

Sept. 23, 1952

R. P. ARTHUR
CROSSBAR SWITCH

2,611,827

Filed Dec. 3, 1949

3 Sheets-Sheet 1

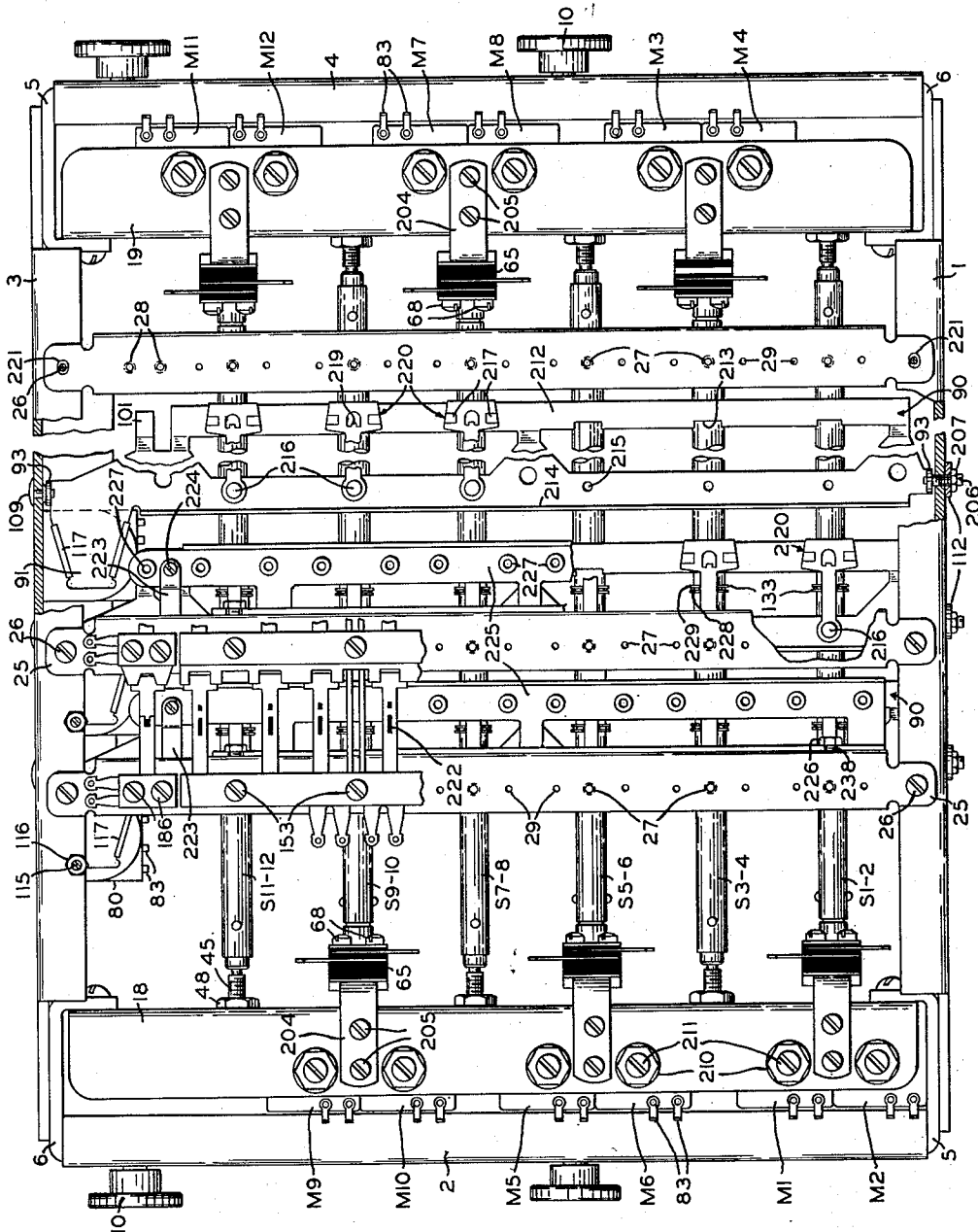


Fig. 1

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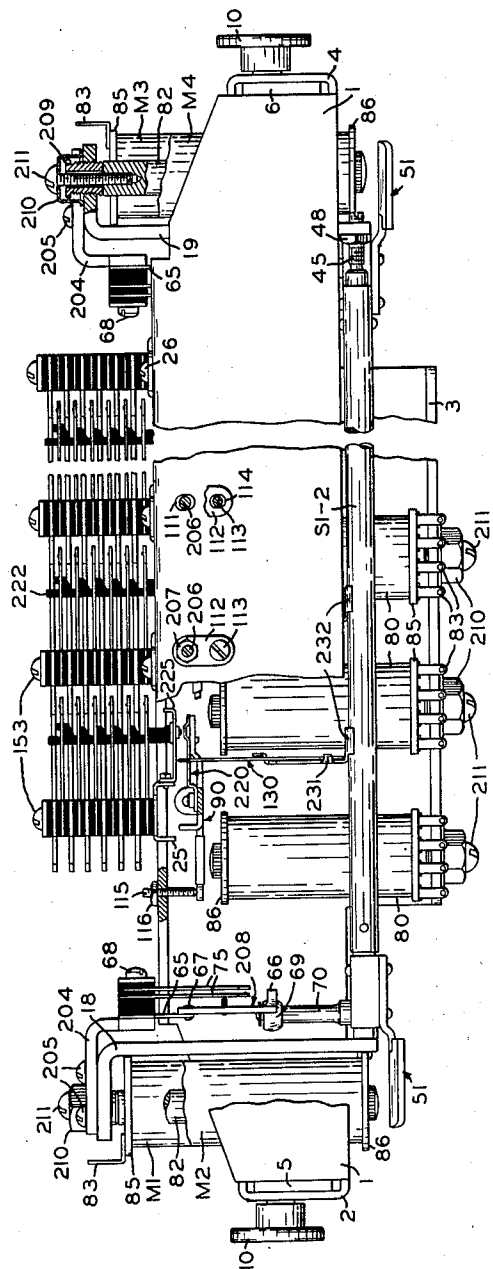
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3 Sheets-Sheet 2

FIG. 2



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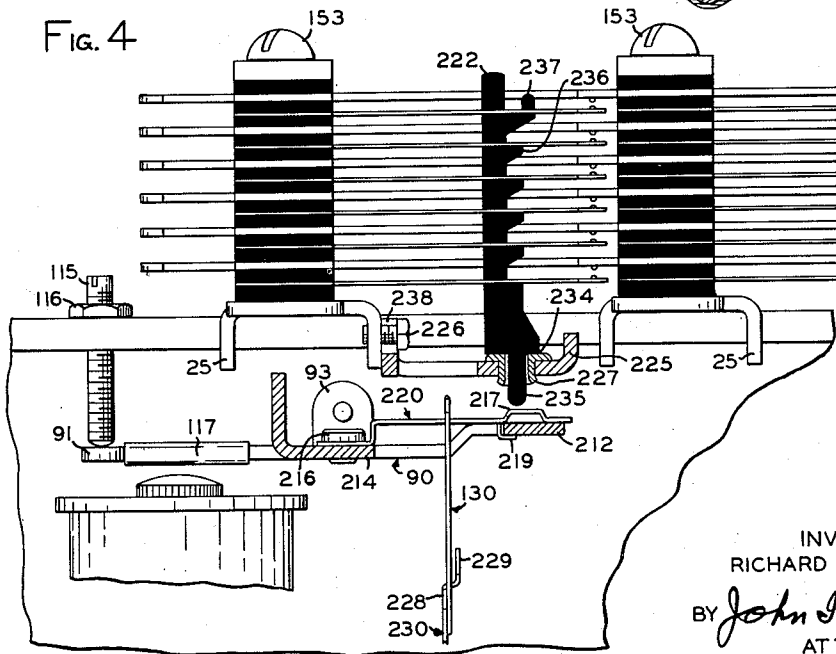
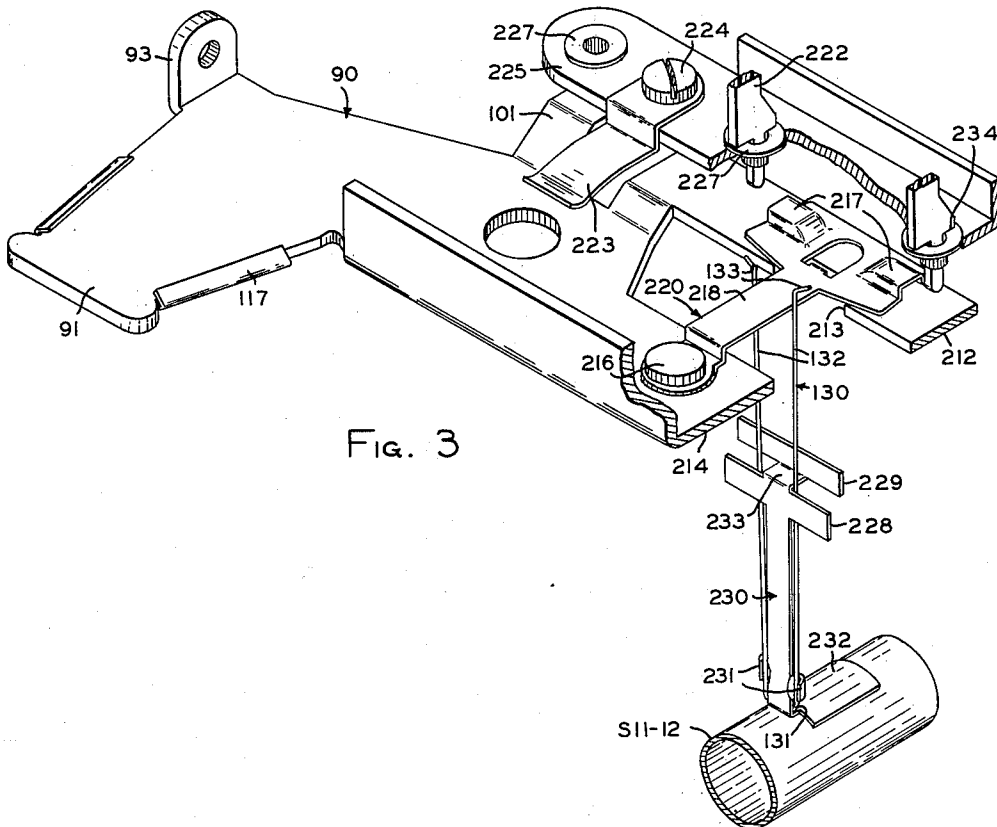
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,611,827

CROSSBAR SWITCH

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mesne assignments, to Kellogg Switchboard and
Supply Company, a corporation of Delaware

Application December 3, 1949, Serial No. 131,003

4 Claims. (Cl. 179-27.54)

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This invention relates to a crossbar switch. Its principal object is to provide a more satisfactory and economical construction of the parts directly involved in the selection and operation of the desired stackup of contact sets. Additional objects are to simplify and improve the construction wherever practicable to facilitate manufacture, assembly, and adjustment.

GENERAL DESCRIPTION

A crossbar switch is one having permanently paired contact members comprising sets (or stackups) arranged in intersecting rows, hereinafter respectively termed vertical rows and horizontal rows. Selecting bars (or shafts) extend along the horizontal rows to select the stackups therein. Hold bars (or armatures), extend respectively along the vertical rows to actuate, and hold, selected stackups.

It has been chosen to illustrate the invention as applied to a crossbar switch as disclosed in the pending application of Richard P. Arthur, Crossbar Switch, Serial No. 8,900, filed February 17, 1948. The noted Arthur application will hereinafter be termed the former application or disclosure.

The principal feature of the invention resides in an improved arrangement of the parts directly involved in selecting and operating a desired stackup of contact members. An outstanding characteristic of the new arrangement is that the underlying actuating member or tab for a stackup is rendered unnecessary, and the associated select lever directly actuates the stackup. In the disclosed embodiment, the stackup includes an actuating ladder which has a wide portion resting on a backstop bar to determine the normal position of the stackup. A reduced depending portion of the ladder passes through an opening in the backstop bar to a level at which it is directly engaged and lifted by the associated select lever.

A related feature is that accurate guiding of the stackup ladder is readily obtained by properly sizing the noted opening in the backstop bar. Abrasive action on the ladder is avoided by an eyelet type of grommet lining the noted opening in the backstop bar.

A further advantage of the noted improved arrangement is that the armature structure for actuating any selected stackup in the same vertical row may be readily produced in one piece from sheet stock.

According to a further feature, the laterally adjustable end bearing of the armature includes

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parts for taking up end play which may otherwise exist at some of the armatures of a switch.

Other objects and features of the invention will appear as the description progresses.

The chosen embodiment of the invention will now be described in connection with the accompanying drawings comprising Figs. 1 to 4, in which:

Fig. 1 shows a top view of the improved crossbar switch;

Fig. 2 shows a front view of the crossbar switch with certain parts broken away, and other parts removed;

Fig. 3 shows a fragmentary perspective view of the stackup selecting and operating mechanism employed at any vertical row of stackups; and

Fig. 4 shows an enlarged fragmentary front view, partly in section, showing the stackup selecting and operating mechanism at one of the stackups in the first vertical row.

DETAILED DESCRIPTION

A detailed description of the construction and operation of the improved crossbar switch will now be given.

I. CONSTRUCTION

Referring now particularly to Figs. 1 and 2, the switch comprises a contact bank providing the desired number and arrangement of stackups, together with a rectangular structure for supporting the contact bank and controlling the desired actuation of the stackups thereof. The supporting and controlling structure includes (1) front and rear frame members 1 and 3, and left and right frame members 2 and 4 suitably secured thereto through corner gussets 5 and 6, (2) six horizontal bars or select shafts S1-2 to S11-12, pivotally mounted between shaft brackets 18 and 19, (3) a desired number of vertical bars or hold-magnet armatures 90, pivotally mounted between front and rear members 1 and 3, and (4) a contact bank providing stackups comprising vertical rows overlying the respective armatures 90, the contact bank being supported on cross channels 25.

The front frame member 1 is an upright member with an inwardly extending upper flange. The rear member 3 is a similar structure, but with an inwardly extending lower flange added. The upper flanges of both members serve as mounting supports for cross members 25 while the lower flange on rear member 3 serves as a mounting support for hold magnets 80. The rear member, being iron, provides a return path for the hold-magnet flux. The exposed face of

front member 1, as seen in Fig. 2, contains elongated holes 111 to receive the armature leveling assembly 112. Rollers 10, attached to the right and left end members 2 and 4, permit the switch to be easily moved forwardly and rearwardly on a suitable track (not shown).

Shaft brackets 18 and 19, extending across the switch frame at the ends, are angle structures with the upper web extending outwardly. They are secured to the rectangular frame by screws passing through corner gussets 5 and 6. The vertical portion of these brackets support the select shafts, S1-2 to S11-12, while the flanged portion supports the select magnets M1 to M12, together with brackets 204. Brackets 18 and 19 provide magnetic return paths for the select-magnet flux.

Cross channels (or support channels) 25 are secured to the upper flanges of front and rear frame members 1 and 3 by screws 26. Elongated apertures 221 permit channels 25 to be adjustably aligned. The contact stackups are secured to the support channels by screws 153 entering tapped holes 27, while the hold-pilot assemblies (at the top of Fig. 1) are secured to the support channels by screws 186 entering tapped holes 28. Holes 29 are provided in support channel 25 for holding dowel pins used only in aligning the stackup members during assembly.

Each vertical row of stackups is provided with a backstop bar 225. Bar 225 is a channel structure with upwardly extending flanges, and is secured at each end to support channel 25 by screws 226 which extend through mounting notches 238 in the backstop bar. Each backstop bar 225 contains punched holes through each of which a reduced portion of a stackup ladder 222 is extended to a level at which it may be engaged and lifted by an associated select lever 220 as will hereinafter be described.

By loosening screws 226, backstop bar 225 may be raised or lowered to adjust the normal position of stackup ladders 222.

IA. Select magnets and shafts

Six pairs of select magnets M1 and M2, M3 and M4, etc., and their associated six select shafts, S1-2, S3-4, etc., are provided for the six pairs of horizontal rows of stackups. The noted select shafts are pivotally mounted to permit their rotation in either direction from normal position to select the corresponding one of the two associated horizontal rows of stackups, depending upon which one of the two associated select magnets is energized.

Each select magnet includes an energizing coil wound on a core 82. To permit external connections the coils of the select magnets are provided with terminals 83 mounted on spoolhead 85. Select magnets M1 and M2, M5 and M6, and M9 and M10 are mounted on shaft bracket 18, while magnets M3 and M4, M7 and M8, and M11 and M12 are mounted on shaft bracket 19. Each select magnet core 82 is drilled and tapped at its mounting end to receive mounting screw 211. Collars 209, against which cores 82 are held by screws 211, are threaded into tapped holes in the flanged portion of shaft brackets 18 and 19. When rotated, they longitudinally adjust the select magnets to determine the front stop position of armatures 51. Collars 209 are provided with a hexagonally shaped shoulder to facilitate their rotation. A hexagonally shaped cup-like member 210 placed over the shoulder of collar 209

locks the structure rigidly in its adjusted position when screw 211 is tightened.

The select shafts are pivotally mounted at each end as fully described in the noted former application. Bearing screw 45, with its lock nut 48, serves to adjust against excessive end play.

Each select shaft has an armature 51 (shown in Fig. 2) underlying each of the two associated select magnets. With the shaft pivoted at a point between the select magnets, energization of either magnet attracts the armature in the corresponding direction to rotate the select shaft in the same direction.

As shown in the former application, each select shaft has an off-normal stackup and shaft-restoring member (on brackets 204) associated with the armature end thereof. From the noted locations of magnets M1 to M12, it will be observed that the first, third, and fifth select shafts are mounted with their armatures at the left end of the switch while the second, fourth, and sixth select shafts are mounted with their armatures at the right end of the switch.

Support brackets 204, mounted above their associated select shafts, are secured to the flanged portion of shaft brackets 18 and 19 by screws 205. The vertical portion of bracket 204 supports the off-normal stackup and shaft restoring member 66.

A shaft restoring member 66 is provided for each select shaft and comprises a flat structure with a V-notched portion arranged to engage shaft positioning rollers 69. Members 66, tensioned against rollers 69 by spring 65 and secured to bracket 204 by off-normal stackup screws 68, position rollers 69 in the V-notched portion. Rollers 69, which are attached to their associated select shafts by studs 70, maintain the unoperated select shafts in their non-selecting position.

The tension of restoring members 66 against positioning rollers 69 is readily adjustable by bending the vertical portion of brackets 204 toward or away from their associated shaft brackets.

Energization of any select magnet will cause the associated select shaft and stud assembly 70 to rotate. Rotation of stud 70 causes rollers 69 to extend member 66 back against the tensioned spring 65 and actuate the off-normal springs 75. Contacts on these springs may be used for pilot purposes to indicate that a select shaft has been moved into a selecting position.

Deenergization of the select magnet will permit the tension of spring 65 against roller 69 to return stud 70 to its center position. This causes the associated select shaft to be returned to its non-selecting position.

IB. Hold magnets and armatures

A hold magnet 80 and associated armature 90 are provided for each vertical row of contact stackups. Hold magnets 80 shown in Fig. 2 are adjustably mounted upon the lower flange of rear frame member 3, below and slightly to the left of their associated stackups. Armatures 90, extending from rear frame members 3 to front frame member 1, are pivotally mounted at each end to permit their rotation to actuate selected stackups of contacts.

The hold magnets are of the same general construction as the hereinbefore described select magnets. The hold magnets are mounted and longitudinally adjusted in the same manner as the noted select magnets.

Mounting tab 93 of armature 90 is pivotally se-

cured to the rear frame member 3 by bearing pin 109 and is pivotally secured to the front frame member 1 by adjustable armature leveling plate assembly 112. As shown in Figs. 1 and 2, bearing screw 206 is threaded through plate 112 to engage armature mounting tab 93 to support and to provide lateral adjustment of armature 90. A slot in the end of bearing screw 206 facilitates this adjustment and lock nut 207 locks the bearing screw in its adjusted position. Plate assembly screw 113 passes through elongated apertures 114 in plate 112 and threads into tapped holes in the face of front frame member 1 to adjustably secure plate 112 to the outside of member 1. Elongated apertures 114 in plate 112 and elongated apertures 111 in the face of the front frame member 1 through which bearing screw 206 passes, permit plate 112 to be raised or lowered to level armature 90. This armature-mounting arrangement serves to properly adjust the clearance under stackup ladder 222 necessary for the selecting levers 220 in assuming their alternate selecting positions. Armature 90 is readily removed by loosening locking nut 207, backing out bearing screw 206, disengaging bearing pin 109 and dropping the armature out of the switch structure.

Armature 90 comprises two principal portions formed integrally with each other; a tractive portion 91 which overlies the upper end of the core of its associated hold magnet and a laterally extending (main) portion which underlies the associated rows of contact stackups. Energization of any hold magnet 80 attracts portion 91 of the associated armature into engagement with the energized magnet, causing armature 90 to rotate about its pivots. A residual clip 117 is provided, as shown in Fig. 3, and attached to tractive portion 91 of armature 90 to eliminate any undesirable residual magnetism.

As previously noted, the front stop position of the armature 90 is regulated by the longitudinal adjustment of the hold magnet. The back stop position of armature 90 is regulated by adjustable back stop screw 115 (shown in Figs. 2 and 4) which is threaded through the upper flanged portion of rear frame member 3 for engagement with the tractive portion 91 of armature 90. Backstop screw 115 is locked into its adjusted position by lock nut 116. Restoring spring 223 shown in Figs. 1 and 3, is secured to backstop bar 225 by screw 224 and is tensioned against armature 90 to retain portion 91 in its normal (unoperated) position against backstop screw 115.

Tab-like portion 101, underlying the associated hold-pilot stackups, serves to actuate the hold-pilot contact sets when the armature is rotated. Tab 101 is upwardly offset so that it lies in the same plane as the top of elevated platform 217 of select lever 220. Armature rotation, therefore, causes the hold-pilot stackup ladder and the selected stackup ladder to be actuated simultaneously.

The laterally extending portion of armature 90 comprises an integrally formed select-lever mounting plate 214 and an elevated plate-like structure 212. Select-lever mounting plate 214 includes six holes 215 for receiving shoulder rivets 216 which pivotally secure select levers 220 to armature 90. Structure 212 includes six recesses 213, the sides of which engage select-lever downwardly extending tab 219 (see Fig. 4) to provide stop positions for select levers 220.

IC. Bank construction

The construction of the contact bank supported on channels 25, to provide the vertical and horizontal rows of selectively operable contact members is as disclosed in the principal embodiment of the former application.

The contact bank, disclosed in this invention, is the modified bank construction of the former application wherein the flexible contact springs are the vertical comb-like conducting strips and the fixed contact members are the horizontal conducting strips.

As seen in Figs. 2 and 4, the stackups comprise six contact pairs instead of the three shown in the modified embodiment of the former application.

ID. Stackup control

As shown in Figs. 2 and 4, a stackup actuating ladder 222 is provided for each stackup of contacts contained in the switch structure. Responding to the rotation of hold-magnet armature 90, stackup-actuating ladder 222, by its upward movement actuates associated contact stackups. Ladder 222, formed from an insulating material, comprises generally a flat elongated structure including forwardly extending step-like lifting portions 236 and 237, a wide portion or shoulder 234 and a reduced downwardly extending portion 235.

Lifting portions 236 and 237 support the downwardly tensioned traveling springs of their associated stackups. The downward tension of the traveling springs causes shoulder portion 234 of ladder 222 to rest on an eyelet type of grommet 227 placed in punched holes in backstop bar 225. Reduced portion 235 extends through grommet 227 to a level, determined by shoulder 234, which permits select levers 220 to be easily positioned beneath it responsive to their associated select shaft rotation. Grommet 227 while preventing abrasive action on the sides and edges of reduced portion 235 also serves as guide holes for the upward and downward movement of ladder 222. The uppermost lifting portion 237 of ladder 222, by an upwardly extending portion, maintains the ladder vertically positioned.

Ladders 222 may be removed by loosening screw 226 and lowering backstop bar 225.

Actuation of any stackup of the contact bank is effected by flexing the traveling springs thereof, upwardly into engagement with their associated fixed contact members. For this purpose, each stackup is provided with an actuating ladder 222, hereinbefore described. Ladder 222 extends through an intermediate portion of the flexible traveling springs of its stackups and its step-like lifting portions 236 and 237 engage the traveling springs, lightly tensioned downwardly.

When ladder 222 is elevated, by energization of the associated hold magnet as hereinafter described, the traveling springs are flexed upwardly until their contact points engage those of the associated fixed contact members. Further upward movement (or over-travel) of ladder 222, after the traveling springs engage the fixed members, causes the traveling spring to bow as the contact pressure is built up. If the previously described armature-leveling adjustment is accurately made, the contact pressure resulting from the desired slight over-travel is the same for all stackups in a vertical row. The extent of the over-travel is determined by the hereinbefore-noted longitudinal adjustment of the hold magnet.

When the energized hold magnet is released,

the tension of the traveling springs against the lifting portion of actuating ladder 222 is great enough to return the ladder to its resting position against grommet 227.

The hold-pilot stackups are assumed to be as disclosed in the former application. The hold-pilot stackup actuating ladder is of the same general construction as actuating ladder 222, one exception being that the hold-pilot ladder is of a shorter length. Rotation of hold-magnet armature 90 causes upwardly extending tab 101 to elevate the hold-pilot stackup ladder thereby actuating the associated contact sets.

IE. Selecting mechanism

In every vertical row of contact stackups, a pair of stackups are associated with each select shaft. A selecting lever 220 is associated with each such pair of contact stackups and when in its normal (unoperated) condition, occupies a position midway between and below the associated pair of stackups. Figs. 2 and 4 represent a front view of levers 220 and show the relationship existing between the levers and stackup ladder 222. A top view of the levers in their normal position are shown in Fig. 1.

Referring particularly to Fig. 3, one such select lever 220 is shown to comprise generally a T-shaped structure lying in a horizontal plane. Select levers 220, formed from sheet metal, and pivotally secured to armature portion 214 by shoulder rivet 216, has two raised platforms 217 and a downwardly extending tab 219 (see Fig. 4). The portion of select lever 220 containing elevated platforms 217 is raised to a level whereby it rests flatly on raised armature portion 212.

When the select lever is positioned beneath the selected stackup by rotation of its associated select shaft provided the hold-magnet armature is in its normal unoperated position, raised platforms 217 are positioned underlying the associated stackup ladder 222.

The downwardly extending tab 219, shown in Figs. 3 and 4, lies within recessed portion 213 (see Fig. 1) and is flanged so as to underlie the hold-magnet armature portion 212 to prevent any upward movement of the select lever unless accompanied by its associated armature 90. When the select lever is moved in either direction for its selecting action, tab 219 in engaging the sides of recesses 213 provide stop positions so that the select levers properly underlies its associated selected stackup.

Each selecting lever is moved from its normal position to its front or rear selecting positions by the positive action of a finger spring 130 acting in response to the select shaft rotation. As viewed from the left end of the switch illustrated in Fig. 1, rotation of the select shafts in a clockwise direction moves the associated select levers 220 to their front-selecting position and counter-clockwise rotation of the shaft moves the select levers to their rear-selecting position. The finger spring 130 as shown in Fig. 3, comprises generally a vertically extending hairpin-shaped member constructed of a single piece of spring material shaped to form a loop 131 at one end and having two vertically extending driving arms 132 terminating in outwardly turned end portions 133.

Arms 132, engaging select lever 220 at its mid-portion 218, serves as a yielding drive means effective to drive the associated select lever, unless restrained, into one of its three positions (the illustrated position, its front select position, 75

and its rear select position) in response to the rotation of its selecting shaft in the corresponding direction.

Arms 132 are driven by neck portion 233 of finger guide 230, against which they are inwardly tensioned. These arms are contained within guide channels 228 and 229. Either finger 132 moves along its guide channel, away from neck portion 233, incidental to its select lever being restrained from following the rotation of the shaft.

Loop portion 131 of spring 130 rests upon the top surface of curved finger-guide mounting 232 and is retained in position by tabs 231. Accordingly, the matched tension of the driving arms 132 provides for a following action of one arm when the other arm is driven, wherefore both arms act as one long spring.

Finger guide 23 is secured to its associated select shaft by mounting structure 232. Finger-guide mounting 232 is a curved structure conforming to the contour of the select shafts and is secured, as by welding, to its associated select shafts.

II. OPERATION

IIA. Select magnet operation

Selection of the first horizontal row of contact stackups occurs responsive to the energization of select magnet M1 (Figs. 1 and 2). The underlying armature portion is attracted upwardly into engagement with the core of select magnet M1 causing select shaft S1-2, viewed from its armature end, to rotate in a clockwise direction. Thereupon, select finger guides 230 of shaft S1-2, one for each vertical row of stackups, are moved to a position underlying horizontal row 1. At each idle vertical row of stackups (hold-magnet armature 90 being in its unoperated position) select-finger guides 230 cause select-finger springs 130 to rotate the associated select lever 220 about its pivot (shoulder rivet 216) toward an effective position below the first horizontal row of stackups. The front elevated platform 217 of select lever 220, as viewed in Fig. 1, is brought effectively beneath reduced portion 235 of its associated stackup ladder 222 in the first horizontal row. The first stackup is thereby selected in each idle vertical row in the switch.

The completion of the rotation of select shafts preferably occurs just as the downwardly extending tab 219 of any select lever 220 is about to strike the side or stop position of recesses 213. The select shafts may be arranged, by the previously described longitudinal adjustment of the select-magnet cores, to rotate through a slightly larger angle than is required for the select levers 220 to reach the noted stop position. This excess shaft rotation, insuring that all the select levers are rotated a sufficient amount, is permitted by virtue of the inherent flexibility of the described select finger springs 130. The driving arms 132 merely yield as soon as tab 219 engages its stop position in recesses 213.

If any vertical row of the switch is in use when the selective action just described occurs, the raised condition of armature 90 causes front raised platform 217 to strike the sides of its associated stackup ladder 222. This action prevents select levers 220 from reaching their selecting positions but does not interfere with the full stroke of the select shaft as the concerned driving arms 132 merely flex as the select shaft completes its movement.

Selection of any horizontal row of contact

stackups is accomplished by the energization of the select magnet associated with the desired row.

II.B. Hold magnet operation

Following the previously described selecting action of horizontal row 1 and while the concerned select magnet M1 is maintained energized, the hold magnet 80 associated with any idle vertical row of contact stackup is energized. Tractive portion 91 of hold magnet armature 90 is attracted downwardly into engagement with the core of hold magnet 80, rotating armature 90 about its pivotally mounting arrangement previously described. This rotating action raises portion 212 of armature 90 with all its selecting levers 220. Each such lever passes ineffectively between the associated reduced portion 235 of stackup ladder 222, except in the case of the selected first stackup of the vertical row associated with the energized hold magnet 80. Select lever portion 217 engages the reduced portion 235 of ladder 222 associated with the noted first stackup and raises ladder 222 causing it to upwardly carry its associated stackup traveling springs.

When the armature stroke is only partially completed, the traveling springs of the noted first stackup engage their associated fixed contact members. The final portion of the movement of the armature 90 causes the traveling springs to bow as contact pressure increases as hereinbefore described. The hold magnet 80 is maintained energized as long as the connection established is to remain intact.

II.C. Select magnet release

The energized select magnet, after the operation of the desired hold magnet, may be deenergized immediately. When this occurs, the cam springs 65 and cam member 66 associated with roller stud 70 attached to the select shaft, return the associated select shaft to its normal unoperated position.

When the selecting shaft used in selecting a particular horizontal row of stackups is returned to its unoperated position, the selecting levers 220 associated with the unoperated hold-magnet armatures are returned to their normal positions, but the lever 220 associated with the operated armature 90 is retained in its selecting position by the downward pressure exerted on it by the traveling springs of the actuated stackup. The rear driving arm 132 of the concerned finger spring 130 remains in its selecting position and flexes as the select shaft is returned to its normal position, while the front driving arm 132 returns with the shaft.

II.D. Hold magnet release

The energized hold magnet associated with an established connection is deenergized when the connection is released. Armature 90, therefore, rotates back to its normal position by virtue of the downwardly exerted pressure of armature-restoring spring 223. The tension of the traveling springs in the operated stackup assist in the initial portion of the return movement.

When the armature portion 212 is lowered, the select lever 220 is released from the ladder 222, whereupon the spring action of the rear driving arm 132 of finger spring 130, exerted against the midportion 218 of select lever 220, causes the select lever to realign itself with finger spring 130 of its associated shaft in its normal position as shown in Figs. 1 and 3.

I claim:

1. In a crossbar switch employing stackups of contact members, select levers for respective pairs of said stackups, an underlying common actuating plate movable toward the stackups for actuating any desired one subject to the associated select lever having been interposed between the actuating plate and such stackup, each select lever comprising a single member in the general form of an elongated sheet of thin material, each lever having an opening therethrough at one end adapting it to be pivoted on the upper side of the actuating plate and to rotate edgewise in either direction from a position intermediate the stackups of its associated pair to a position operatively below either desired one, said lever including a tab extending downwardly from and then parallel to the main portion of the lever to provide opposed surfaces for guiding the movement thereof, said plate being slotted below the downwardly extending portion of any tab to receive such portion, the said parallelly extending portion of any tab extending beyond the edge of the slot to guidingly underlie the under surface of the actuating plate.

2. In combination in a crossbar switch, an elongated actuating plate consisting of a single plate-like member pivoted at its ends for rotation about an axis lying near its rear edge, such rotation being between a released position and an actuated position for any selected one of an overlying row of stackups of contact members, select levers for respective ones of said stackups, such levers extending across the plate and comprising a row extending along it, means pivoting each select lever on the plate for rotation about an axis extending through the plate near the rear edge thereof for rotation in the plane of the plate between a non-select position and a select position underlying the associated one of said stackups, said actuating plate having openings therethrough underlying the select levers, and lever-control means extending through said openings into effective engagement with said levers respectively to rotate them as desired between their respective said positions.

3. In combination in a crossbar switch, an elongated actuating plate consisting of a single plate-like member pivoted at its ends for rotation about an axis lying near its rear edge, such rotation being between a released position and an actuated position for any selected one of an overlying row of stackups of contact members, select levers for respective ones of said stackups, such levers extending across the plate and comprising a row extending along it, means pivoting each select lever on the plate for rotation about an axis extending through the plate near the rear edge thereof for rotation in the plane of the plate between a non-select position and a select position underlying the associated one of said stackups, said actuating plate having openings therethrough underlying the select levers, lever-control means extending through said openings into effective engagement with said levers respectively to rotate them as desired between their respective said positions, and guide means attached to the respective levers, the guide means for any lever extending through the associated one of said openings into association with the under surface of the front part of the plate to limit upward displacement of the lever incidental to the said rotation thereof.

4. In a crossbar switch, a mounting frame in-

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cluding end members and longitudinal front and rear members secured together, cross members extending between said front and rear members and supported thereon, a contact bank supported on said cross members, said bank including contact members comprising actuatable stackups disposed in rows extending across the frame, actuating bars and means pivotally supporting them between said longitudinal members in operative relationship with said rows respectively, said supporting means for any said bar including a bearing plate adjustably mounted on one of said longitudinal members for movement toward and away from the contact bank to shift one pivot point of any actuating bar with respect to the said contact bank, and means adjustably

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mounted on the said bearing plates respectively for movement toward and away from the opposed longitudinal member to regulate end play at the associated one of said actuating bars.

RICHARD P. ARTHUR.

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