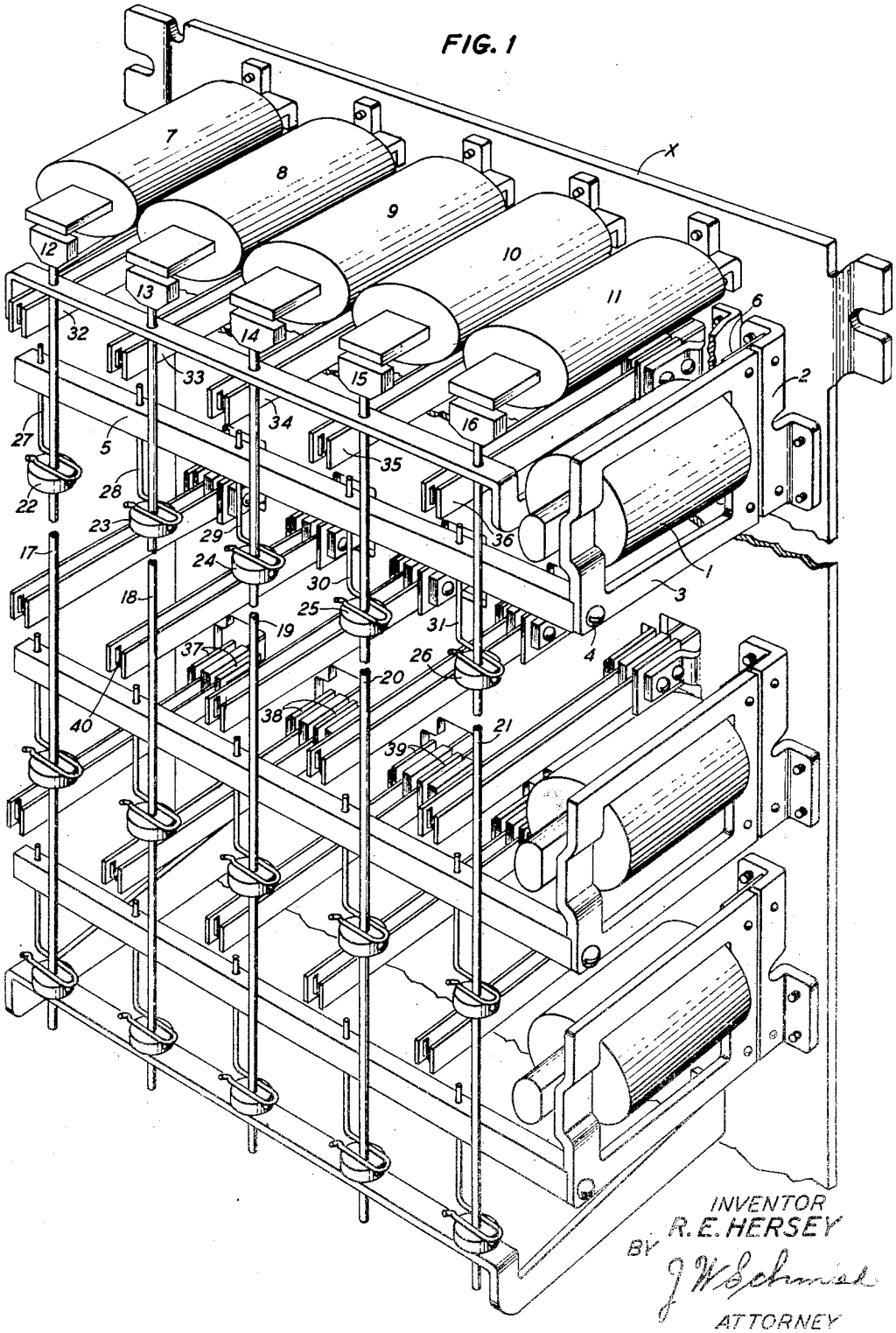
July 22, 1952 R. E. HERSEY 2,604,542

CROSS-POINT SWITCHING MECHANISM

Filed Sept. 1, 1948 2 SHEETS—SHEET 1

FIG. 1



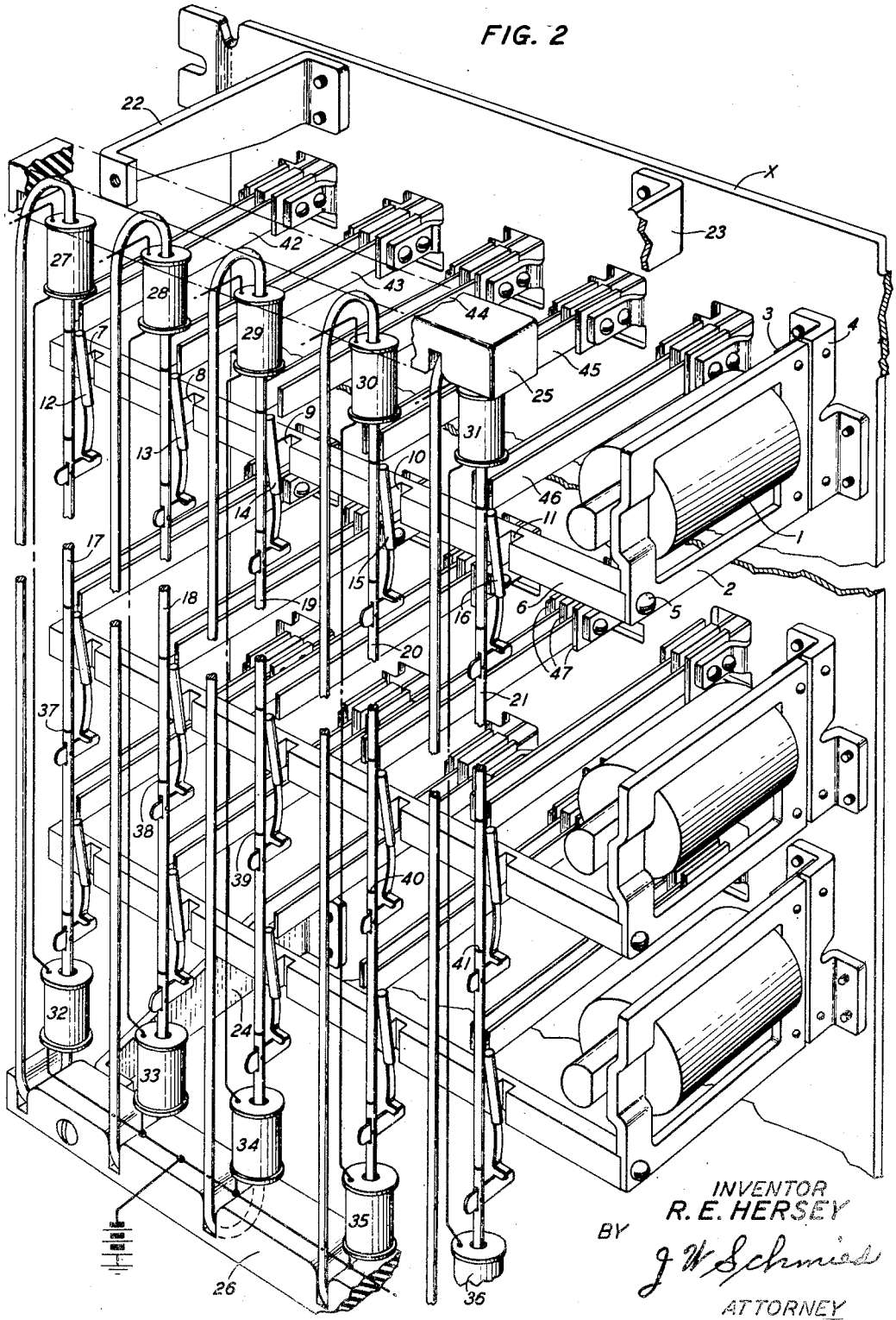
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CROSS-POINT SWITCHING MECHANISM

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FIG. 2



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CROSS-POINT SWITCHING MECHANISM

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4 Claims. (Cl. 179—27.54)

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This invention relates to selective switching mechanisms and more specifically to switching mechanisms of the cross bar type as employed in telephone communication systems.

An object of this invention is to improve the operating efficiency of this type switch and to simplify the operating elements so as to facilitate manufacture and assembly of the switch and reduce maintenance cost.

Various kinds of cross bar switches have been designed heretofore. Many of them work on the principle of selecting and longitudinally moving one bar of one coordinate set of bars and then selecting and longitudinally moving one bar of another coordinate set of bars. Two or more contacts at the intersection of these two bars are operated usually by a rigid finger which is anchored at one end in such a manner as to allow universal movement; said movement being caused by the conjoint operation of the aforementioned cross bars. In other types of cross bars flexible fingers are utilized at the cross-points rather than the rigid fingers.

One embodiment of this invention features a rigid finger moved first by one coordinate bar to cause the springs at the intersection of the two bars to make contact. The rigid finger at one end protrudes through a hole in the horizontal cross bar as shown in the drawing. Since the hole in the horizontal cross bar has a larger diameter than the rigid finger, the rigid finger can move freely in a vertical direction in the hole. This vertical movement is caused by the longitudinal movement of the vertical cross bars as shown in the drawing. The other end of the rigid finger has been formed into a slotted loop in such a manner that the finger can move in a direction transverse to the vertical cross bar, which fits into the slotted loop and guides the motion of the finger. As the finger moves transversely it moves one or more of the springs and establishes an electrical connection or connections within that set of springs.

The abovementioned feature of this embodiment of the invention illustrates the simplicity of construction which allows ease of assembly and maintenance, as well as a low cost of manufacturing. Also this construction has the advantage that the fingers are free from flexibility and will not vibrate as a connection is broken. Since the diameter of the fingers is of little importance, they can be made of relatively heavy, durable stock. A relatively heavy construction of the finger will decrease the possibility of it becoming bent or distorted and thus will decrease the possibility of faulty operation.

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In another embodiment of the invention, the finger is mounted at one end in a slot in the vertical bar in such a manner that the finger can pivot in a plane substantially normal to the plane formed by the vertical coordinate set of cross bars. The finger is made to pivot into a slot provided therefor in the horizontal cross bar, said horizontal cross bar being designed to move longitudinally so that once the finger has been positioned in the slot of the horizontal cross bar and the horizontal bar has been actuated, the finger comes into contact with one of the springs and establishes a contact between the springs. The vertical cross bar comprises a flux conducting metallic loop which is positioned substantially at a right angle to the horizontal cross bar. Around one segment of the loop are placed coils which magnetize the loop. As the loop is spaced with flux insulating material at regular distance intervals, there is created a series of electromagnets. Adjacent to each electromagnet is a finger. This finger is a permanent magnet, the polarities of which are so arranged that the poles of the permanent magnet finger and the poles of the corresponding electromagnet of the vertical loop are similarly arranged with respect to each other, i. e., north pole to north pole and south pole to south pole. The result is that when the loop is magnetized the permanent magnet finger is repulsed into the corresponding slot in the horizontal cross bar. When the loop has been demagnetized and the horizontal cross bar has assumed its normal position, the permanent magnet finger will be magnetically attracted out of the slot and back to the loop.

This construction also has the advantage of being simple, thus providing for ease of manufacture and simplicity of operation and maintenance.

The two embodiments of this invention illustrate how either magnetic or mechanical means can be utilized to set the actuating finger against the spring.

The foregoing and other features of the invention will be discussed in greater detail in the following specifications.

Referring to the drawings:

Fig. 1 shows a perspective drawing of the first mentioned embodiment of the invention. For the sake of clarity only a few of the intersecting operating bars are shown.

Fig. 2 shows a perspective drawings of the second-mentioned embodiment of the invention. Again only a few of the intersecting operating bars are shown.

Referring now to Fig. 1 the frame structure

for the switch comprises a metal plate X onto which is fastened hold magnet such as 1 and the base 2 of armature 3 of said hold magnet 1. Fastened to the armature 3 by screw 4 is a cross bar such as 5. The armature 3 is fastened to its base 2 by means of a spring plate 6 which allows the armature 3 to move. Select magnets 7, 8, 9, 10 and 11 are also fastened to the metal plate X. The armatures 12, 13, 14, 15, 16 of said select magnets are fastened to the vertical cross bars 17, 18, 19, 20, 21, respectively, so that when a select magnet such as select magnet 11, is energized, vertical cross bar 21 is drawn up with armature 16. Fingers 27, 28, 29, 30, 31 at one end rest on lift hubs 22, 23, 24, 25, 26, respectively and at the other end are inserted through holes in a cross bar such as 5. The fingers are able to follow the movement of the horizontal cross bar 5 by virtue of the manner in which they rest on the said lift hubs. The slotted loop arrangement of the lower end of the fingers allows free movement transverse to the vertical cross bars. Pressure of the fingers 27, 28, 29, 30, 31 against springs 32, 33, 34, 35, 36 causes the springs to establish an electrical contact. The said springs 32, 33, 34, 35, 36 are fastened to the metal plate X but are electrically insulated from metal plate X by insulating bars such as 37, 38, 39.

Referring now to Fig. 2 the holding magnet such as 1 is fastened to the metal plate X. The armature 2 of hold magnet 1 is secured to the metal plate X through a spring 3 and base 4. Fastened to the armature 2 by means of screw 5 is horizontal cross bar 6. Horizontal cross bar 6 is equipped with slots 7, 8, 9, 10, 11 into which one end of fingers 12, 13, 14, 15, 16 are designed to fit, respectively. The other ends of these fingers rest in slots in vertical cross bars 17, 18, 19, 20, 21. Brackets 22, 23, 24 secure frame pieces 25 and 26 to the metal plate X. The vertical cross bars 17, 18, 19, 20, 21 are secured to the two frame pieces 25 and 26. It will be noted that the vertical cross bars do not have a movement when a switch is operated. Rather there is a magnetic action. Around each of the vertical cross bars are placed two coils, one adjacent to each of the two frame pieces 25 and 26. Since the vertical cross bars are constructed in segments, the said segments being separated by nonmagnetic insulating segments such as 37, 38, 39, 40, 41, energization of the said coils will produce a series of electromagnets. Energization of coils 31 and 36, for example, will create a series of electromagnets down the vertical cross bars which will magnetically repulse the fingers adjacent to vertical cross bar 41 into the slots provided therefore in the horizontal cross bars. The fingers 12, 13, 14, 15, 16 are permanent magnets.

Adjacent to each intersection of a vertical and a horizontal cross bar is a set of springs such as 42, 43, 44, 45, 46. When the springs are forced together due to the pressure of a finger, a contact is established. The two springs of a set of springs are electrically insulated from each other and from the metal plate X by means of insulators such as 47.

The operation of the embodiment of the cross bar switch as shown in Fig. 1 will now be described. Since this is a two-out-of-five code register system, two of the select magnets 7, 8, 9, 10, 11 will be energized by known means not shown. For example, assume that select magnets 8 and 10 are energized. Armatures 13 and 15 are operated to move vertical cross bars 18 and 20 longitudinally upward. The lift hubs 23 and 25, being rigidly secured to the vertical cross bars, will push the fingers 28 and 30 upward to cause them to extend far enough through the holes in horizontal cross bar 5 so that when said horizontal cross bar 5 is moved longitudinally to the left the fingers 28 and 30 will come into contact with spring sets 33 and 35, respectively.

Each set of springs has a set of contacts such as 40. The pressure of the fingers 28 and 30 against the springs 33 and 35 will close sets of contacts similar to 40 and establish the desired electrical connections. A hold magnet such as 1 is operated subsequent to select magnets 8 and 10 thereby actuating the horizontal cross bar 5 after the fingers 28 and 30 have been raised into position to come into contact with the spring sets 33 and 35, respectively. No other contacts such as 40 will close, other than those of spring sets 33 and 35 because all the other fingers in the cross bar 5 row will pass underneath their respective spring sets. After the abovementioned contacts have been established select magnets 8 and 10 are deenergized and the vertical cross bars 18 and 20 resume their normal positions. The two fingers 28 and 30 remain pinned against the spring sets 33 and 35 however to sustain the electrical connections until hold magnet 1 is deenergized. During the time the electrical connections at spring sets 33 and 35 are being maintained the other intersections of the cross bar switch, with the exception of those in the cross bar 5 row, are able to operate to register other two-out-of-five codes. To release the connections at spring sets 33 and 35 it is only necessary to deenergize hold magnet 1. Horizontal cross bar 5 will resume its normal position and fingers 28 and 30 will drop down into their normal positions.

The operation of the alternative embodiment of the invention as shown in Fig. 2 will now be discussed in detail. This modification of the invention is also used in a two-out-of-five code register system. Assume that any two of the select five magnets 27—32, 28—33, 29—34, 30—35, 31—36 are energized. For example, assume that select magnets 28—33 and 30—35 are energized. This creates a series of magnets in the vertical cross bars 18 and 20. As described before the fingers 13 and 15 are permanent magnets. The polarities of the finger magnets and the individual magnets constituting the vertical cross bar are so aligned with respect to each other that one repulses the other resulting in the fingers 13 and 15 being forced into the slots 8 and 10, respectively, of cross bar 6. The next step in the operation is the energization of one of the hold magnets. Assume that hold magnet 1 is energized, armature 2 is actuated which causes the horizontal cross bar 6 to move longitudinally to the left. Since the fingers 13 and 15 are now in slots 8 and 10, respectively, they will be moved against the spring sets 43 and 45, respectively. Each spring has a contact on its inner face such as 40 in drawing 1. The pressure of the fingers 13 and 15 against the spring sets 43 and 45 closes these contacts and establishes the desired electrical connection. After the horizontal cross bar 6 has been actuated and electrical contact established, select magnet 28 and 30 can be released, allowing all the fingers associated with that particular vertical cross bar to return to their normal positions except those fingers at the intersections of cross bars 6, 18 and 20. As in the case of the first embodiment of the invention, other code signals can be received by the cross bar system

during the time that contacts exist in spring sets **43** and **45**. To release the spring sets **43** and **45** it is only necessary to deenergize hold magnet **1**. Armature **2** and horizontal cross bar **6** resume their normal positions and since the fingers are permanent magnets, they are now freely attracted to the deenergized vertical cross bars **18** and **20**.

It should be noted that these two embodiments of the invention differ only in the respect that in the case of the first discussed modification the fingers are positioned to actuate the contacts by means of mechanical force, i. e., a longitudinal movement of the vertical cross bars, whereas the second embodiment of the invention employs magnetic forces to so position the fingers.

What is claimed is:

1. A selective switch comprising a plurality of groups of contacts coordinately arranged, a plurality of selection control members arranged adjacent said contacts along one of said coordinates, a plurality of selectable elements supported by each of said control members, one adjacent to each of said groups of contacts, a plurality of contact actuating elements located adjacent said groups of contacts along a different coordinate from the coordinate along which said selection control members are arranged, electromagnetic repulsion means for actuating said selective elements away from their normal position and into engagement with said actuating members.

2. A selective switch comprising a plurality of groups of contacts coordinately arranged, a plurality of selection control members arranged adjacent said contacts along one of said coordinates, a plurality of permanently magnetized selectable fingers supported by each of said selection control members, one adjacent to each of said coordinately arranged groups of contacts, a plurality of contact actuating bars located adjacent said groups of contacts along a different coordinate from the coordinate along which said members are arranged, said selection control members being a series of electromagnets magnetically coupled to said fingers so as to apply an opposing magnetic field thereto thereby causing repulsion of said selectable fingers from their normal position and into engagement with said actuating bars, and means for applying a longitudinal force along the axes of said actuating bars to move said selectable fingers against said contacts thereby closing said contacts.

3. A selective switch comprising a plurality of groups of contacts coordinately arranged, a plurality of selection control members arranged adjacent said contacts along one of said coordinates, a plurality of selectable fingers supported by each of said selection control members, one adjacent to each of said coordinately arranged groups of contacts, a plurality of contact actuating bars located adjacent said groups of contacts along a different coordinate from the coordinate along which said selection control members are arranged, each of said selection control members

comprising a metallic loop of magnetic material, and a plurality of coils wound around a section of said loop, said metallic loop being broken at distance intervals by non-magnetic insulating discs to produce a series of electromagnets in said loop, one electromagnet for each adjacent contact, said electromagnets operating to repulse said fingers into engagement with said control actuating bars.

4. A selective switch comprising a plurality of groups of contacts coordinately arranged, a plurality of selection control members arranged adjacent said contacts along one of said coordinates, a plurality of permanently magnetized selectable fingers supported by said selection control members, one adjacent to each of said coordinately arranged groups of contacts, a plurality of contact actuating bars located adjacent said groups of contacts along a different coordinate from the coordinate along which said selection control members are arranged, each of said selection control members comprising a metallic loop of magnetic material and a plurality of coils wound around sections of said loop, said metallic loop being spaced at intervals by nonmagnetic discs to produce a series of electromagnets in said loop, one electromagnet for each adjacent contact, said electromagnets being magnetically coupled to said selectable fingers so as to apply an opposing magnetic field thereto thereby causing repulsion of said selectable fingers from their normal position and into engagement with said actuating bars, and means for applying a longitudinal force along the axes of said actuating bars to actuate said selectable fingers against said contacts thereby closing said contacts.

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