magnetic reeds 14 and 15 sealed through one end of a non-magnetic, for example vitreous, enclosing vessel 16, the external portions 14' and 15' of the members 14 and 15, respectively, being adapted to serve as electrical terminals. The reed 15 extends inwardly of the base 17 of the envelope 16 a distance substantially greater than does the other fixed reed 14. Also, for advantageous and functional reasons, as will appear presently, the reed 15 is of greater flux carrying capacity than the other reed 14.

Mounted from the member 15 by a non-magnetic, electrically conductive leaf 18, and extending between the reeds 14 and 15, is a flexible reed or armature 19. Advantageously, the members 15 and 19 are so related that in the absence of energizing signals, applied as described hereinafter, the armature 19 is in immediate proximity to, or face-to-face abutting relation with, the fixed reed 15.

A specific illustrative embodiment of one aspect of this invention includes a generally cylindrical $\frac{1}{8}$ inch diameter case or housing 16 which is about $\frac{15}{16}$ of an inch in length. The embodiment further includes a 0.010 inch by 0.062 inch by $\frac{17}{32}$ of an inch long flexible magnetic reed or armature 19, a 0.010 inch by 0.062 inch by $\frac{17}{32}$ of an inch long fixed magnetic reed member 14, a 0.025 inch by 0.080 inch by $\frac{7}{8}$ of an inch long fixed or locking magnetic reed 15, and a 0.004 inch by 0.062 inch by $\frac{5}{16}$ of an inch long non-magnetic support or leaf member 18.

The reeds 14, 15 and 19 may be of any suitable magnetic material, pure iron, for example, and the ratio of the cross sectional area of the element 14 to that of the greater flux carrying capacity reed 15 may advantageously be, as in the above-described embodiment, approximately 1:3.

As illustrated in Fig. 3, the switching units 13 are so positioned with relation to their respective apertures 12 that in each unit the fixed reed 15 and the armature 19 are coupled magnetically to or encompassed by a respective select coil 10, and both the fixed members 14 and 15 are coupled magnetically to or encompassed by a respective hold coil 11.

Thus, each switching unit is subject to magnetic influence by one pair of select and hold coils and only by that pair. For example, in the array illustrated in Fig. 1, the switching unit 13 at the lower left-hand corner of the array is subject only to influence by the select coil 10¹⁰ and the hold coil 11¹.

The operation of each of the switching units will be understood best by reference to Fig. 3. Assuming the unit in normal condition, that is, with neither the associated select nor hold coil energized, the armature or flexible reed 19 is in the position shown and the contact (established between reeds 14 and 19) is open. Now if the select coil 10 is energized, the armature 19 and the fixed reed 15 are of the same magnetic potential

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and, therefore, the armature 19 moves into engagement with the fixed reed 14, thereby closing the contact. If the hold coil 11 then is energized, the armature is locked in the closed contact position and so remains even though the select coil 10 becomes deenergized.

If the hold and select coils are energized in the inverse order to that above described, the operation is as follows: Upon energization of the hold coil 11, the magnetic potentials of the armature 19 and the fixed reed 15 are different, so that as a consequence the movable reed 19 is attracted to and locked against the fixed reed 15, that is, the switch is locked in the open contact condition. If with the hold coil 11 energized, the select coil 10 then is energized, the member 19 remains in the open position, that is, against the member 15, because of the fact that, as noted heretofore, the member 15 is of greater magnetic flux carrying capacity than the other fixed reed 14.

In either of the cases above described, that is, energization of the select and hold coils in the order named or in the reverse order, the armature 19 will return to the position illustrated in Fig. 3, the normal position, upon deenergization of both the select and hold coils.

Referring now to Fig. 1, it will be noted that the corresponding terminals of the several switching units are connected electrically together by bus bars or wires 20 and 21. Associated with each vertical column of switching units is an auxiliary switching unit 22. The latter may be of known construction and comprises two reeds 23 and 24 which move into engagement with each other whenever the corresponding hold coil is energized and remain in such closed condition only so long as the hold coil is energized. (In one switching system illustratively embodying the principles of this invention, there are required as many units 22 per hold coil as there are units 13 per crosspoint.)

Briefly, in the matrix of Fig. 1, the switching unit at any crosspoint operates to the closed position whenever the respective select coil is energized, and is locked in closed condition upon energization of the associated hold coil. When in a locked operated condition, the unit remains operated while either select or hold coil is energized, returning to a normal condition only if both coils are released. Any unit which is in the locked open condition remains so even if the respective select coil is energized or released. It returns to normal only when its encompassing hold coil is released.

The operation of the switching array as a coordinate switch may be understood from the following example: Assume that select coil 10² is energized; then, all the switching units 13 encompassed by this select coil are operated to the closed position. Then, if a hold coil, for example 11², is energized, the switching unit in the aperture common to the select coil 10² and the hold coil 11² is locked in the operated condition. All the other switching units, except the unit 22, encompassed by the hold coil 11² are locked in the open position. The auxiliary switching unit 22 associated with hold coil 11² operates when this coil is energized so that a circuit is completed between the horizontal bus bar or wire and the vertical bus bars or wires associated with the switching unit specified. If the select coil 10² is then deenergized, the specified switching unit remains in an operated condition because of energization of the hold coil associated therewith. The circuit mentioned is opened only by release of both the select coil 10² and the hold coil 11².

It will be noted that once the specified switching unit, that is, the one at the crosspoint defined by coils 10² and 11², is in the locked operated position, it will not return to normal in response to either subsequent energization or deenergization of the select coil 10². However, upon subsequent energization of the select coil 10² followed by energization of any of the hold coils other than hold coil 11², the switching unit at the crosspoint defined by the two coils energized will be operated. While any switching unit is operated all the other units

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in the same column therewith are held in locked open condition and cannot be affected by operation of any select coil until the respective hold coil is released.

What is claimed is:

1. A coordinate switch comprising a group of select coils, a group of hold coils, said groups being arranged in crosswise relation thereby defining a row-and-column array of crosspoints, a switching unit at each crosspoint, each switching unit including a fixed contact member of magnetic material, a support member of magnetic material arranged in parallel spaced relation to the fixed member and having an extension portion thereof projecting beyond the fixed member, the support member having a greater flux-carrying capacity than the fixed member, a movable contact member of magnetic material supported from the extension portion and arranged in parallel spaced relation with the support member and in overlapping spaced relation with the fixed member, the fixed member and the support member being electromagnetically coupled at the crosspoint with a hold coil, the movable contact member and the support member being electromagnetically coupled at the crosspoint with a select coil, whereby the energization of the hold coil subsequent to the energization of the select coil causes the movable contact member to become latched in engagement with the fixed member, the energization of the hold coil prior to the energization of the select coil causing the movable contact member to become latched in engagement with the support member.

2. A switching device comprising a group of select coils, a group of hold coils, said groups being positioned in coordinate relation thereby providing a plurality of crosspoints arranged in columns and rows, a switching unit at each of the crosspoints, each unit including a pair of fixed magnetic members in spaced overlapping relationship, one of the members having a greater flux-carrying capacity than the other member and having a portion beyond one end of the other member, a movable magnetic member mounted from said portion and projecting into proximity of said other member, said fixed members of each unit being in electromagnetic coupling relation with a respective one of said hold coils, said one fixed member and movable member of each unit being in electromagnetic coupling relation with a respective select coil, means for electrically connecting a fixed member of each unit in each of the columns to a common respective terminal, and an auxiliary switching unit connected in series with each said terminal and operable in response to energization of the corresponding hold coil.

3. A switching device comprising a pair of magnetic members in spaced overlapping relation, one of said members having an end portion extending beyond the corresponding end of the other member and having a greater flux carrying capacity than said other member, a movable magnetic member mounted from said extending portion and projecting between said pair of members, a first signal winding coupled to said one and said movable members, and a second signal winding coupled to said pair of members.

4. A switching device comprising a pair of fixed magnetic reeds in spaced overlapping relation, one of said reeds having an end portion extending beyond the corresponding end of the other reed, a movable magnetic reed overlying said portion and extending into proximity to said end, a first signal coil encompassing said one and said movable reeds, and a second signal coil encompassing said pair of fixed reeds.

5. A switching device comprising an envelope, a pair of fixed magnetic members in spaced overlapping relation within said envelope and having terminal portions projecting from said envelope, one of said members having a portion beyond the corresponding end of the other of said members, and a movable magnetic member overlying said portion and extending into proximity to said end,

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said movable magnetic member being electrically connected with said one fixed member by non-magnetic means, said one fixed member having a greater flux carrying capacity than said other member.

6. A switching device comprising an envelope, a pair of magnetic reeds in parallel relation within said envelope and sealed through one end thereof, one of said reeds being of greater flux carrying capacity than the other and extending inwardly beyond the other reed, a flexible magnetic reed overlying the extending portion of said 10

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one reed and projecting into proximity to said other reed, and electrically conductive non-magnetic means mounting said flexible reed from said portion.

References Cited in the file of this patent

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