

Aug. 17, 1948.

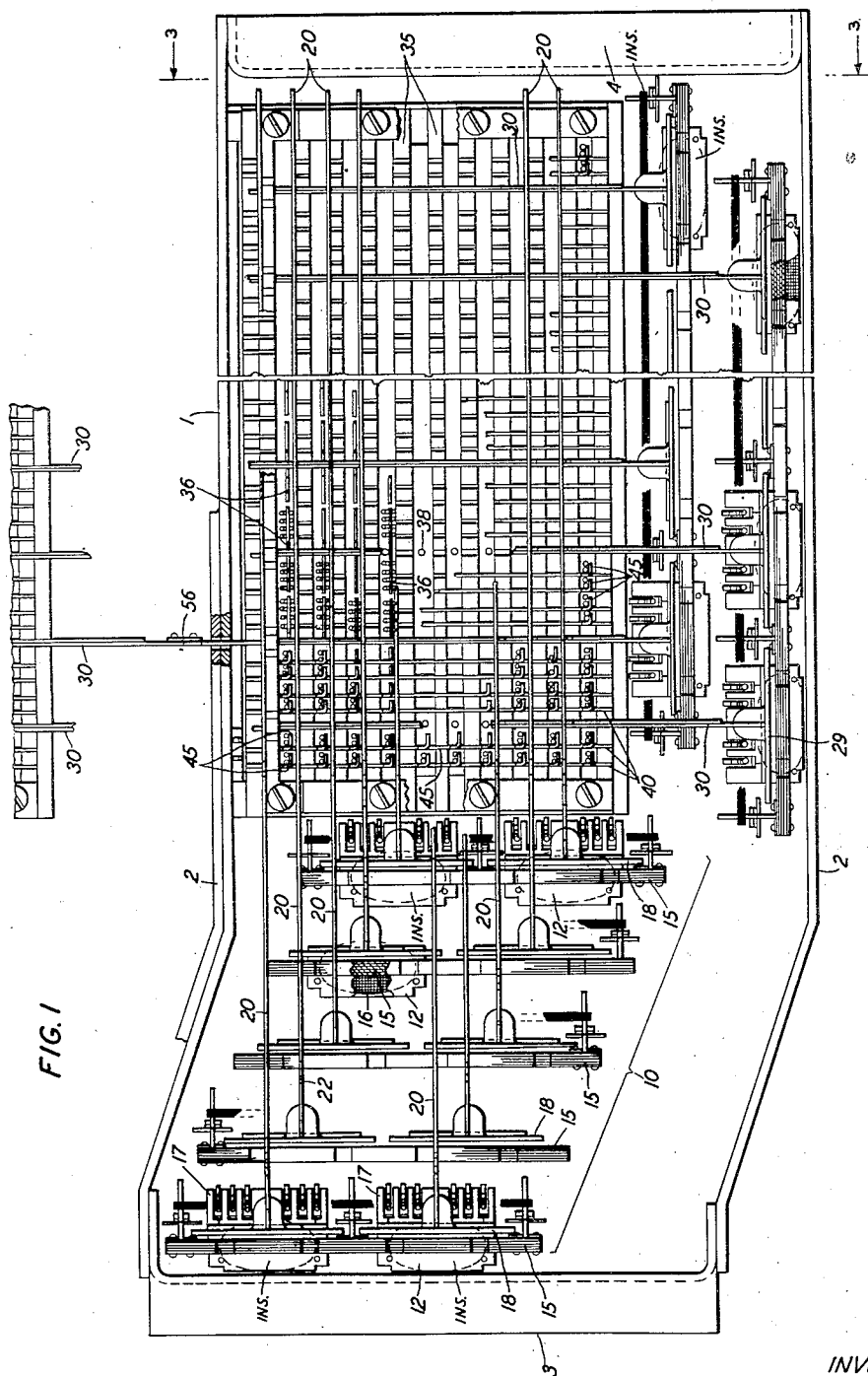
H. C. HARRISON

2,447,010

CROSSBAR SWITCH

Filed Aug. 28, 1946

4 Sheets-Sheet 1



INVENTOR
H. C. HARRISON
BY
P. C. Smith

ATTORNEY

Aug. 17, 1948.

H. C. HARRISON

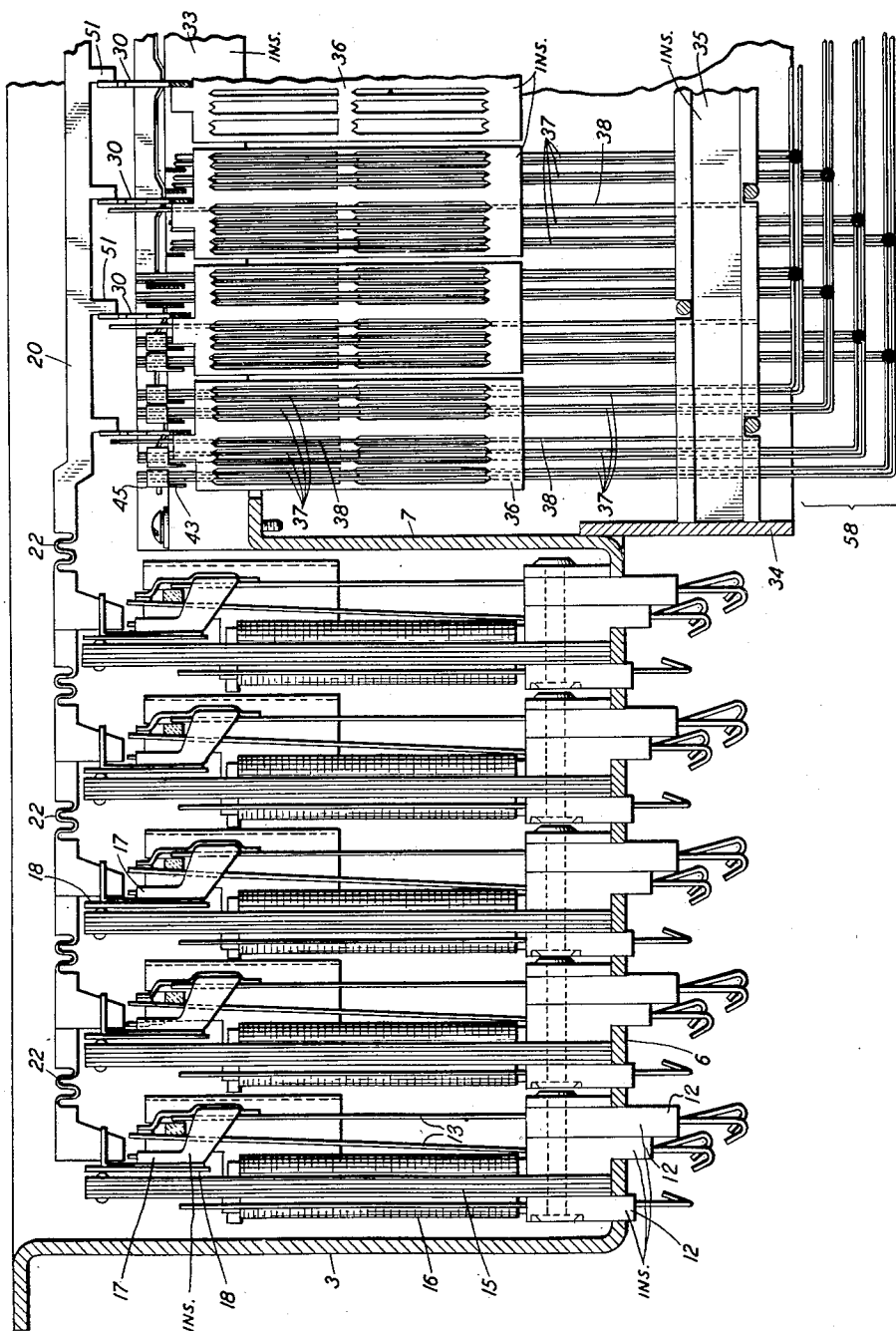
2,447,010

CROSSBAR SWITCH

Filed Aug. 28, 1946

4 Sheets-Sheet 2

FIG. 2



INVENTOR
H. C. HARRISON
BY
P. C. Smith
ATTORNEY

Aug. 17, 1948.

H. C. HARRISON

2,447,010

CROSSBAR SWITCH

Filed Aug. 28, 1946

4 Sheets-Sheet 3

FIG. 3

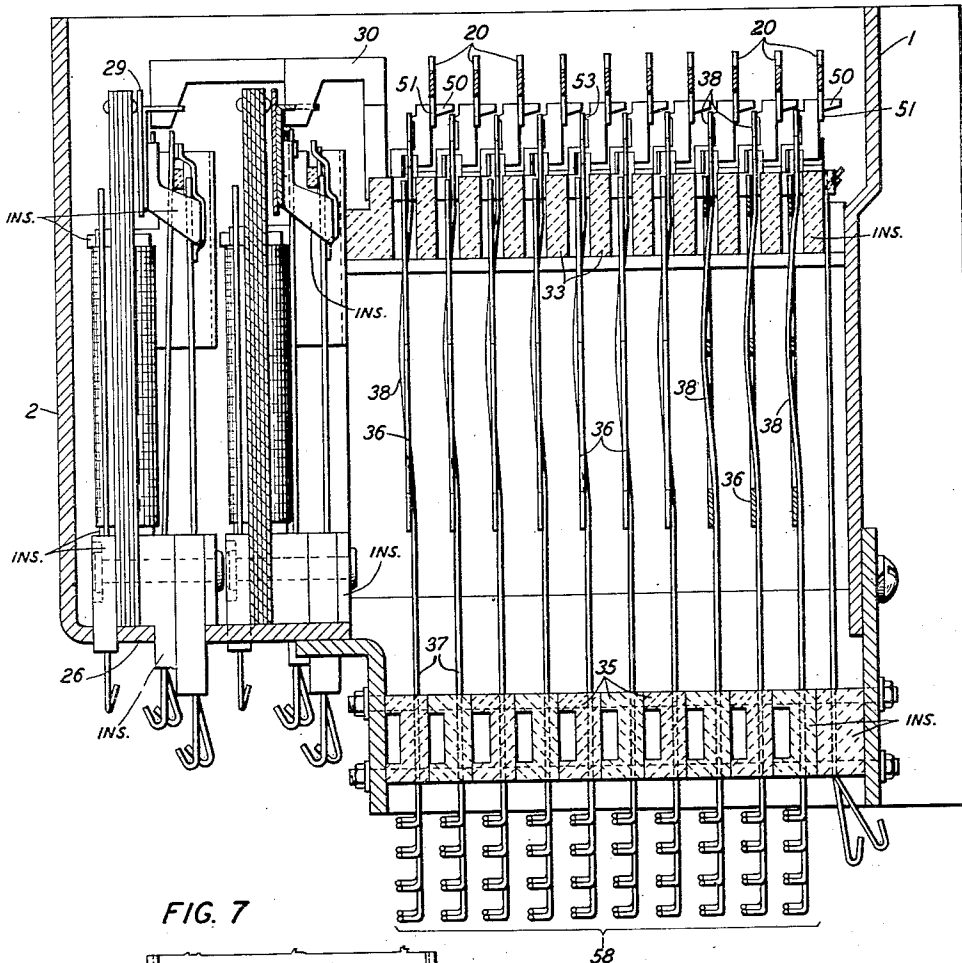
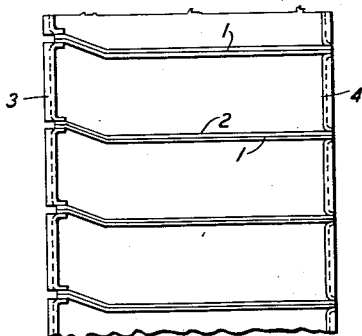


FIG. 7



INVENTOR
H. C. HARRISON
BY
P. C. Smith
ATTORNEY

Aug. 17, 1948.

H. C. HARRISON
CROSSBAR SWITCH

2,447,010

Filed Aug. 28, 1946

4 Sheets-Sheet 4

FIG. 6

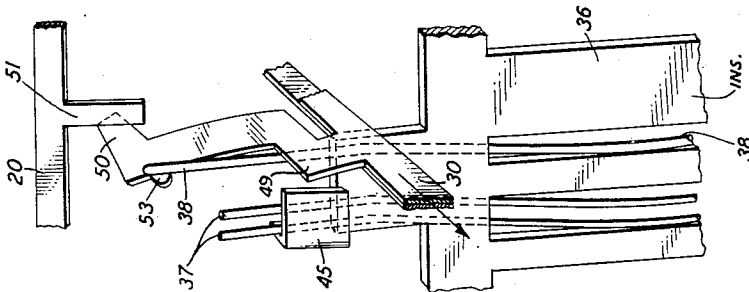


FIG. 5

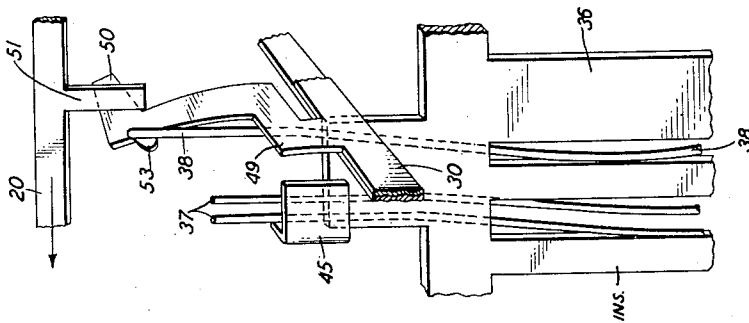
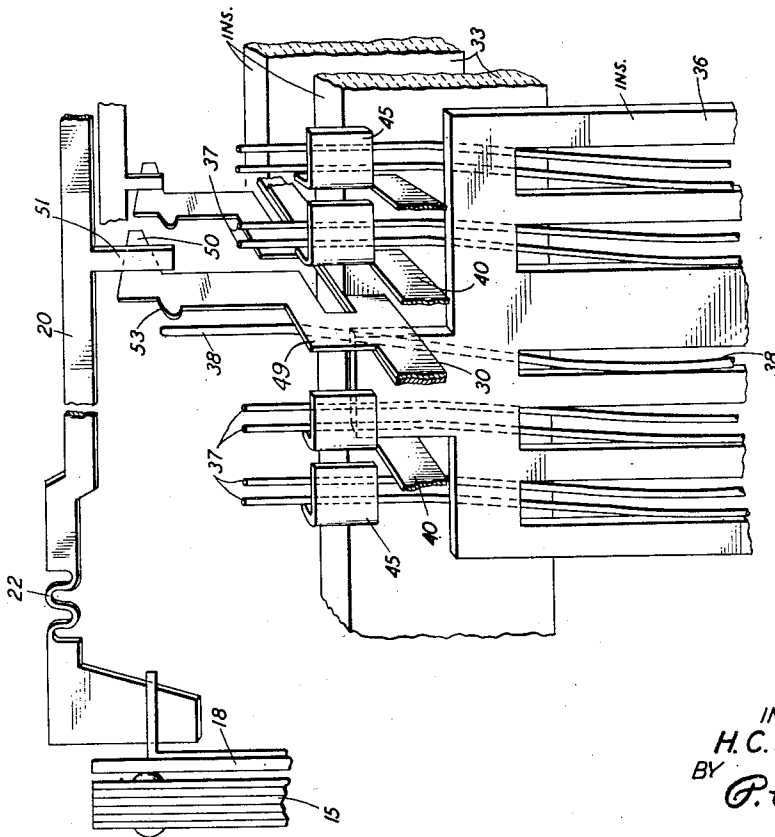


FIG. 4



INVENTOR
H. C. HARRISON
BY *P. C. Smith*
ATTORNEY

UNITED STATES PATENT OFFICE

2,447,010

CROSSBAR SWITCH

Henry C. Harrison, Port Washington, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application August 28, 1946, Serial No. 693,594

4 Claims. (Cl. 179—27.54)

1

This invention relates to switching mechanisms and particularly to improvements in cross bar switching connectors employed in telephone systems for establishing electrical connections.

An object is to simplify and reduce the size and weight of cross bar switch structures and improve the operating characteristics thereof.

Another object is to so construct the individual switches that a plurality thereof can be coupled together and with a number of the individual parts of the switches eliminated.

Heretofore cross bar switching mechanisms have been used in which coordinate contacting members were controlled for selection at intersecting points to establish electrical connections by means of longitudinally movable horizontal and vertical intersecting control bars or tapes.

The present invention relates to cross bar switches of this general type and particularly to improvements in switches of this type as disclosed in my Patent 2,362,551 of November 14, 1944.

The various features of this improved switching arrangement in accordance with the present invention are concerned primarily with a simplified arrangement of contact springs and contact wires and their cooperation, the arrangement of molded insulation strips, the arrangement of operating cards and other parts to reduce still further the over-all size and weight of cross bar switch structures and to simplify the assembling and improving the operating characteristics.

Another feature relates to a new arrangement of the parts so that the switch structures of a group may be coupled together and whereby all holding magnets operating hold bars, except those for the first switch in the group, may be eliminated.

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

Fig. 1 shows a front view of the switch structure arranged in accordance with the applicant's invention;

Fig. 2 discloses a portion of the switch shown in Fig. 1 looking from the side thereof;

Fig. 3 is a cross-section taken on line 3—3 of Fig. 1;

Figs. 4, 5 and 6 show enlarged perspective views of the operating parts at a cross-point where connections are established between contact springs and in various positions; and

Fig. 7 shows one general arrangement of assembling a group of the cross bar switches shown in Fig. 1.

Referring now to the drawing, and particularly

2

to Figs. 1, 2 and 3, a general description will be made of the various parts thereof. The switching device is provided with a frame consisting of a top member 1, a bottom member 2, a left-hand member 3 and a right-hand member 4 welded together. The left-hand member 3 extends at right angles towards the rear as shown at 6, and then forward as shown at 7 to form a U-shaped member and to which a series of magnet structures, ten in number, are connected, as shown in general at 10 in Fig. 1. The laminated core 15 of each of these magnets is secured to the member 6 by a screw, not shown, and has secured thereto near its point of attachment to the member 6, three blocks 12 of insulating material into which are molded the coil terminal leads and the two sets of off-normal springs 13. The energizing coil 16 surrounds one leg of the core 15. To one of these off-normal contact springs is connected an insulating block 17 on which an armature 18 is attached near the front end of core 15 for the operation of the contacts and for operating the individual select bar, such as 20. Each bar 20 is in the form of flat flexible tape and is cut down as at 22 and folded back upon itself to provide a means for adjusting the length of the tape between the armature and the first set of cross-point contacts. These tapes 20 extend in front of the switch over the field of switch contact springs and wires.

At the bottom of the switch there is mounted on an extension 26 of the lower frame member 2 similar magnet structures, which may be ten or more in number, and which are of the same construction as the magnets for the select tapes. To these armatures, such as 29, are connected the vertical hold bars 30 and which are located in front of the switch contact field. These hold bars are also in the form of narrow flat tapes. Between the extension 7 of the left-hand side member 3 and the right-hand side member 4 are mounted horizontally positioned insulation plates 33 and on the extension 7 at the rear is mounted an additional metal member 34. Between this member and the side member 4 are mounted other horizontal insulation plates 35. In each of these insulation plates 35 is mounted a horizontal row of contact spring wires 37 in the form of pairs of wires extending forwardly between corresponding insulation plates 33. These wires are divided into groups of four pairs of wires each at each cross-point of the select tapes and the holding tapes, and the wires are threaded in and out through openings in an operating card individual to the group, such as 36. Associated with each operating card is an operating spring 38 similarly

threaded in and out through openings in the card and embedded in a rear insulation horizontal bar 35. Associated with each corresponding group of four pairs of wires at each cross-point and running in the vertical direction is a contact member, that is, there is one contact member for each vertical row of pairs of wires, four such vertical contact members being associated with each hold tape. The first row of such vertical contact members or springs is marked 40. These vertical contact springs supported in slots in the horizontal insulating plates 33 as shown in Fig. 2 at 43, for example, and are provided near the front of the structure with angular extensions such as 45 for engagement with the corresponding pairs of contact wires as is clearly indicated in Figs. 4, 5 and 6. The distance between the horizontal insulation plates 33 and the corresponding plates 35 is only sufficient to permit the passage of the horizontal rows of pairs of contact wires and associated operating cards and to permit a slight movement thereof to make contact with the vertical contact springs and the distance between the groups of four pairs of contact wires is reduced to a minimum. This is possible due to the fact that the magnets for operating the select tapes are staggered as in the above-mentioned patent in five groups. The hold magnets are also staggered in two groups of five each to save space in the horizontal direction. As the select tapes, contact wires and contact strips are thin, flexible and light, the weight of this mechanism has been considerably reduced.

The arrangement for operating the cards to establish connections at the cross-points between pairs of contact springs and the associated contact springs will now be described by reference particularly to Figs. 4, 5 and 6. Fig. 4 shows an operating card 36 with its associated four pairs of contact wires 37 and the operating finger 38 with a select bar 29 and a hold bar 30. As noted, the hold bars are slidably mounted in transverse slots in the insulation plates 33 and are provided with a forwardly extending projection 49 at each cross-point. This projection in turn has an angular extension 50 which is located in proximity to a corresponding projection 51 on a select bar. The hold bars may be constructed from a comparatively stiff ribbon or strip with a flexible attachment having the projections 49 extending therefrom. Normally the operating pin 38 for each card 36 rests against the insulation plate 33 on the upper side of the opening through which the card 36 and the operating finger 38 project. This locates the card 36 with its four pairs of contact wires a proper distance away from the projections 45 on the vertical contact strips to regulate the contact gap between these members. When, therefore, an armature 18 and the associated select bar 20 are operated, the projections 51 will engage the corresponding extensions 50 on the hold bars 30 and bend the projections 49 towards the left as shown in Fig. 5, so that the knobs 53 on the projections 49 will be located on the opposite side of the operating fingers 38 at the associated cross-points, as shown in this Fig. 5. Then if a hold bar is operated forwardly as shown in Fig. 6 the corresponding operating finger 38 will be caught or engaged between the knob 53 and the middle part of the projection 49 at this cross-point and moved forward. Thus the associated card 36 will be moved in the same direction and cause the four pairs of contact wires 37 to engage the associated corresponding projections 45 on the vertical contact strips. The

knob 53 and member 49 will now hold the established connection at this cross-point while the select bar 20 may be released. When hold bar 30 is released the knob 53 will slip off the pin 38 and permit the card and pin to return to normal and the connection is at this cross-point opened. It should be observed that this movement of the card 36 to establish a connection may be exceedingly small and the distance between the plates 33 may therefore be correspondingly narrow so that the space occupied by the plates, cards and contact wires is reduced to the minimum. With this construction the cross bar switch unit will therefore be still further reduced in size and weight than that disclosed by the above-mentioned patent and as the various parts consist of very thin strips and small size wires and narrow insulation plates and of simple shapes the manufacturing cost of the parts is small.

If it is desired to combine a number of these cross bar switch units into a series or pile, as shown in Fig. 7 in general, the units may be piled on top of each other with the bottom frame member 2 of one unit resting against the top frame member 1 of a lower unit. When such a pile-up or combination of switches is made the operating or hold magnets 20 and associated parts will be removed from all but the lower switch unit and the corresponding hold bars of the succeeding switches connected together by means of a simple strap 56 as shown in Fig. 1 for one of these vertical hold bars. This makes the assembling of switches in larger groups exceedingly simple and considerable saving in the use of hold magnets is effected and in addition there is no waste space between the switch units. If it is desired to interconnect the corresponding pairs of wires from cross-points in these horizontal rows they may be welded or soldered together in the manner disclosed at 53 in Fig. 2. It should also be noted in this figure that the off-normal contacts 13 and the terminals for the individual coils 16 which extend towards the rear of the structure are bent so as to permit interconnection or assembling to outside wiring with sufficient room between the terminals to prevent short-circuiting and easy accessibility for soldering such wiring to the terminals.

The switch units need not necessarily be assembled one above another as disclosed in Fig. 7 but may be assembled with the member 1 of one unit adjacent member 2 of the next unit and with all units supported on either their end members 3 or 4 or the assembly of units could be positioned so that all of the select tapes 20 tie in the same horizontal plane. If possible, the assembly should be mounted in such a manner that there will be a minimum collection of dust on contact surfaces.

What is claimed is:

1. In a cross bar switch for establishing connections, coordinately arranged cross bars in which each hold bar comprises a stiff strip, located vertically and a flexible attachment thereto having a projection at each cross-point while each select bar comprises a stiff strip located horizontally and having a projection at each cross-point, vertical contact strips running parallel to the hold bars and each having an angular projection at each cross-point serving as contact points, and arranged in sets, each set associated with a particular hold bar, sets of contact wires in pairs each pair serving as a single contact point for a corresponding projection on a contact strip, horizontally located

5

insulation strips, one of said insulation strips being provided for each horizontal row of cross-points, said vertical contact strips being supported in transverse slots in said insulation strips, while the hold bars are slidably movable in transverse slots in said insulation strips, insulation strips each running parallel with and located behind and in the same horizontal plane with a corresponding first-mentioned insulation strip and in each of which is molded a corresponding horizontal row of said contact wires, an operating finger for each set of contact wires at each cross-point molded in the corresponding last-mentioned insulation strips, an insulation card at each cross-point in which the corresponding sets of contact wires and finger are threaded, each said set of contact wires and finger being tensioned to cause said finger to rest against a corresponding first-mentioned insulation strip so that said contact wires maintain a fixed contact gap between them and the associated projections on the associated vertical contact strips, an armature yieldably connected to one end of each select bar, select magnets for attracting corresponding armatures to shift the associated select bars longitudinally, said select magnets being located in staggered relation so that the select bars may be separated only as required for the free movement of the cards transversely between two adjacent horizontal insulation strips, an armature yieldably connected to one end of each hold bar, hold magnets for attracting corresponding hold bars to shift them longitudinally, said hold magnets being located in staggered relation so that the hold bars may be located as close together as is merely required by the cards which are wide enough only to accommodate the associated sets of contact wires and rods mounted thereon plus a reasonable space between the cards for easy operation and a housing for mounting said insulation strips, magnets and bars, said select bars being arranged to have their projections engage associated flexible projections on all hold bars to a position where when a hold bar is shifted the flexed projection thereon will engage the associated finger and cause said finger to shift the associated card and contact wires to engage associated extensions on the associated contact strips to establish connections at the corresponding cross-point.

2. In a cross bar switch for establishing electrical connections, coordinately arranged cross bars in which the hold bars are provided with a flexible extension at each cross-point while the select bars are provided with an extension finger at each cross-point, contact sets running parallel to the hold bars, sets of contact wires at each cross-point engageable with the associated contact strips and arranged in rows running parallel with the select bars, an operating finger associated with each set of contact wires, molded plastic strips running between each row of said contact wires and in which said contact strips are supported and in which the hold bars are slidable longitudinally, molded plastic strips in each of which is embedded a corresponding row of contact wires and the associated fingers, plastic cards to each of which is secured a corresponding set of contact wires and the associated finger, said cards for each said row of contact wires and fingers being located between said first-mentioned corresponding plastic strips, a select magnet for shifting each select bar, a

6

hold magnet for shifting each hold bar, said fingers and contact wires being so located in relation to the contact strips and to the cross bars that on the operation of a select bar followed by the operation of a hold bar, the projections on this operated select bar flex the associated projections on the hold bars and the flexed projection on this operated hold bar shifts the finger and card at the corresponding cross-point for connecting the associated contact wires with the corresponding contact strips to establish connections at said cross-point.

3. In a cross bar switch for establishing electrical connections, coordinately arranged cross bars in which the hold bars are provided with a flexible extension at each cross-point and the select bars are provided with a finger at each cross-point, a series of plastic strips each lying parallel with and below a corresponding select bar, contact strips lying in groups below the select bars and each group in parallel relation to a corresponding hold bar and securely fixed in said plastic strips, while the hold bars are slidably mounted in slots in said plastic strips, a plastic strip lying parallel with and some distance below each of said first-mentioned plastic strips, a set of pairs of contact wires and an operating finger secured to said last-mentioned plastic strips at each cross-point and extending upwardly between and above the first-mentioned plastic strip with each pair of wires in position to contact with a corresponding contact strip, a plastic card for each set of contact wires and its associated finger and on which said wires and pin are secured with each card extending from near the base of said wires and finger upwardly to slightly below the associated contact strips and hold bars, a select magnet for slidably moving each select bar, a hold magnet for slidably moving each hold bar, said flexible extensions on the hold bars being located so that when a select bar is moved the fingers thereon flex the associated flexible extensions on the hold bars and when a hold bar is moved, the flexed extension thereon engages the associated operating finger to move the associated card and contact wires so that said contact wires engage the associated contact strips to establish electrical connections.

4. A plurality of cross bar switches, each switch comprising an equal number of coordinately arranged cross bars in which each hold bar comprises a stiff rib with a flexible extension at each cross-point and in which each select bar comprises a stiff rib with a non-flexible finger at each cross-point, a series of contact strips, divided in groups, each group located in parallel relation to an associated hold bar, a series of plastic strips each located in parallel relation to a corresponding select bar and in which the contact strips are supported and in which the hold bars are slidably movable in slots, pairs of contact wires at each cross-point located perpendicular to the contact strips with each pair associated with a particular contact strip for the establishing of a connection therewith, plastic strips located below the above-mentioned plastic strips and in which said contact wires are embedded, an operating finger associated with each group of pairs of wires at each cross-point embedded in said last-mentioned strips, a card for each group of pairs of wires at a cross-point and to which said wires and fingers are attached, a housing for each said cross bar switch, said housings being located side by side so that the

7

corresponding hold bar ribs of the succeeding switches are located end to end, a connecting means between corresponding hold bar ribs in said succeeding switches, a select magnet for slidably moving each select bar of said switches, a hold magnet for each group of connected hold bar ribs for slidably moving said connecting ribs as a unit, said flexible extensions on the hold bars in said switch being so located in relation to the associated fingers on the select bars that on the

8

movement of a select bar in any switch, the fingers on the select bar flex the associated extensions on the associated hold bars and on the movement of a particular group of connected hold bar ribs, the flexed extension thereon in the corresponding switch engages the corresponding operating finger and causes the card attached thereto to move the associated wires to connect with the corresponding contact strips.

HENRY C. HARRISON.