F. A. LUNDQUIST.

CROSS BAR LINE SWITCH.

APPLICATION FILED NOV. 27, 1916.

1,303,084.

Patented May 6, 1919.

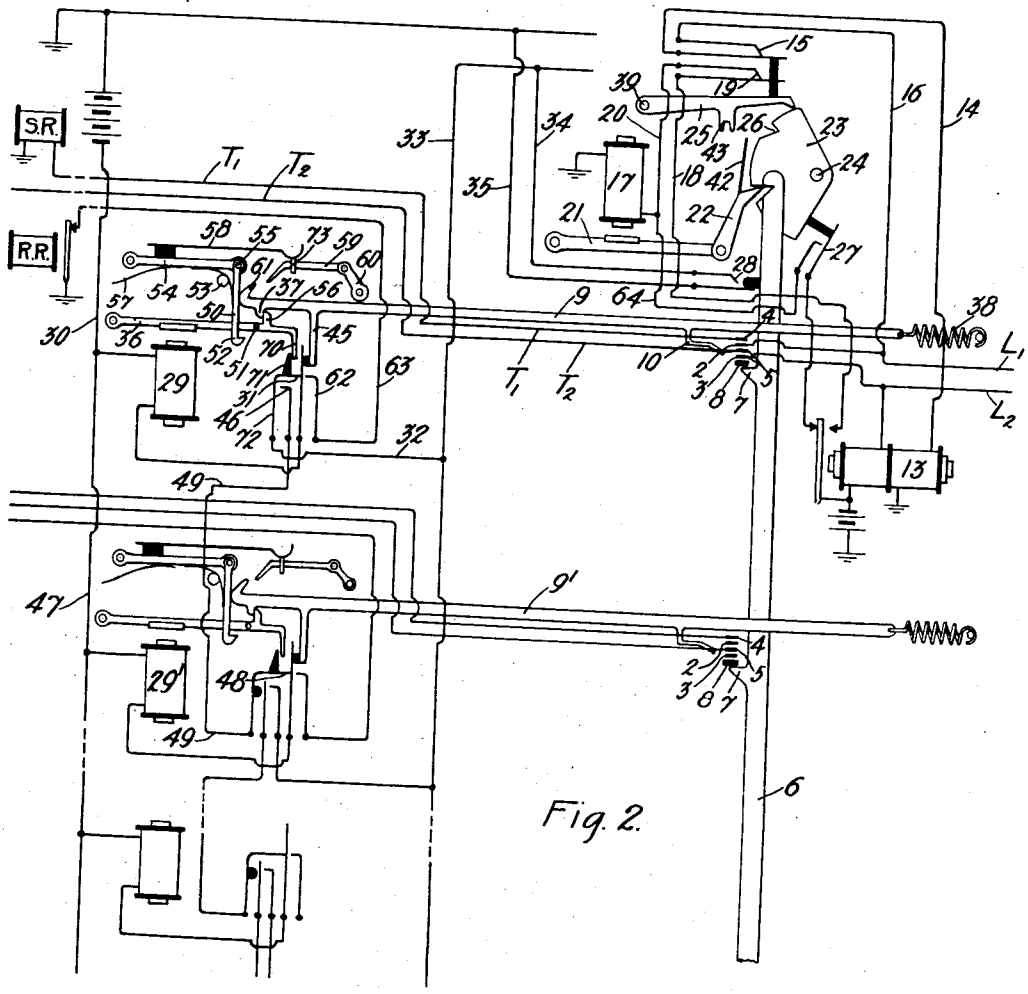


Fig. 2.

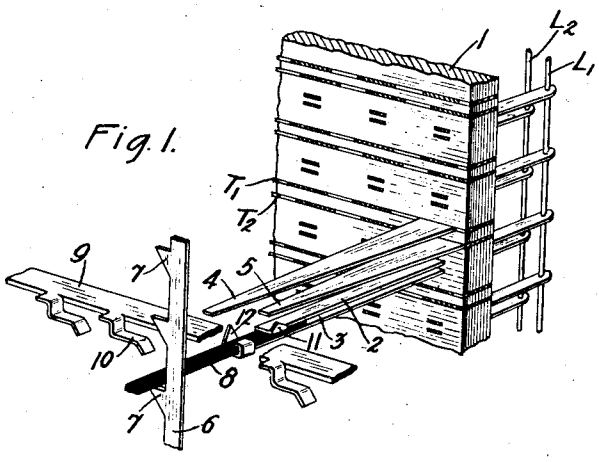


Fig. 1.

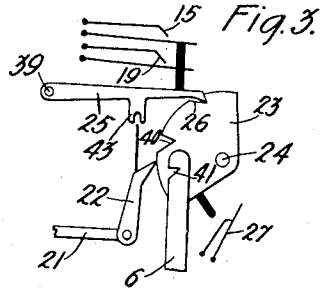


Fig. 3.

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UNITED STATES PATENT OFFICE.

FRANK A. LUNDQUIST, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

CROSS-BAR LINE-SWITCH.

1,303,084. Specification of Letters Patent. Patented May 6, 1919.

Application filed November 27, 1916. Serial No. 133,612.

To all whom it may concern:

Be it known that I, FRANK A. LUNDQUIST, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Cross-Bar Line-Switches, of which the following is a full, clear, concise, and exact description.

This invention relates to switching mechanisms for use in telephone systems, and more particularly to switches of the cross-bar type, that is, switches in which interconnection between incoming and outgoing lines is effected by the coöperative action of a bar in one of two sets of intersecting bars with a bar in the other of such sets.

The principal object of this invention is to effect the interconnection of lines in a cross-bar switch by the actuation of the corresponding sets of contact terminals in response to the successive longitudinal movements of a pair of intersecting cross-bars.

The switch herein disclosed is adapted to be used as a line switch or trunk finder, and as such, may be arranged to serve a plurality of subscriber's lines and a corresponding plurality of trunk lines.

In a preferred embodiment of the invention, each individual switching apparatus comprises a contact bank in which incoming line terminals are multipled vertically, and outgoing line terminals are multipled horizontally across the bank. These terminals are in the form of projecting contact springs which are in operative relation to each other at the various points of intersection of the rows formed by them. Individual to each set of incoming line multiples is a longitudinally movable bar, and associated with each set of outgoing line multiples is a bar, movable longitudinally in a direction at right angles to the direction of motion of the bars individual to the incoming lines. At the points of intersection of these auxiliary bars means are provided for effecting the interconnection of two sets of terminals upon the successive actuation in a longitudinal direction of two intersecting auxiliary bars.

In the drawings, Figure 1 is a perspective view of a section of the switch structure showing the terminal bank with its projecting spring contacts and the auxiliary cross-bars for effecting an interconnection of the spring contacts. In Fig. 2, is shown a schematic representation of the operating mechanisms and the circuits of a switch embodying the features of this invention. Fig. 3 is a detached view showing a part of the operating mechanism in one stage of its operation.

Referring to the drawings, incoming lines, such as L_1, L_2, terminate in a contact bank 1 in multiples such as 2, 3, which have the form of contact springs and extend in a vertical direction across the panel, and outgoing lines or trunks T_1, T_2 terminate in multiples 4, 5, which are likewise in the form of contact springs and extend horizontally across the contact bank. A plurality of line bars 6, each individual to a set of multiples of an incoming line and suitably mounted to permit of a vertical movement thereof, extend across the panel. Each bar 6 is provided with projections 7, each associated with a bar 8 of non-conducting material rigidly secured to each pair of line terminals 2, 3. Means are provided for causing a vertical movement of a line bar 6 upon the initiation of a call over the line L_1, L_2 with which such bar 6 is associated. whereupon the non-conducting bars 8 are raised to place them in operative relation with lugs 10 on horizontal trunk bars 9.

The trunk bars 9, individual to each set of trunk multiples, are mounted in such a manner as to be capable of movement in a longitudinal direction. The depressed lugs 10 integral with the trunk bar 9 are each associated with a bar 8, and are shaped in a manner such that, upon the horizontal movement of a trunk bar 9, a bar 8 individual to the multiples of a line L_1, L_2, and previously positioned by a line bar 6, will be engaged by a lug 10 on the actuated trunk bar and raised thereby to cause the engagement of the contact points 11 and 12 of the calling line multiple contact springs 2, 3 with the idle trunk multiples 4, 5. The line L_1, L_2 is thereby extended to the trunk T_1, T_2.

The invention will be best understood and the features thereof best appear, from a description of the operation of a switch, of the character described, in connecting the line with an idle trunk.

Upon the initiation of a call over the line L_1, L_2, relay 13 is energized over a circuit extending from ground, right-hand wind-

ing of relay 13, conductor 14, contacts 15, conductor 16, over line L_1 to the substation apparatus of the calling subscriber, line L_2, left-hand winding of relay 13 to grounded battery. Relay 13 thereupon attracts its armature, closing the following circuit for magnet 17: grounded battery, armature and front contact of relay 13, conductor 18, contacts 19, magnet 17, to ground. The magnet 17 attracts its armature 21, and by means of a pawl 22 pivotally mounted at the extremity thereof, raises the line bar 6. By means of the projections 7 thereon, all the bars 8 associated with multiples 2, 3, of the line L_1, L_2 are raised into a position to be engaged by the downwardly bent portion of the lugs 10 upon movement of any trunk bar 9. Bar 6, upon its upward movement, closes at contacts 28 a circuit for trunk bar release magnet 29 as follows: grounded battery, conductor 30, magnet 29, normally closed contacts 31, conductor 32, conductors 33, 34, contacts 28, conductor 35, to ground. Magnet 29 in attracting its armature 36 disengages catch 56 from a projection 37 on the trunk bar 9. The bar 9 on being released is moved in a horizontal direction under the action of a spring 38, whereby the inclined section of the lug 10 rides under one of the previously raised bars 8. The bar 8 is thus raised an additional amount, and contacts points 11, 12 thereupon engage the multiple spring contacts 4, 5 of the trunk T_1, T_2.

Simultaneously with the upward movement of the bar 6, pawl 22 causes the partial clockwise rotation of a sector 23 which is rotatably mounted on a pin 24 fixed to the frame (not shown). A pawl 25 pivoted on a pin 39 thereupon drops into a recess or notch 26. As a result of this operation contacts 15 and 19 are opened, and contact 27 is closed, as is more clearly indicated in Fig. 3, which shows sector 23 in rotated position. At contact 19 the circuit for magnet 17 is opened and magnet 17 thereupon releases its armature 21. Pawl 22 disengages notch 40 in sector 23, and also disengages the line bar 6 which then falls back, and allows the bars 8, associated with the remaining multiples of line L_1 and L_2, to return to their normal positions out of operative relation with the lugs 10 of any trunk bars 9 that may be subsequently operated. Pawl 22 will take the position shown in Fig. 3, and will thereby place a vertically extending projection 42, integral therewith, in operative relation with a cup-shaped projection 43 on pawl 25.

At contacts 15, the circuit for relay 13 is broken, but relay 13 will remain energized over a new circuit closed for its left-hand winding immediately upon the extension of line L_1, L_2 to the trunk T_1, T_2 through the stepping relay SR of the succeeding selector or connector switch. This circuit will be as follows: grounded battery, left-hand winding of relay 13, line L_2, through the substation apparatus of the subscriber, line L_1, multiple contact 2, trunk multiple 4, trunk T_1, relay SR, to ground. Relay 13 is slow acting and will hold up during the sending of selective impulses over the line L_1, L_2 to any selective switching apparatus to which trunk T_1, T_2 may extend. The relay SR, however, will respond to the impulses and will control the step-by-step operation of the particular switch to which it is individual.

Upon the actuation of the trunk bar 9, the movement of an arm 45 carried thereby allows contact 62 to be closed. Contact 46 is not closed, however, as long as magnet 29 is energized since a hook-shaped member 70 carried by armature 36 engages a projection 71 on spring 72 and prevents the operation of these contacts. The closure of contact 62 maintains magnet 29 energized over a circuit from grounded battery, conductor 30, winding of magnet 29, contact 62, conductor 63, to ground at the armature and back contact or relay RR, which is a relay at the succeeding switch next to be operated. The relay RR is preferably the first slow relay of any well-known type of step-by-step selector switch, and will be energized when such switch is taken for use and will remain energized until the release of the switch. After the calling line has been extended to such selector switch, the relay RR will be energized and will open the circuit of magnet 29 which thereupon deënergizes. The retraction of the armature 36 allows contact 46 to be closed.

A call coming in on any line other than L_1, L_2 during the busy condition of the latter will cause the release of trunk bar 9′ upon the closure of a set of contacts 28 associated with the line bar of such other calling line. The extended starter circuit for magnet 29′ will be as follows: grounded battery, conductors 30 and 47, winding of magnet 29′, contact 48, conductor 49, contacts 46 and 72, conductors 32, 33 and 34, contact 28, conductor 35 to ground.

A pivoted arm 54 carries a swinging pawl 50 which is spring-pressed outwardly upon movement of bar 9, motion of pawl 50 being limited by a pin 51 mounted on armature 36. When magnet 29 retracts its armature, the hook-shaped portion 52 of pawl 50 engages pin 51.

A restoring arm 59 is pivotally mounted on a constantly rotating crank arm 60, and is normally held out of engagement with a projection 61 on trunk bar 9 by means of a flat spring 58 mounted on arm 54. The arm 59 slides through a suitable guide 73 mounted on the end of spring 58. Arm 54 is held in its normal position by the action of a flat spring 57.

When the circuit over line L_1, L_2 is broken, upon the subscriber hanging up his receiver, relay 13 deënergizes and closes the following circuit for magnet 17: ground, magnet 17, conductor 64, contact 27, armature and back contact of relay 13, to grounded battery. Magnet 17 attracts its armature, and pawl 22, previously positioned as shown in Fig. 3, is given an upward movement, and by means of the projection 42 thereon raises pawl 25 out of the notch 26 in the sector thus permitting the restoration of the sector 23 and its associated contacts 15, 19 and 27. Simultaneously relay RR of the succeeding switch is deënergized and places ground on conductor 63, completing thereby the following circuit for magnet 29: grounded battery, conductor 30, magnet 29, contacts 62, conductor 63, armature and back contact of relay RR, to ground.

Magnet 29 attracts its armature 36, and by means of the arm 50, in engagement with pin 51, causes downward movement of spring 58, which places the restoring arm 59 in position to engage the projection 61 on trunk bar 9. The crank shaft 60, upon its rotation, returns the trunk bar 9 to normal by means of the arm 59, whereupon the lug 10 is withdrawn from engagement with bar 8. The bar 8 is thereupon restored to its normal position by virtue of the resiliency of the spring contacts 2, 3.

Trunk bar 9, on being restored to normal, opens contacts 62, breaking thereby the circuit for magnet 29. Magnet 29 retracts its armature, a catch 56 thereon engaging a projection 37 on the trunk bar 9 and holding it in its normal position. Bar 9 also forces arm 50 out of engagement with pin 51, allowing arm 54 to return to normal. Arm 54 is restored and retains the reciprocating restoring member 59 in its normal inoperative position by means of spring 58.

What is claimed is:

1. In a switching device, a plurality of fixed contacts, incoming lines multipled to certain ones of said fixed contacts, outgoing lines multipled to others of said fixed contacts, resilient projecting portions integral with certain ones of said fixed contacts, a movable bar individual to each incoming line, a movable bar individual to each outgoing line, and means to establish a connection between an incoming line and an outgoing line as a result of the successive movements of said resilient projecting portions upon operation of an incoming line bar and an outgoing line bar.

2. In a switching device, a plurality of fixed contacts, incoming lines multipled to certain ones of said fixed contacts, outgoing lines multipled to others of said fixed contacts, resilient projecting portions integral with certain ones of said fixed contacts, means to operate said resilient projecting portions in separate successive movements to establish a connection between an incoming line and an outgoing line.

3. In a switching device, a plurality of fixed contacts, incoming lines multipled to certain ones of said fixed contacts, outgoing lines multipled to others of said fixed contacts, resilient projecting portions integral with certain ones of said fixed contacts, a movable bar individual to each incoming line, a movable bar individual to each outgoing line, means to advance a set of resilient projecting portions into one stage of operation upon actuation of an incoming line bar, and means to advance said portions to a second stage of operation upon actuation of an outgoing line bar to establish a connection between an incoming and an outgoing line.

4. In a switching device, fixed contacts, incoming lines multipled to certain ones of said fixed contacts, outgoing lines multipled to others of said fixed contacts, resilient projecting portions integral with certain ones of said fixed contacts, a movable bar individual to each incoming line, a movable bar individual to each outgoing line, means to operate an incoming line bar to displace certain ones of said projecting portions, and means coöperative with a projecting portion in its displaced position and operable upon movement of an outgoing line bar to establish connection between an incoming and an outgoing line.

5. In a switching device, multiply connected fixed contacts arranged in rows, said rows being arranged in groups, an incoming line connected to each row of contacts in one of said groups, an outgoing line connected to each row of contacts in a second one of said groups, sets of resilient projecting portions integral with the fixed contacts to which incoming lines are multipled, a movable bar individual to each incoming line, a movable bar individual to each outgoing line, means to move an incoming line bar to displace a row of projecting portions, and means to operate an outgoing line bar to further displace one of said sets of projecting portions to establish connection between an incoming and an outgoing line.

6. In a switching device, multiply connected fixed contacts arranged in vertical rows, multiply connected fixed contacts arranged in horizontal rows, an incoming line connected to each vertical row of contacts, an outgoing line connected to each horizontal row of contacts, resilient projecting portions integral with said vertically arranged fixed contacts, a plurality of vertical bars, a plurality of horizontal bars, means to move a vertical bar to displace a row of projecting portions, and means to operate a horizontal bar to further displace

said projecting portions to establish connection between an incoming and an outgoing line.

7. In a switching device, multiply connected fixed contacts arranged in vertical rows, multiply connected fixed contacts arranged in horizontal rows, an incoming line connected to each vertical row of contacts, an outgoing line connected to each horizontal row of contacts, resilient projecting portions integral with said vertically arranged fixed contacts, a vertically movable bar individual to each incoming line, a horizontally movable bar individual to each outgoing line, a plurality of cam surfaces carried by each of said horizontal bars equal in number to the number of vertical bars, means to move a vertical bar to displace a row of projecting portions into a position wherein they may be engaged by the adjacent cam surfaces of horizontal bars, and means to operate a horizontal bar to cause said set of projecting portions to be further displaced by the action of one of said cam surfaces to establish connection between an incoming and an outgoing line.

8. In a switching device, a plurality of fixed contacts, incoming lines multipled to certain ones of said fixed contacts, outgoing lines multipled to others of said fixed contacts, a movable bar individual to each incoming line, a movable bar individual to each outgoing line, means to establish a connection between an incoming and an outgoing line upon operation of an incoming line bar and an outgoing line bar, means to restore an operated incoming line bar to its normal position after connection has been established, and means to restore said operated outgoing line bar when connection is no longer desired.

9. In a switching device, a plurality of fixed contacts, incoming lines multipled to certain ones of said fixed contacts, outgoing lines multipled to others of said fixed contacts, a movable bar individual to each incoming line, a movable bar individual to each outgoing line, means to establish a connection between an incoming and an outgoing line upon operation of an incoming line bar and an outgoing line bar, means to operate an incoming line bar, and means controlled by the operation of an incoming line bar to operate an idle one of said outgoing line bars.

In witness whereof, I hereunto subscribe my name this 24th day of November, A. D. 1916.

FRANK A. LUNDQUIST.