

Aug. 10, 1943.

A. W. HORTON, JR

2,326,647

SWITCHING MECHANISM

Filed May 31, 1941

FIG. 1

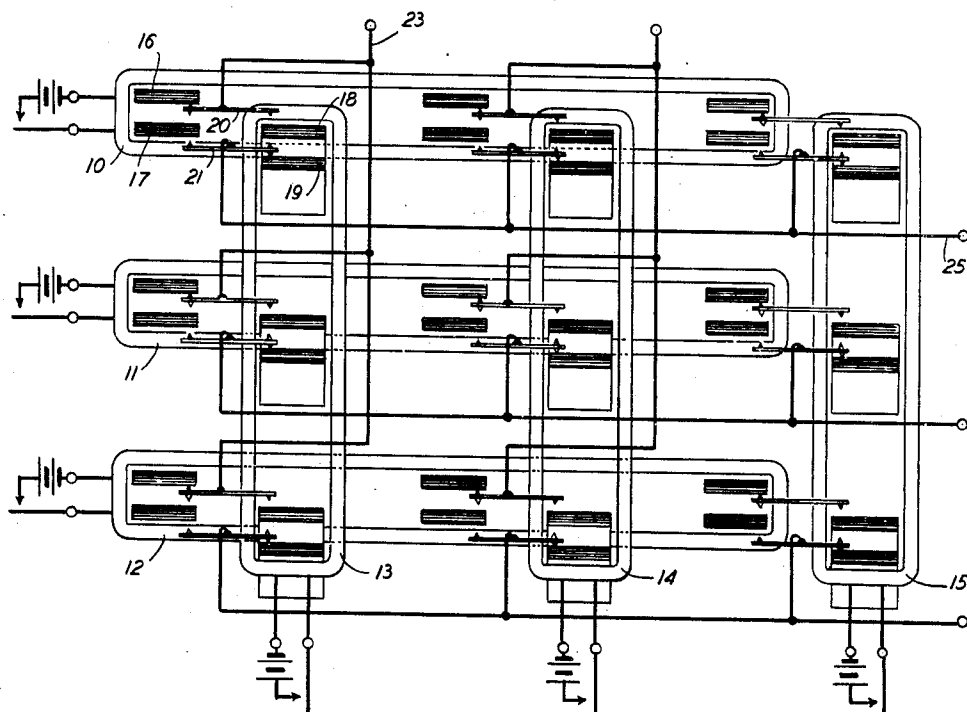
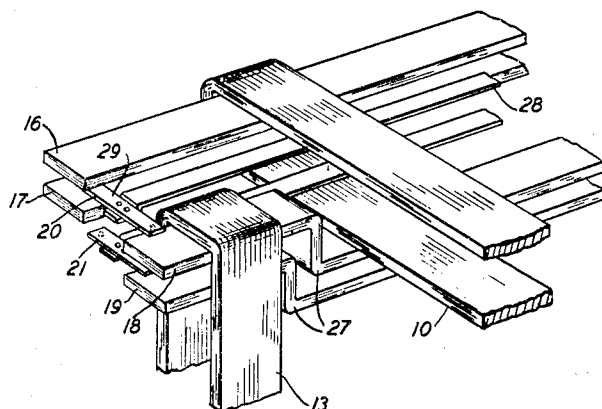


FIG. 2



INVENTOR
A. W. HORTON, JR.
BY *M. T. McKenney*
ATTORNEY

UNITED STATES PATENT OFFICE

2,326,647

SWITCHING MECHANISM

Arthur W. Horton, Jr., South Orange, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application May 31, 1941, Serial No. 396,049

4 Claims. (Cl. 179—27.54)

This invention relates to switching mechanisms and particularly to mechanism employed to establish electrical connections, such as telephone or other communication connections.

An object is to reduce the cost and increase the utility of such mechanisms.

Heretofore such switches have been employed in which the well-known cross-bar principles were applied to mechanisms in which two groups of coils were arranged to cross each other and having contact elements located at the intersecting points of said coils and whereby the energization of a coil in one group followed by the energization of a coil in the other group caused the contact elements at the crosspoint of said coils to be energized to establish electrical connections between said contact elements. Such switching devices were generally arranged so that the coils in one group always had to be energized first as the select coil to select the row of contact elements from which a particular set of contact elements were to be chosen by the energization of a holding coil in the other group. The holding coil was maintained energized as a holding means to maintain the established connection while the select coil was deenergized. In these switches after a connection has been established, the energizing current for the holding coil had to be considerably reduced to prevent the energized condition of this holding coil from interfering with the subsequent energization of coils to establish subsequent connections. In a copending application by George Robert Stibitz, Serial No. 396,081, filed March 31, 1941, arrangements have been disclosed in which magnetic contact elements are specially arranged at the crosspoints of the coils so that such reductions of the energizing currents for the holding coils are not necessary and whereby a connection is accomplished by certain sequences of energization and deenergization of the select coil involved and all of the holding coils while the holding coil involved is maintained fully energized.

It is a feature of the present invention to provide a switching device of the character of these types of switches in which magnetic elements at a crosspoint are arranged to establish connections in response to the energization of a coil of one group as the select coil followed by the energization of a coil of the other group as a holding coil and then followed by the deenergization of the first energized coil, in which the coil serving as a select coil or as a holding coil may be chosen from either group of coils and in which the maintaining of the holding coil fully ener-

gized to hold the established connection will not interfere with subsequent connections established in the same manner or be interfered with by such subsequently established connections. A switching mechanism in accordance with the applicant's invention may comprise connecting mechanisms arranged in horizontal and vertical rows, with the mechanism at each crosspoint consisting of two flexible magnetic springs and four stationary magnetic plates arranged so that an upper of said springs is normally in contact with an upper outside plate and the other or lower spring is normally in contact with a lower outside plate, while the other two plates are located intermediate said springs normally out of contact therewith, but with the upper and lower springs to the intermediate plates. A group of horizontal coils is provided with one coil for each horizontal row of mechanisms, with each coil surrounding the upper plate and one of the intermediate plates of the corresponding horizontal row, while another group of vertical coils is provided with one coil for each vertical row of mechanisms, with each coil surrounding the lower plate and the other intermediate plate of the corresponding vertical row. This arrangement of the switching mechanism enables the energization of any coil of either group followed by the energization of any coil in the other group and then followed by the deenergization of the first energized coil to create a magnetic flux at the crosspoint of said coils to actuate the associated springs and to open their connections with the two outside plates and close connections with the intermediate plates to establish an electrical connection between said springs and said intermediate plates. This arrangement of the switching mechanism also enables succeeding electrical connections to be established in the same manner without interfering with the previously established connections or be interfered with by the fully energized condition of the coil serving as the holding coil in said previously established connections.

This invention has been illustrated in the accompanying drawing in which Fig. 1 shows an arrangement of crossed coils with associated connecting mechanisms at each crosspoint in a more or less diagrammatic form showing the circuit connections to be established at the crosspoints to illustrate the applicant's invention, while Fig. 2 shows a fragmentary perspective view of the connecting mechanism at a crosspoint with parts of two intersecting coils.

Referring now to the drawing, and particularly

to Fig. 1, three horizontal coils 10, 11 and 12 have been shown and three vertical coils 13, 14 and 15 have been shown with the connecting mechanisms provided at each crosspoint of said horizontal and vertical coils. Each connecting mechanism consists of an upper outside plate 16 of magnetic material, two intermediate plates 17 and 18 of magnetic material and a lower outside plate 19. Between the upper plate 16 and the intermediate plates 17 and 18 is placed a magnetic contact spring 20, normally making contact with plate 16 and between these intermediate plates and the lower plate 19 is placed a magnetic contact spring 21 normally making contact with plate 19. The upper springs 20 in each vertical row are connected by means of a circuit 23 and the lower springs 21 in each horizontal row are connected by means of a circuit 25 so that when two intersecting coils are operated, connections may be established between the circuits 23 and 25, for example, over contacts 20 and 21 through the intermediate plates 17 and 18 as will be described hereinafter. Actual construction details of the mechanism at the crosspoint may be as shown in Fig. 2. It will be noted in this figure that the plates 16 and 17 are surrounded by the horizontal coil 10 while the plates 18 and 19 are surrounded by the coil 13. To permit the horizontal coil 10 to be wound in this manner, the plates 18 and 19 at each crosspoint are bent downwardly and then towards the back of the structure as shown at the points 27 in this Fig. 2. Each of the contact springs 20 and 21 may consist of a forwardly extending spring portion 22 that may be of non-magnetic material and a transverse portion 29 of magnetic material secured to portion 22. While no mounting means has been shown for the plates and the contact springs, it should be understood that any suitable means may be provided to keep these elements and the coils in proper relation to and electrically insulated from each other. Each coil is provided with a circuit as shown comprising a source of current and a contact element in series with the coil winding for the energization of the coil by the closing of the associated contact element and for the deenergization of the coil by the opening of the associated contact element.

The operation of this switching mechanism will now be described. As stated, it is immaterial whether the coils of one group or the other are operated first as select coils while the coils of the other group are operated last as holding coils as an operating mechanism will be actuated to establish a connection at a crosspoint of an energized horizontal coil and an energized vertical coil regardless of the order in which they are energized. If it is assumed that coil 10 is energized, first as a select coil, it will be noted that the plate 16 in the corresponding horizontal row will be magnetized to maintain the connection already established between this plate and spring 20 while the plate 17 will be magnetized to attract the spring 21 and establish a connection between this plate and spring 21 as well as between plate 18 and this spring 21, while the connection between spring 21 and the lower plate 19 will be opened. These conditions will, of course, prevail at the connecting mechanism at each crosspoint where this energized horizontal coil crosses other vertical coils. If now it is assumed that the vertical coil 13 is energized as a holding coil it will be observed that as the spring 21 has already been attracted by plate 17 and has been shifted to make contact with plate 18, it

will be maintained in this position due to the magnetizing of plate 18 by coil 13. The spring 20 which is held attracted to plate 16, on the other hand, will not be attracted by the magnetizing of plate 18 as the magnetization of plate 18 is not sufficient to pull the spring 20 down away from contact with plate 16 at this time. However, if the horizontal coil 10 is now deenergized, the coil 13 being energized, will cause plate 18 to attract spring 20 to make contact with plate 18. Thus, it will be seen that at this particular crosspoint a connection is now established between the circuits 23 and 25 through spring 20, plates 17 and 18 and spring 21. The springs corresponding to spring 21 at other crosspoints of this coil 10 and the vertical coils such as 14 and 15 will be released from the associated plates corresponding to plate 17. In this case, therefore, the coil 10 acts as a select coil and coil 13 as a holding coil with the coil 13 fully energized.

On the other hand, if one of the vertical coils shall serve as the select coil, a horizontal coil will serve as a holding coil. If it is assumed then that the vertical coil 13 is first energized, as a select coil, it will be noted that the spring 21 will remain in its normal position and be held attracted by plate 19 while the spring 20 will be pulled downwardly by the magnetizing of plate 18 and thus make connection with this plate 18 as well as with plate 17. Now, if, for example, the horizontal coil 10 is energized as the holding coil, the plate 17 will be magnetized and hold the spring 20 in its attracted position. If, now, the coil 13 is deenergized, it will be noted that the spring 21 will be attracted by the plate 17 and consequently it will make contact with plate 17 so that a connection will now be established between the circuits 23 and 25 through spring 20, plate 17 and spring 21. Thus, in this case coil 13 acts as the select coil and coil 10 as the holding coil with the coil 10 fully energized.

What is claimed is:

1. A switching device comprising groups of connecting mechanisms arranged in horizontal and vertical rows, each group consisting of two flexible magnetic springs and four stationary magnetic plates, an upper of said springs being normally in contact with an upper outside plate and the other or lower spring being normally in contact with a lower outside plate while the other two plates are located intermediate said springs, a group of coils one for each horizontal row of mechanisms, each coil surrounding the upper plate and one of the intermediate plates of a corresponding horizontal row of said mechanisms, another group of coils one for each vertical row of said mechanisms, each coil surrounding the lower plate and the other of said intermediate plates of a corresponding vertical row of said mechanisms, and circuit means for energizing any coil in one group, any coil in the other group and for energization of said first energized coil to establish magnetic fields at the crosspoint of said coils to actuate the associated springs to open their connections with the outside plates and to connect said springs with the intermediate plates to establish an electrical connection between said springs through said intermediate plates, said connections being established regardless of the order in which said coils are energized.

2. A switching device comprising groups of connecting mechanisms arranged in horizontal and vertical rows each group consisting of two

flexible magnetic springs and four stationary magnetic plates, an upper of said springs being normally in contact with an upper outside plate and the other or lower spring being normally in contact with a lower outside plate while the other two plates are located intermediate said springs normally out of contact with said springs, a group of coils one for each horizontal row of mechanisms, each coil surrounding the upper plate and one of the intermediate plates of a corresponding horizontal row of said mechanisms, another group of coils one for each vertical row of said mechanisms, each coil surrounding the lower plate and the other of said intermediate plates of a corresponding vertical row of said mechanisms, to cause said springs to open their connections with the outside plates and connect with the intermediate plates to establish a circuit connection between said springs at a crosspoint of a coil of each group in response to magnetic fields produced at said crosspoint when said coils are energized and one of the coils is then deenergized regardless of the order in which these coils are energized, one of the springs contacting with said intermediate plates in response to the energization of the first energized coil and the other spring contacting with said intermediate plates in response to the energization of the second energized coil and the deenergization of said first energized coil.

3. A switching device comprising groups of connecting mechanisms arranged in horizontal and vertical rows each group consisting of two flexible magnetic springs and four stationary magnetic plates, an upper of said springs being normally in contact with an upper outside plate and the other or lower spring being normally in contact with a lower outside plate while the other two plates are located intermediate said springs normally out of contact with said springs, a group of coils one for each horizontal row of mechanisms, each coil surrounding the upper plate and one of the intermediate plates of a corresponding horizontal row of said mechanisms,

another group of coils one for each vertical row of said mechanisms, each coil surrounding the lower plate and the other of the intermediate plates of a corresponding vertical row of said mechanisms, and means for energizing one coil of one group, for energizing a coil of the other group and for deenergizing said first coil for establishing respective magnetic fields at the crosspoint of these coils to cause one of the springs at said crosspoint to be actuated by the field produced by the energization of said first coil to disconnect from its associated plate and connect with the intermediate plates and to then cause the other spring to be actuated by the field produced by said second coil and the deenergization of said first coil to disconnect from its associated plate and connect with said intermediate plates and to cause the field produced by the energization of said second coil to lock said two springs in connection with said intermediate plates.

4. A switching device comprising two groups of coils arranged to cross each other, a circuit controlling mechanism at each intersecting point of said two groups of coils including two contact springs and an intermediate contacting member to which said two contact springs may be attracted to establish a connection between them, a source of current in each circuit, a contact element in each circuit for closing said circuit to energize the associated coil and for opening said circuit to deenergize the associated coil, the circuit controlling mechanism at the intersecting point of a coil of each group being arranged so that the closing of the circuit for either one of said coils attracts one of said contact springs to the intermediate contacting member and the closing of the circuit for the other of said coils and the opening of the circuit first closed attracts the other contact spring to the intermediate contacting member to establish a circuit between said two springs.

ARTHUR W. HORTON, JR.