

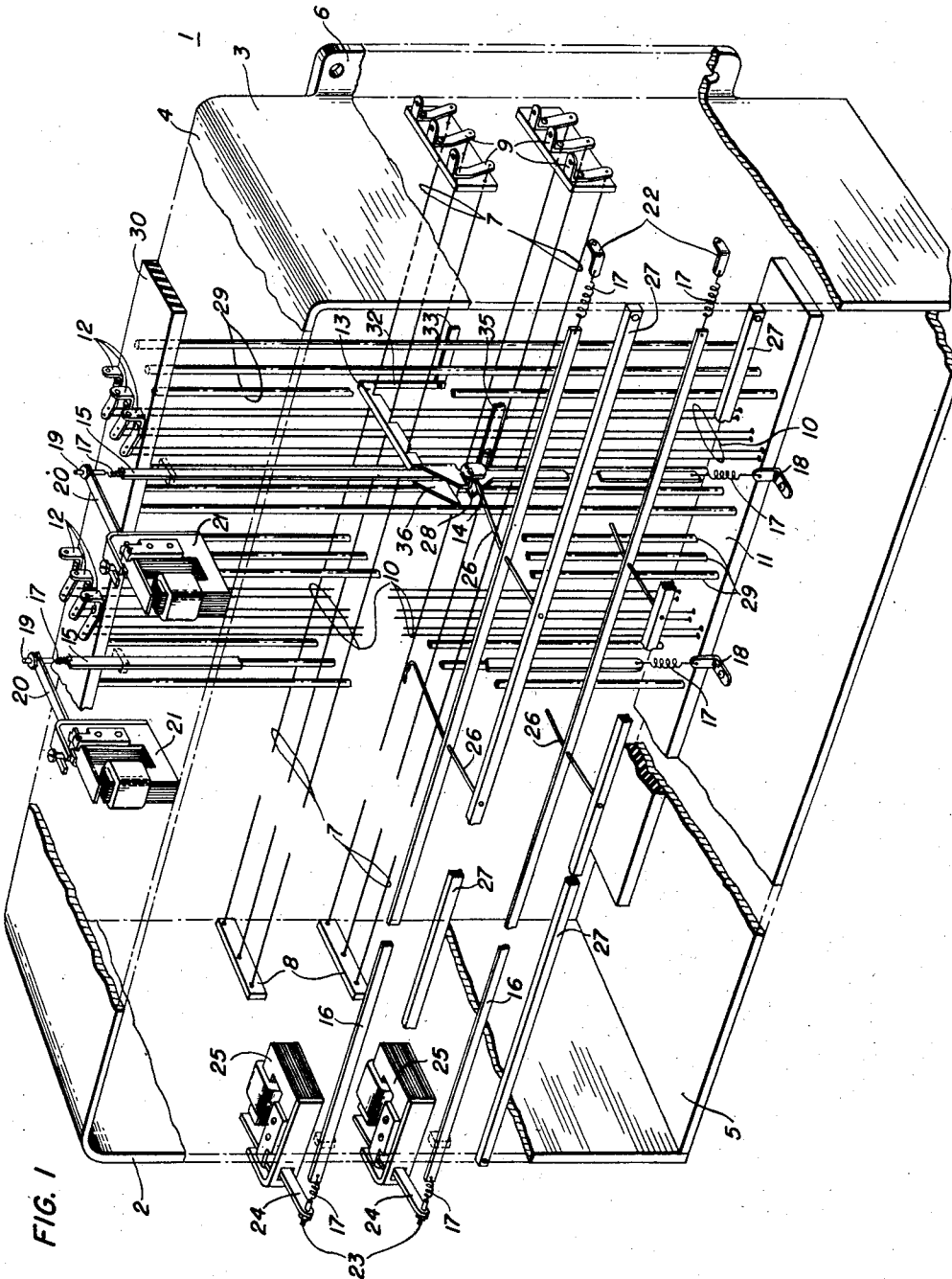
Aug. 1, 1950

R. L. PEEK, JR
CROSS WIRE SWITCH

2,517,022

Filed Dec. 30, 1947

3 Sheets-Sheet 1



INVENTOR
R. L. PEEK, JR.
BY
P. C. Smith
ATTORNEY

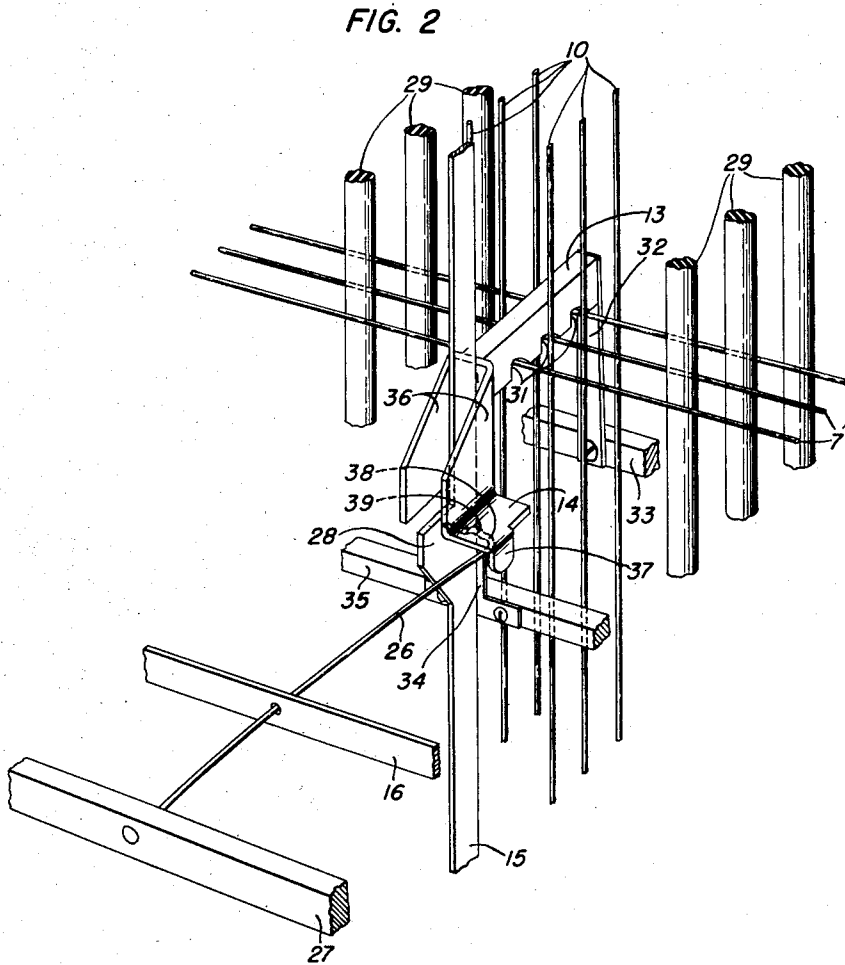
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3 Sheets-Sheet 2



INVENTOR
R. L. PEEK, JR.
BY
G. B. Smith
ATTORNEY

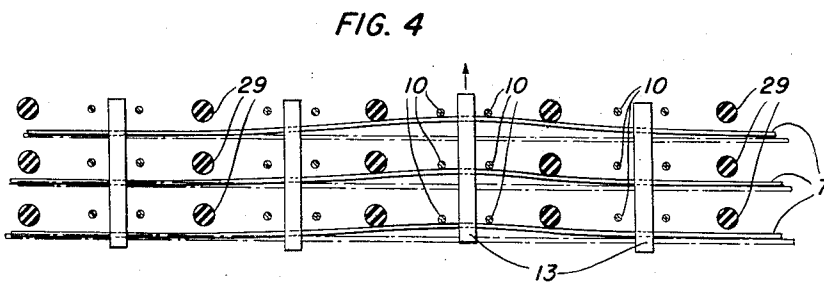
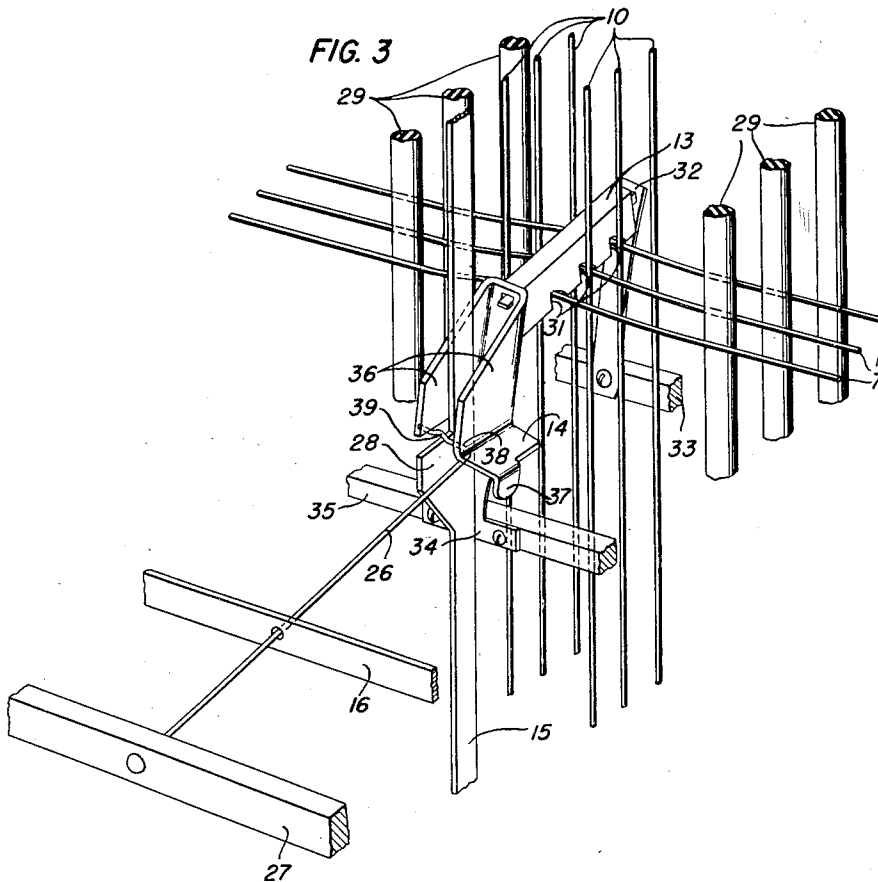
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INVENTOR
R. L. PEEK, JR.
BY *P. C. Smith*
ATTORNEY

UNITED STATES PATENT OFFICE

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CROSS-WIRE SWITCH

Robert L. Peek, Jr., New York, N. Y., assignor to
Bell Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

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8 Claims. (Cl. 179—27.54)

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This invention relates to switching devices and more particularly to telephone switch mechanisms of the cross bar type.

The objects of this invention are to simplify the structure, improve the reliability, and increase the speed of operation of selective switches.

These objects have been accomplished by utilizing a self-multiplying switch comprising a plurality of sets of tensioned wire conductors positioned in coordinant proximity to other sets of tensioned wire conductors and arranged to be selectively brought into engagement therewith through the actuation of an operating card located at each junction point. Each operating card is supported by two cantilever springs, one of which is integral with an actuating lever. A cantilever, flexible selecting finger, when moved into its operated position by a tensioned selecting tape, serves to bridge the actuating lever in such a fashion that movement of the associated lugged hold tape causes the actuating lever to move the actuating card and thereby bring the selected sets of wires into positive electrical contact. Increased reliability of operation is attained by utilizing double vertical wires mating with each horizontal conductor, and by the particular mounting of the operating card which brings the mating conductors together with a wiping movement. The increased speed of operation is attained by employing low mass selecting and holding tapes mounted in tension.

The foregoing and other features of the invention will be hereinafter discussed in detail with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of a switch constructed in accordance with the invention with certain duplicate parts broken away, omitted, or shown in phantom for purposes of clarity;

Fig. 2 is an enlarged perspective showing the contact operating mechanism of one of the cross-points of the switch in a normal or unoperated position;

Fig. 3 is a perspective of the mechanism shown in Fig. 2 in an operated position; and

Fig. 4 is a plan view taken at a section immediately above a horizontal row of cross-points showing one of the sets of contacting wires in its operated position.

Referring now particularly to Fig. 1, the switch comprises a rectangular frame 1 having side members 2 and 3, a top member 4, and a base member 5, and mountable in a bay by means of brackets 6. A plurality of horizontal conduct-

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ing wires 7, fixed in mounting plates 8 of insulating material on side member 2, extend through side member 3 and are fixed to wiring terminals 9. A plurality of vertical conducting wires 10, fixed in a base mounting plate 11 of insulating material on base member 5, extend through the top member 4 and the top mounting plate 12 and are fixed to wiring terminals 12. The terminals 9 and 12 are sprung outwardly at their outermost edges to maintain the conducting wires 7 and 10 under the proper tension. The horizontal or line conductors 7 are arranged in sets, each set comprising, in the present embodiment, three wires lying in a horizontal plane. The vertical or trunk conductors 10 are also arranged in sets, each set comprising six wires arranged in two adjacent vertical planes, three wires per plane. The horizontal and vertical conductors, which may be made of or clad with precious metal, are so positioned one relative to another that a single line conductor 7, suitably actuated, will engage with a pair of trunk conductors 10 (Fig. 4).

It will be seen that a plurality of junction or cross-points are formed by the above-described arrangement of coordinately positioned wires. In order selectively to establish contact at any one of these cross-points, an actuating means comprising an operating card 13 and an actuating lever 14 is associated with the horizontal or line conductors 7 at each cross-point as will be more fully described hereinafter. The selective operation of these actuating means is accomplished by coordinately situated low mass tapes 15 and 16 which are supported in tension by the action of opposing springs 17. Each vertical or hold tape 15 is attached at the lower end through its associated spring 17 and a bracket 18 to the base member 5, extends upwardly through an aperture in the frame top member 4, and is connected at its upper end through a spring 17 and a tension adjusting means 19 to the armature 20 of a hold magnet 21. Each horizontal or select tape 16 is attached through a spring 17 and a bracket 22 to the frame side member 3, extends through an aperture in the frame side member 2, and is connected through a spring 17 and tension adjusting means 23 to the armature 24 of a select magnet 25. Identical springs 17 are provided at each end of each tape balancing one another so that the magnet works only against the useful load plus the stiffness (but not against the bias) of the tensioning springs.

The earlier-mentioned advantage of high speed

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operation through the use of low mass tensioned tapes accrues from the fact that the lightest member which will transmit mechanical force is one used in tension, and a tension linkage may therefore have the smallest inertia load increment for a high speed switch. And although but a limited number of cross-points have been shown in Fig. 1 for purposes of clarity, tape actuation has the further advantage of permitting an increase in the size of the switch without a prohibitive increase in the inertia load.

Each select tape 16 serves to control a plurality of selecting fingers 26 which are mounted in support bars 27 extending across the front of the frame 1. When moved into its operated position by the select tape 16, each selecting finger 26 forms a link between a lug 28 on the hold tape 15 and the side arms 36 of the actuating lever 14 such that the subsequent operation of the hold tape 15 will bring the mating wires at that cross-point into electrical contact.

Since upon operation of the switch a set of horizontal conductors 7 are moved toward the rear of the switch by a selected operating card 13, the dimensions of the various elements must be so interrelated that the moved horizontal conductors will contact only those vertical conductors 10 at the particular cross-point selected. However, to obviate the possibility of any of the other sets of vertical conductors 10 being contacted, a plurality of insulating rods or guard insulators 29 may be provided. These guard insulators 29 are rigid insulating rods extending from the base mounting plate 11 to the top mounting plate 30, are arranged in set of three, are positioned a suitable distance rearwardly of each of the horizontal conductors 7, and each set is centered between adjacent sets of vertical conducting wires 10.

The various elements of the switch associated at a cross-point may be more clearly seen by reference to Fig. 2. The operating card 13 is located in the area between the two parallel rows of three wires each which comprise a set of six vertical conducting wires 10, and has three suitably located notches 31 therein to accept the horizontal conductors 7. The operating card 13 is mounted at its rearmost end by means of a cantilever-mounted card-support spring 32 affixed to a support bar 33 at the rear of the frame 1 and is mounted at its front end by means of the actuating lever 14 which has an extending spring portion 34 mounted on a support bar 35 at the front of the frame 1. The operating card 13 is affixed to the spring members by means of a projection at each end of the card engaging a rectangular aperture in the spring 32 and in the actuating lever 14, respectively. The actuating lever 14 has two side arms 36 which extend forwardly and provide a channel through which the hold tape 15 passes. The selecting finger 26 mounted in a support bar 27 acts as a cantilever the free end of which can be moved by the select tape 16, and, in the unoperated position, rests against the positioning backstop 37 which is integral with one of the actuating lever side arms 36. The selecting finger 26 is bent at right angles near its free end, and the portion 38 thus formed is slightly kinked as at 39.

In operating the switch, as shown in Fig. 3, one of the select magnets 25 is energized thus carrying the select tape 16 to the left and moving the selecting finger 26 into a position whereby the portion 38 effectively bridges the two actuating lever side arms 36. Subsequent energization of

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a hold magnet 21 carries the associated hold tape 15 upwardly, whereupon the lug 28, associated with the particular cross-point, contacts the portion 38 of the selecting finger 26 and moves the actuating lever side arms 36 upwardly. The actuating lever 14, acting as a bell crank lever pivoted about the support bar 35, forces the operating card 13 rearwardly. Since the operating card 13 is supported by two cantilever springs, its movement is substantially normal to the plane of the contacting wires, but the slight downward movement of the card as the springs flex performs the useful function of bringing the horizontal conductors 7 into contact with the vertical conductors 10 with a slight wiping motion thereby increasing the certainty of electrical contact. The slight kink 39 in the selecting finger portion 38 locks over the hold tape lug 28 so that the selecting finger 26 will not restore upon release of the select magnet 25 as long as the hold magnet 21 is operated.

Referring now to the plan view in Fig. 4, upon actuation of the operating card 13, the three horizontal conductors 7 are carried rearwardly and into contact with their respective vertical conductors 10. The conductors 7 may also contact the adjacent guard insulators 29 and thereby be prevented from contacting any of the conductors 10 except those in the particular set associated with the cross-point being actuated.

Release of the select magnet 25 while hold magnet 21 remains operated allows all of the selecting fingers 26 to be restored to their unoperated positions except for the one selecting finger at the operated cross-point. Therefore, once any selected cross-point is locked in its operated position, any other cross-point may be actuated except those associated with the hold magnet of the locked cross-point. The select fingers 26 are sufficiently flexible so that the subsequent operation of the select magnet associated with a held select finger is not impeded by the fact that one of its select fingers is in the operated position.

Release of the hold magnet 21 allows the hold tape 15 to return, and the operating card 13 moves to its normal unoperated position under the effect of the cantilever springs 32 and 34, thereby allowing the conductors 7 to break contact with the conductors 10.

In accordance with the invention, a switch may be constructed having a large number of cross-points and, if required for circuit functions, the sets of vertical and horizontal conductors may comprise greater numbers of wires than herein depicted. The embodiment described in this specification is to be interpreted as illustrative, and not in a limiting sense.

What is claimed is:

1. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other, a plurality of operating cards, one positioned at the junction of each set of line conductors with each set of trunk conductors and movable to flex one set of conductors into engagement with another set of conductors, a plurality of flexible select tapes, a plurality of flexible hold tapes, opposing spring members at each end of each of said tapes for tensioning each of said tapes, means for operating each of said tapes, a plurality of select fingers operable by each of said select tapes, and means responsive to the operation of one of said select fingers in response to the operation of the associated select tape followed by the operation of one of said hold tapes

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for operating one of said cards to effect an electrical connection between a set of line conductors and a set of trunk conductors.

2. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other, a plurality of operating cards, one positioned at the junction of each set of line conductors with each set of trunk conductors and movable to flex one set of conductors into engagement with another set of conductors, a plurality of flexible hold tapes each having a plurality of projections thereon, one for each set of line conductors, a plurality of flexible select tapes, opposing spring members at each end of each of said tapes for tensioning each of said tapes, a plurality of select fingers operable by each of said select tapes, there being a select finger for each set of trunk conductors, an operating magnet for each of said tapes, and means responsive to the operation of one of said select fingers in response to the operation of the associated select tape followed by the operation of one of said hold tapes for operating one of said cards to effect an electrical connection between a set of line conductors and a set of trunk conductors.

3. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other, a plurality of operating cards, one positioned at the juncture of each set of line conductors with each set of trunk conductors and movable to flex a set of line conductors into engagement with a set of trunk conductors, a flexible hold tape for each set of trunk conductors and having a projection thereon for each set of line conductors, a flexible select tape for each set of line conductors, opposing spring members at each end of each of said tapes for tensioning each of said tapes, a plurality of select fingers operable by each of said select tapes, there being a select finger for each set of trunk conductors, an operating magnet for each of said tapes, and means responsive to the operation of one of said select fingers in response to the operation of the associated select tape followed by the operation of one of said hold tapes for operating one of said cards to effect an electrical connection between a set of line conductors and a set of trunk conductors.

4. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other, a plurality of operating cards, one positioned at the juncture of each set of line conductors with each set of trunk conductors and movable to flex one set of conductors into engagement with another set of conductors, an actuating lever associated with each of said operating cards, a flexible hold tape for each set of trunk conductors and having a projection thereon for each set of line conductors, a flexible select tape for each set of line conductors, opposing spring members at each end of each of said tapes for tensioning each of said tapes, a plurality of select fingers operable by each of said select tapes, there being a select finger for each set of trunk conductors, and an operating magnet for each of said tapes, one of said select fingers upon operating in response to the operation of the associated select tape effecting a mechanical linkage between the associated projection on one of said hold tapes and the associated actuating lever, said hold tape in operating then operating said actuating lever to cause the operating card

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to effect an electrical connection between a set of line conductors and a set of trunk conductors.

5. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other such that a plurality of junction points are formed, an operating card associated with a set of line conductors at each of said junction points and movable to flex the set of line conductors into engagement with the mating set of trunk conductors, a flexible hold tape for each set of trunk conductors and having a projection thereon at each of the junction points, a flexible select tape for each set of line conductors, opposing spring members at each end of each of said tapes for tensioning each of said tapes, a select finger at each of the junction points and operable by one of said select tapes, an operating magnet for each of said tapes, and an actuating lever associated with each of said operating cards, one of said select fingers upon operating in response to the operation of the associated select tape effecting a mechanical linkage between the associated projection on one of said hold tapes and the associated actuating lever, said hold tape in operating then operating said actuating lever to cause the operating card to effect an electrical connection between a set of line conductors and a set of trunk conductors.

6. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other, a plurality of operating cards, one positioned at the junction of each set of line conductors with each set of trunk conductors and movable to flex one set of conductors into engagement with another set of conductors, a pair of cantilever springs supporting each of said operating cards, such that the movement of each of said operating cards is substantially parallel to the plane of the flexed conductors, a plurality of tensioned select tapes, a plurality of tensioned hold tapes, means for operating each of said tapes, a plurality of select fingers operable by each of said select tapes, and means responsive to the operation of one of said select fingers in response to the operation of the associated select tape followed by the operation of one of said hold tapes for operating one of said cards to effect an electrical connection between a set of line conductors and a set of trunk conductors.

7. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other, a plurality of insulating rods, one located adjacent each line conductor and between adjacent sets of trunk conductors, a plurality of operating cards, one positioned at the junction of each set of line conductors with each set of trunk conductors and movable to flex one set of conductors into engagement with another set of conductors, a plurality of flexible select tapes, a plurality of flexible hold tapes, opposing spring members at each end of each of said tapes for tensioning each of said tapes, means for operating each of said tapes, a plurality of select fingers operable by each of said select tapes, and means operative upon the operation of one of said select fingers in response to the operation of the associated select tape followed by the operation of one of said hold tapes for operating one of said cards to effect an electrical connection between a set of line conductors and a set of trunk conductors, said set of line conductors also contacting the adjacent insulating rods such that said

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set of line conductors engages only the selected set of trunk conductors.

8. In an automatic telephone switch, sets of line conductors and sets of trunk conductors arranged coordinately but out of contact one with the other, a plurality of operating cards, one positioned at the juncture of each set of line conductors with each set of trunk conductors and movable to flex one set of conductors into engagement with another set of conductors, an actuating lever associated with each of said cards and having a pair of spaced side arms extending therefrom, a hold tape for each set of trunk conductors and having a projection thereon for each set of line conductors, a select tape for each set of line conductors, a plurality of select fingers operable by each of said select tapes, there being a select finger for each set of trunk conductors, and an operating magnet for each of said tapes, one of said select tapes in operating positioning the associated ones of said select fingers to bridge

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the pairs of spaced side arms on the associated actuating levers so that upon operation of a hold tape the associated projection on said hold tape contacts the associated select finger thereby operating the associated actuating lever to cause the associated operating card to effect an electrical connection between a set of line conductors and a set of trunk conductors.

ROBERT L. PEEK, JR.

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