

July 20, 1943.

C. N. HICKMAN

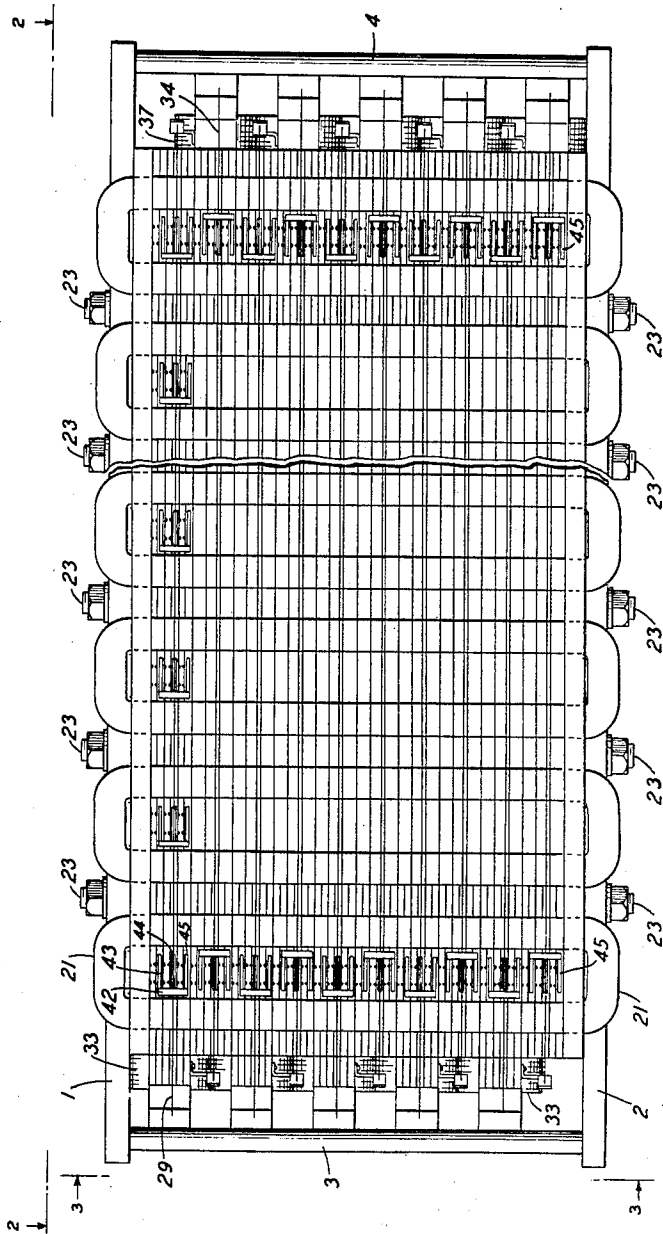
2,324,623

SWITCHING DEVICE

Filed Dec. 30, 1941

3 Sheets-Sheet 1

FIG. 1



INVENTOR
C. N. HICKMAN
BY *M. R. McKenney*
ATTORNEY

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C. N. HICKMAN

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FIG. 2

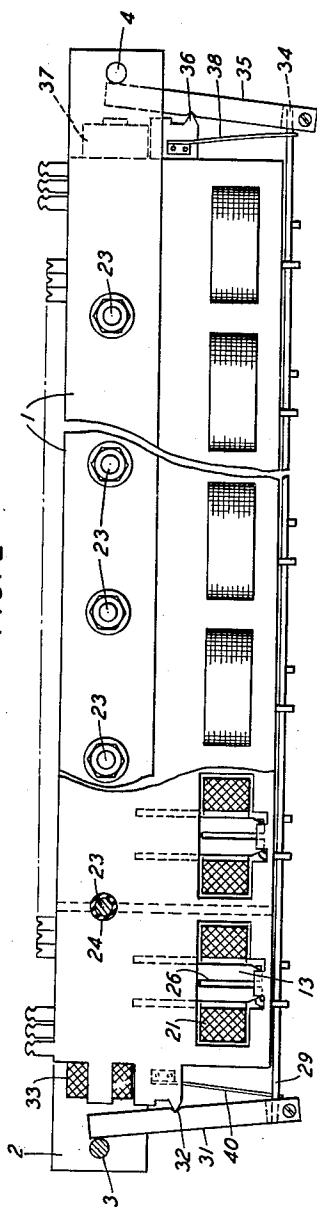


FIG. 4

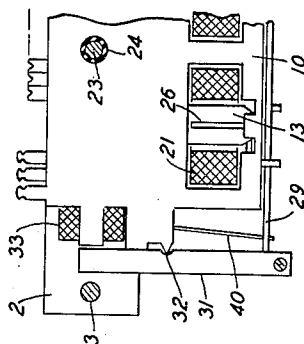
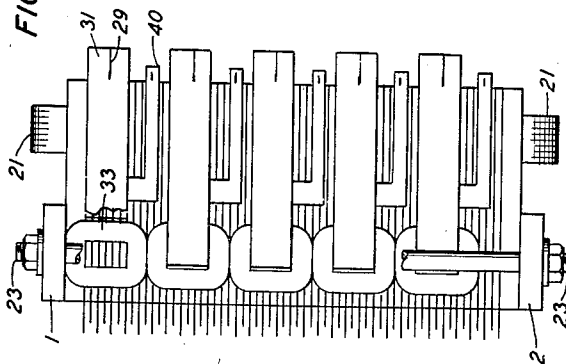


FIG. 3



INVENTOR
C. N. HICKMAN
BY *M. T. McFarney*
ATTORNEY

July 20, 1943.

C. N. HICKMAN

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FIG. 5

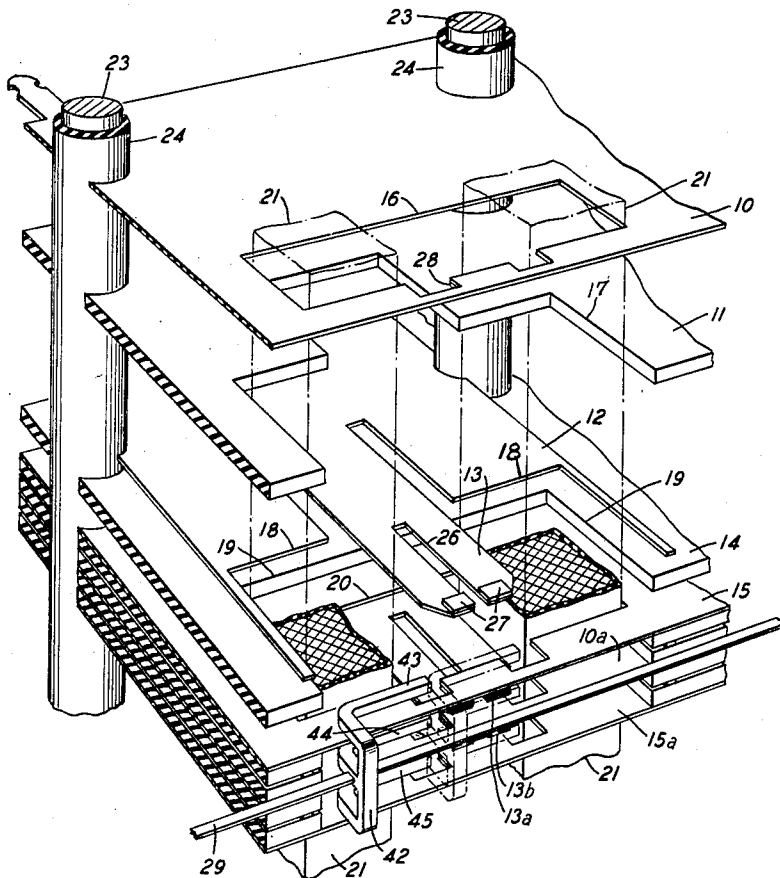


FIG. 6

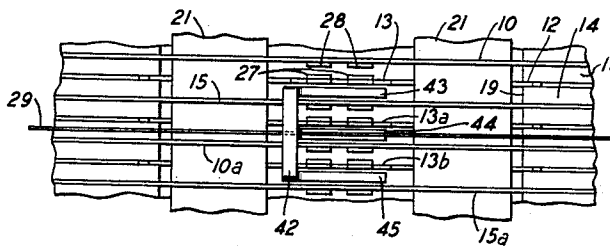
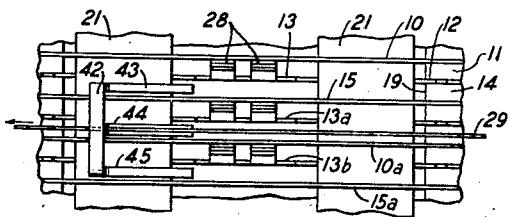


FIG. 7



INVENTOR
C. N. HICKMAN
BY *M. G. McKenney*
ATTORNEY

UNITED STATES PATENT OFFICE

2,324,623

SWITCHING DEVICE

Clarence N. Hickman, Jackson Heights, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application December 30, 1941, Serial No. 424,865

5 Claims. (Cl. 179—27.54)

This invention relates to switching devices and particularly to switching devices of the coordinate or crossbar type for use in establishing connections in automatic telephone systems.

An object is to simplify the construction and the operating characteristics of such switches.

Another object is to reduce to a minimum the mechanically movable parts.

Heretofore coordinate switches have been employed in which two sets of coils are arranged to cross each other to form openings at each cross-point of said two sets of coils and in which magnetic contacts are inserted in the openings at said cross-points so that the energization of a coil in one coordinate direction and a coil in the other coordinate direction causes the contacts of the cross-point of said coils to be energized to establish electrical circuit connections. Arrangements have also been made in the relay art in which the core of the relay is employed as one circuit contact and the armature as another circuit contact to establish an electrical circuit connection between said core and armature.

The present invention relates to a coordinate switch structure and partakes to some extent of the principles of the above-mentioned switch structures and relays, and a feature thereof is an arrangement in which a series of horizontally located magnetic plates are interspersed with magnetic contact springs arranged in vertical rows and in which vertical coils surround each vertical row of contacts and passes through openings in said horizontal plates and in which the plates and contact springs serve as means for establishing electrical circuit connections by the aid of so-called reluctance controlled fingers. The arrangement is such that a ribbon or bar is placed in front of a horizontal plate and an associated horizontal row of contact springs to which is connected control fingers each of which is inserted between an individual contact spring and the plate below it. Each bar may, if so desired, carry more than one finger at each cross-point where it crosses a vertical row of contact springs to control the establishing of circuit connections between a plurality of contact springs and the associated plates at each such cross-point. The operation of this arrangement is such that when a bar is shifted longitudinally by a magnet, the attached fingers are removed from between the corresponding contact springs and plates below them and when a coil is then energized, the contact springs, where the fingers have been removed and which are surrounded by the energized coil,

will each be magnetized to be attracted individually by the plate above it to establish an electrical connection therewith. The remaining contact springs surrounded by this coil and whose fingers have not been removed, will remain in normal position due to the shunting paths for the magnetic flux provided by the interposed fingers between these contact springs and the plates below them.

This invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows a front view of a crossbar switch embodying the applicant's invention;

Fig. 2 is a top view of the switch structure shown in Fig. 1;

Fig. 3 is a left-hand side view of the switch shown in Fig. 1;

Fig. 4 is a fragmentary top view showing one of the bars in operated position as controlled by a magnet;

Fig. 5 is an exploded view of a section of the crossbar switch shown in Fig. 1;

Fig. 6 shows an enlarged fragmentary section of the switch looking from the front thereof with a set of control fingers in normal position; while

Fig. 7 shows the same view as in Fig. 6 but with this set of control fingers removed from between the contact springs and plates.

Referring now to the drawings, this switch structure consists of a frame having a top plate 1, a bottom plate 2, a left-hand connecting rod 3 and a right-hand connecting rod 4 for the top and bottom plates. Between these top and bottom plates 1 and 2 are mounted the horizontally located magnetic plates and vertical rows of magnetic contact springs in the following manner. If reference is made particularly to Fig. 5, which shows an exploded view of a section of these plates and springs, it may be considered that the plate 10 is an upper magnetic plate which extends horizontally across the full length of this switch structure. Below this plate is mounted an insulation plate 11 and below this is a magnetic member 12 which is cut out to form a magnetic contact spring 13. Below this member 12 is an insulation plate 14 and below plate 14 is another magnetic plate 15 identical with plate 10. Similar groups of layers consisting of plates 10 and 11, member 12 and plates 14 and 15 are provided in the switch for the full length of it in the vertical direction with the plates 10, 11, 14 and 15 extending the full length of the switch in a horizontal direction while members 12 are repeated in vertical and horizontal rows. It should be noted that the plates 10 and 11,

member 12 and plates 14 and 15 are provided with cut-out portions 16, 17, 18, 19 and 20, respectively to form two parallel vertical openings throughout the full length of the switch structure in a vertical direction. Through these openings is passed a vertical coil of wire 21. A coil such as 21 is placed in each succeeding pair of vertical openings for the full length of the switch in a horizontal direction. Thus each coil surrounds a separate vertical row of contact springs 13 and is itself surrounded by the corresponding associated plates 10 and 15 throughout the structure. All of these plates and members are held together by bolts such as 23 placed between adjacent coils throughout the full length of this structure. These bolts are insulated by being surrounded by insulation sleeves such as 24. Therefore in this structure as described, there will be a series of horizontally located magnetic plates interspersed with series of magnetic contact springs comprising vertical rows with each vertical row of contact springs surrounded by a coil. It will be observed that the contact springs 13 are bifurcated as shown at 26 and provided with two contacts 27 on the free forward ends of these bifurcated members. These contacts 27 are arranged to be in position to make electrical contact with similar contacts such as 28 on the lower side of the plates above the springs. Therefore, when a connection is made between a pair of contacts 27 and a pair of contacts 28, an electrical connection is established for circuits that may be connected to these contact springs and plates. Consequently, on the operation of the mechanism as will be described hereinafter, a connection may be made, for example, between a plate 10 and a spring 13 at any cross-point throughout the switch.

In front of these horizontal plates and vertical rows of springs are arranged bars such as 29. Each of these bars is arranged to move longitudinally. For example, the first bar 29 at the top is attached to an armature 31 pivoted at 32 and arranged in front of the core of a magnet 33 mounted at the back of the switch structure for the shifting of this bar longitudinally towards the left. The next bar 34 is arranged to move longitudinally towards the right by being attached to an armature 35 pivoted at 36 and arranged in front of the core of a magnet 37 mounted at the opposite end of the switch structure. The succeeding bars are alternately arranged to move in opposite directions by similar armatures and magnets. These bars are held in normal position by leaf springs for example bar 29 by a spring 38 mounted on the right-hand side of the switch structure and bar 34 by a spring 40 attached to the left-hand side of the switch structure. Each bar is provided opposite succeeding vertical rows of contact springs 13 with control fingers one of which has been shown in perspective in Fig. 5 and marked with the numeral 42. This control finger is shown in its shifted position towards the left and is provided with three prongs. Normally as shown in Fig. 6 the upper prong 43 is located between the vertical spring 13 and the plate 15 below it, the second prong 44 is located between a vertical spring 13a and a plate 10a below it, while the prong 45 is located between the vertical spring 13b and a plate 15a below it. Thus this control finger 42 will have control over the connections at three points, simultaneously as will be described hereinafter.

The operation of this mechanism is as follows: If it is considered that the bar or tape 29 is moved

longitudinally towards the left from the position shown in Fig. 6 to the position shown in Fig. 7 by the operation of the magnet 33 attracting the armature 31, all of the control fingers 42 on this tape 29 will thereby be moved from between the contact springs and the plates below them in the first three horizontal rows that is prong 43 will be moved from between spring 13 and plate 15, prong 44 will be moved from between spring 13a and plate 10a and prong 45 will be removed from between spring 13b and the plate 15a. If now the first coil 21 is energized, the magnetic flux produced by this coil causes the spring 13 to be attracted to plate 10 and have its contacts 27 make electrical connections with contacts 28 on plate 10, as the distance between spring 13 and plate 10 is smaller than between spring 13 and plate 15, that is, the flux will follow the path of least resistance. Similarly, spring 13a will be attracted to plate 15 and spring 13b will be attracted to plate 10a for the same reason as plate 13 was attracted to plate 10. These actions will take place at the cross-point between the first vertical row of contact springs 13, 13a and 13b and the first rows of horizontal plates comprising plates 10, 15 and 10a. However, the magnetic flux, produced in coil 21 at the cross-points of this coil and the succeeding groups of three plates each of which consists of an upper plate, which is in each instance the lower plate of a preceding group and the two plates below this common plate and associated contact springs, will not produce the above effects as the prongs corresponding to prongs 43, 44 and 45 will be in normal positions between the succeeding plates and springs in this vertical row. In these cases, consequently, the magnetic flux will pass through the paths of least resistance which in each instance exists between a contact spring and a plate below it and the intermediate prong and thus maintain the springs in their normal positions. The shifting of the bar 29 and the energizing of the first coil 21 will therefore only establish connections at the cross-point of this bar and coil between the associated springs and upper plates. It should be observed that after these connections are established, the bar 29 may be released by the magnet 33 to normal position but as the connections between the springs are already established to the respective plates above them, these springs will remain in this position even though the control finger 42 and its projections are returned to normal. If now or soon after the coil 21 is energized its energization is reduced to a point where it will only maintain the established connection, other similar connections at the cross-point of any other vertical and any other or the same bar may be established in the same manner. This is possible as even though the coil 21 is maintained sufficiently energized to hold the previously described connection its reduced energization will not affect the establishing of such succeeding connections, as, for example, when another bar corresponding to bar 29 is shifted, while the fingers on this other bar at the cross-point of coil 21 are shifted, the remaining amount of energization of coil 21 will not be sufficient to attract the springs at this cross-point to the plates above them. With the structure shown which may have ten vertical coils, ten succeeding connections may be established at ten cross-points in succession and maintained simultaneously.

While this switch arrangement provides for the establishing of three simultaneous connec-

tions at each energization of a coil and the movement of a bar, other arrangements may be made in which a lesser or a greater number of connections may be made by the removal of projections from the control fingers or the adding of such projections as desired without departing from the spirit of the invention.

What is claimed is:

1. In a coordinate switch, a series of horizontal magnetic contact plates, a layer of magnetic contact springs between each pair of adjacent plates, energizing coils each surrounding a group of separate springs comprising one spring from each layer, a control finger interposed between each spring and the plate below it, means for shifting the group of fingers associated with each layer of springs to remove said fingers from between the associated springs and the plate below, said parts being so arranged that the energization of a coil and shifting of a group of fingers causes the spring surrounded by said coil and whose associated finger has been shifted to be magnetically attracted to the adjacent plate above it to establish an electrical connection between said plate and spring.

2. In a coordinate switch, a series of horizontal magnetic contact plates, a horizontal row of magnetic contact springs between each pair of adjacent horizontal plates arranged to form vertical rows of springs across said plates, each vertical row comprising a spring from each horizontal row, a coil surrounding each vertical row of springs, a magnetic control finger between each spring and the plate below it to comprise a horizontal row of fingers associated with each horizontal row of springs, means for shifting each horizontal row of fingers from between the associated springs and the plates below them, said parts being so located that when a coil is energized and a horizontal row of fingers are shifted the spring at the cross-point of said coil and said shifted row of fingers will be attracted by the plate above it to make electrical contact therewith while the remaining springs surrounded by said coils will remain in normal position due to the shunting effect of the interposed fingers.

3. In a switch, a series of magnetic contact plates arranged horizontally on top of each other, a layer of electromagnetic contact springs arranged between each pair of adjacent plates, said springs being further arranged so that vertical rows are formed with each row containing a spring from each layer, a coil surrounding each vertical row of springs each coil extending through apertures in the plates, a control finger interposed between each spring and the plate below it arranged to form a horizontal row of contact fingers for each layer of springs, connecting rods each connecting an independent group of horizontal rows of control fingers, a magnet for shifting each rod independently to remove the associated control fingers from between the associated springs and the plates below, said plates and springs being so located in relation to each other and to the associated coils and control fingers that when a rod is shifted by

its magnet and the associated fingers removed from between the associated springs and the plates below them and when a coil is energized, the springs whose associated control fingers have been removed and which are surrounded by the energized coil are magnetically attracted towards the associated upper plates to establish electrical circuit making connections with said plates while the remaining springs in the same vertical row will remain in their normal position due to the shunting effect of the interposed fingers for said magnetic flux.

4. In a switch, magnetic contact plates on the top of each other, a layer of magnetic contact springs interposed between each pair of adjacent plates, energizing coils each surrounding a group of springs one from each interposed layer, magnetic shunting means between each spring and the plate below it, means for removing said shunting means from between any layer of contact springs and the plate below it, said elements being so arranged that when a coil is energized and any one of said shunting means has been removed the spring surrounded by the energized coil and whose shunting means has been removed is magnetically attracted towards the plate above it to make an electrical connection therewith while the remaining springs surrounded by said energized coil remain in their neutral position due to the presence of the shunting means between said springs and the plate below for the magnetic flux produced by the energizing coil.

5. In a coordinate switch, a series of magnetic contact plates arranged in one coordinate direction, a row of magnetic contact springs in the other coordinate direction interposed between each pair of adjacent plates, energizing coils arranged in the first coordinate direction, each surrounding a separate group of springs including one spring from each row and extending through apertures in all of said plates, a control finger of magnetic material interposed between each spring and the plate on one side of it, a series of connecting rods each connecting the contact fingers of a plurality of separate adjacent rows of such fingers in said second-mentioned coordinate direction, a magnet for each connecting rod for shifting it to remove the associated control fingers from between the springs and associated plates, said relationship between the springs, plates, coils and control fingers being such that on the energizing of a coil and a magnet flux produced by said coil will, due to the removal of the control fingers at the cross-point of the associated operated rod and the energized coil, cause the springs at said cross-point to be attracted and moved in contact with the respective plates on the side opposite the side from which the control fingers were removed and cause the control fingers at the cross-points of said energized coil and other rods to be held in normal position by magnetic attraction of the associated plates on the side where the control fingers are in normal position.

CLARENCE N. HICKMAN.