Dec. 2, 1924. 1,517,425

C. J. HENDRICKSON ET AL

AUTOMATIC TELEPHONE SWITCH

Filed Jan. 7, 1922

Fig. 1.

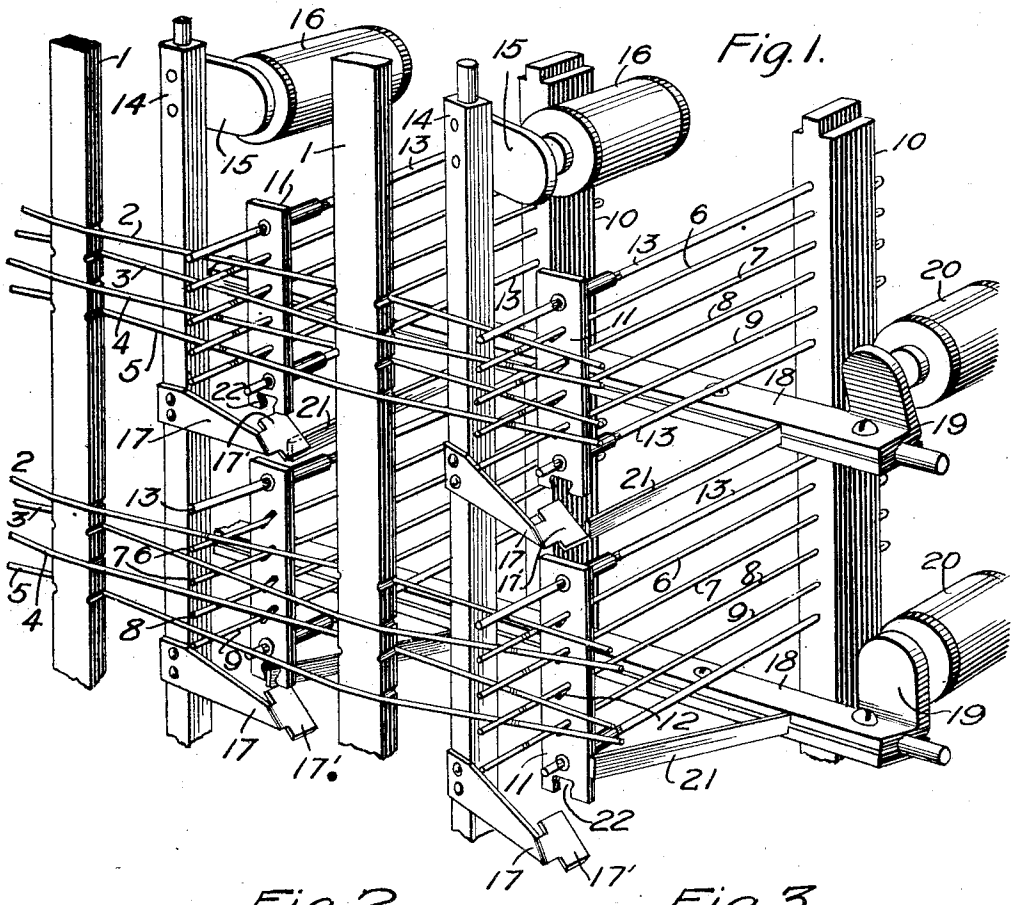


Fig. 2.

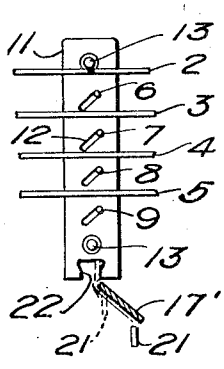
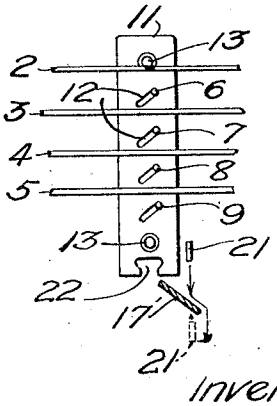


Fig. 3.



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by W. E. Beatty. Atty

Patented Dec. 2, 1924. 1,517,425

UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SWITCH.

Application filed January 7, 1922. Serial No. 527,564.

To all whom it may concern:

Be it known that we, CHARLES J. HENDRICKSON and VICTOR F. MILLER, citizens of the United States, both residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Automatic Telephone Switches, of which the following is a full, clear, concise, and exact description.

This invention relates to automatic switching apparatus and more particularly to coordinate switches of the type adapted for establishing connections in an automatic telephone exchange system.

The present invention is an improvement on the switch structure described in the copending application of Herbert B. Taylor, Serial No. 527,586 filed January 7, 1922, and likewise the switch structure described in the British Patent No. 183,438 issued to Western Electric Company, Limited, accepted September 6, 1923. The last-mentioned British patent is directed to an automatic telephone system in which the present structure is particularly well adapted for use. In that system, certain rotatable bars are each assigned to groups of incoming lines, other rotatable bars are assigned individually to link conductors and still others to outgoing lines or trunks. Each of the incoming line bars being associated with a plurality of incoming lines is, necessarily, operable to participate in the establishment of coexisting connections between a plurality of its associated incoming lines and idle trunks and by such arrangement a very important economy is effected in that the number of operating bars and auxiliary parts is materially reduced.

It has been found that successive operations of the line bars of the switch structure shown and described in the above noted British Patent No. 183,438 of 1923 sometimes has a tendency to disturb existing connections sufficiently to produce noise on the subscriber's lines. This is due to the fact that a mechanical connection continues to exist between the operated contacts and the line bar.

In the copending application of H. B. Taylor, referred to above, there is described and claimed a switch structure by which the above tendency is eliminated.

The present invention not only overcomes the above tendency but in addition provides a structure in which the line bar operating magnets are required to perform a small and uniform amount of work compared with the widely varying load in switches of this type developed heretofore, and it also provides a simpler and more economical device from a manufacturing standpoint.

The object of this invention is therefore to provide a simple and economical switch structure of the character above described having operating means common to groups of incoming lines whereby successive operations of such common operating means are ineffective to disturb existing connections.

A further object of the invention is to provide a switch structure wherein the line bar magnets are required to move a comparatively small and uniform load.

The principal feature of the invention consists in the combination with normally disengaged contacts of an operating mechanism comprising an operating member which is normally movable in a path wherein it is ineffective with respect to the contacts and selectively operable means, preferably in the form of a cam or the like for diverting the aforementioned member from its normal path to effect operation of the contacts. In the setting up of a connection the operating member engages the cam whereby it is diverted from its normal path, but in continuing this movement becomes disengaged therefrom so that subsequent operations of the cam carrying medium are ineffective with respect to the established connection.

Other features of the invention will be clear from the detailed description which follows.

With reference to the accompanying drawing, Fig. 1 is a fragmentary perspective view of a coordinate switch in accordance with this invention; Fig. 2, is a detail view illustrating the operation of the switch mechanism, and Fig. 3 is a view similar to Fig. 2 further illustrating the operation of the switch mechanism.

The structure shown consists in general of a stationary grid comprising the vertical bars of insulating material 1, and sets of interwoven cross wires 2, 3, 4 and 5 referred to

hereinafter as link conductors, together with vertical rows of active wire contact sets 6, 7, 8 and 9 and operating mechanism for selectively moving the various sets of active contact wires into engagement with their associated link conductors.

The structure may be of any desired width and height to accommodate as many vertical rows of active contact sets and as many sets per row as may be required.

Certain of the vertical rows of contact sets are assigned to incoming lines and the others to outgoing lines or trunks. Since there are only two such vertical rows illustrated in Fig. 1, it may be assumed that the vertical row to the left of the figure is one of those which are assigned to incoming lines and that the vertical row to the right of the figure is one of those which are assigned to outgoing lines or trunks.

Each vertical row which is assigned to incoming lines is, according to the system described in the aforementioned British Patent 183,438 of 1923, divided into a plurality of groups each comprising a plurality of active contact sets, which are connected in multiple to an incoming line. Since each active contact set of any vertical row is associated with a different set of link conductors, it will be apparent that each incoming line has access to several sets of link conductors, but since there are ordinarily several vertical rows of active contact sets assigned to incoming lines, it will also be apparent that several incoming lines have access to each set of link conductors. It is, therefore, seen that the sets of link conductors are apportioned to the incoming lines on a percentage basis, the number depending upon traffic requirements.

The active contact wires 6, 7, 8 and 9 are made preferably of a suitable spring metal such as phosphor bronze and in the present instance are embedded in vertical bars of insulating material 10, which are supported at their end portions in the switch frame which is not shown. The rearwardly extending ends of the active contact wires may be formed, if desired, into soldering terminals whereby suitable electrical connections may be obtained.

Each set of active contact wires is provided with an operating card 11 having diagonal apertures 12 through which the active wires extend in juxtaposition to the grid wires or link conductors. The operating cards 11 are shown supported on resilient wires 13 which like the active contact wires are embedded in the vertical bars 10. The free ends of the wires 13 are tensioned downwardly so as to normally hold the active contact wires out of engagement with their associated link conductors and the upper one of each pair of wires 13 is made of such length as to normally rest on the top wire of the link conductor set associated therewith, thus acting as a back stop for the active contact wires.

With each vertical row of active contact sets there is associated a vertical rotatable bar 14 which is provided at one end with an armature 15 arranged to be attracted by an electromagnet 16 whereby the bar 14 is rotated out of its normal position in response to each energization of said electromagnet. On each vertical bar 14 there is provided a number of cam arms or guides 17, each of which is individual to a set of active contact wires. The function of these cam arms will presently be shown.

With each set of link conductors, 2, 3, 4 and 5 there is associated a horizontal rotatable bar 18, each of which is provided with an armature 19 and an electromagnet 20 whereby the bar is rotated from normal to off normal position. Each horizontal bar or link bar, as it may be properly termed, is provided with a number of arms 21 which are resilient in the horizontal direction, but comparatively stiff vertically. Each of these arms 21 is individually associated with a set of active contact wires and a cam arm 17.

The operating cards 11 are each provided at their lower ends with a notch or recess 22 with which their associated arms 21 are adapted to engage, but it will be noted that, normally, arms 21 are free to move in a vertical path to one side of their respectively associated operating cards 11. This is true, however, only while the cam arm 17 associated with any of the arms 21 is in its normal position as shown at the lower right-hand portion of Fig. 1 wherein the arm 21 is shown in its off normal ineffective position.

When the vertical bar 14 is rotated out of its normal position by electromagnet 16, the end portions 17′ of the cam arms 17 thereof are moved into a position wherein they intercept the paths of their associated arms 21 as shown in Figs. 2 and 3.

Fig. 2 shows a cross section of the end portion 17′ of a cam arm which has been moved into its selected position and also shows in full lines an end view of an arm 21 in its normal position and in dotted lines other positions of the arm 21 as it moves upwardly and is flexed laterally to engage the recess 22 of the operating card 11. The continued movement of the arm 21 as illustrated in Fig. 2 results in lifting the operating card 11 so as to permit the active contact wires 6, 7, 8 and 9 to engage the link conductors 2, 3, 4 and 5 respectively. The operated link bar together with the arms 21 thereon remain in their off normal position throughout the duration of the connection, but the vertical bars 14 may be immediately restored to normal. The arm 21

in its operated position is entirely clear of its associated cam arm 17 so that any subsequent movement of the cam arm is ineffective to disturb the connection already established.

As soon as a vertical bar 14 associated with a group of incoming lines and a horizontal link bar 18 have been operated to establish a connection, the vertical bar 14 may be immediately reoperated to participate in the connection of another of its associated incoming lines with a set of idle link conductors. Thus, it will be seen that a cam arm 17 may operate several times during a period in which its associated contact set continues operated and if such successive operations were to even slightly disturb the existing connection an objectionable amount of noise would result on the subscribers' lines.

It should be noted that the load on the magnets 16 associated with incoming lines does not vary with the number of coexisting connections as is the case with the switch structures previously referred to and accordingly magnets 16 may be of relatively small size.

In the system described in the aforementioned British Patent No. 183,438 of 1923 the incoming lines and outgoing lines or trunks are simultaneously connected to common link conductors and this is accomplished by first rotating two vertical bars, one of which is associated with a particular group of incoming lines and the other with an idle trunk and thereafter rotating a horizontal bar which is associated with an idle set of link conductors accessible to the particular incoming line which it is desired to connect with. In a system of that character then, only two of the arms 21 of any link bar 18 would be in use at any one time but all the arms 21 of the operated link bar are in their uppermost positions regardless of the fact that all but two are performing no function. Fig. 3 illustrates in full lines an arm 21 in its upper non-operating position, and a cross section through the end portion 17′ of a cam arm 17 in its selected position. Now in the event of the link bar 18 which carries arm 21 of Fig. 3 being restored to normal while the cam arm 17 remains in its selected position as shown, it is essential that the arm 21 shall be able to return to normal immediately. The present invention provides for such restoration by having the back surface of the end portion of the cam disposed at an angle to the path of arm 21 so that upon the arm 21 engaging therewith on its return movement it will be flexed to one side and around the end portion of the cam as indicated by the arrows in Fig. 3.

What is claimed is:

1. A switch structure comprising active and passive contacts, a member for operating said contacts, said member being normally movable independently of the active contacts in a path wherein it is ineffective to operate said active contacts, and means effective, when operated, to cause said member while moving in its normal path to deviate from its said path to operate said active contacts.

2. A switch structure comprising active and passive contacts, a member for operating said active contacts, said member being normally operable independently of the active contacts and ineffectively with respect to said active contacts, a guide, and means for moving said guide whereby said guide is operable to cause a subsequent operation of said member to be effective with respect to said active contacts.

3. A switch structure comprising normally disengaged contacts, a member for operating said contacts, said member being normally movable separately from the contacts in a path wherein it is ineffective to operate said contacts, and a cam effective, when operated to cause said member to deviate from its normal path to operate said contacts.

4. A switch structure comprising normally disengaged contacts, a member for operating said contacts, said member being normally movable separately from the contacts in a path wherein it is ineffective to operate said contacts, means for operating said member, a cam, and means for moving said cam into the path of said member whereby said member is caused to deviate from its normal path to operate said contacts.

5. A switch structure comprising normally disengaged contacts, a member for operating said contacts, said member being operable ineffectively with respect to said contacts, a cam, and means for moving said cam whereby said cam is operable to cause a subsequent operation of said member to effect connection between said contacts, said connection being unaffected during its continuation by subsequent operations of said cam.

6. A switch structure comprising normally disengaged contacts, a pair of coordinately disposed bars, a rotatable resilient member carried by one of said bars, a cam carried by the other of said bars, means for operating the first-mentioned bar to move said resilient member, means for operating the second-mentioned bar to move said cam, a movement of said cam followed by a movement of said resilient member being effective to interengage said contacts.

7. A switch structure comprising normally disengaged contacts, a pair of coordinately disposed rotatable bars, a resilient member carried by one of said bars, a cam carried by the other of said bars, means for rotating said first-mentioned bar, means for rotating said second-mentioned bar, an operation of said second-mentioned bar followed by an operation of said first-mentioned bar being effective to interengage

said contacts, and operation of said bars in the reverse order being ineffective to interengage said contacts.

8. A switch structure comprising normally disengaged contacts, a pair of coordinately disposed rotatable bars, a resilient member carried by one of said bars, a cam carried by the other of said bars, means for rotating said first-mentioned bar, means for rotating said second-mentioned bar, said cam having two surfaces both of which are disposed angularly to the normal path of said resilient member, said cam in its off-normal position being disposed in the normal path of said resilient member whereby said resilient member in its movement from normal is engaged by one of said cam surfaces and thereby diverted from its normal path to effect interengagement of said contacts, the other of said cam surfaces being adapted to permit said resilient member to restore to normal from its off-normal non-operating position while said cam is in its off-normal position.

9. In a switch structure, a plurality of rows of passive contact sets, a plurality of rows of active contact sets, said last-mentioned rows being disposed coordinately to said first-mentioned rows, each set of active contacts being associated with a set of passive contacts, a rotatable bar for each row of passive contacts, a rotatable bar for each row of active contacts, said first-mentioned bars being disposed coordinately to said second-mentioned bars, each of said first-mentioned bars being provided with a plurality of laterally extending resilient arms, one for each set of active contacts associated therewith, each of said second-mentioned bars being provided with a plurality of cams, one for each set of active contacts associated therewith, the conjoint rotation of one each of said bars being effective to move their jointly associated set of active contacts into engagement with its passive contacts, said engagement being independent of subsequent operations of one of the bars involved in its establishment.

10. In a switch structure coordinate rows of contact sets, coordinately disposed rotatable bars, cams on certain of said bars, each of said cams being associated with one of said contact sets, resilient members on others of said bars, each of said resilient members being associated with one of said cams, the conjoint operation of one each of said bars when operated in a certain order being effective to operate their conjointly associated contact set and conjoint operation of one each of said bars in the reverse order being ineffective to operate their conjointly associated contact set.

11. In a switch structure, passive contacts, active contacts normally disengaged from said passive contacts, an operating element for said active contacts having a recess, a rotatable bar, a resilient member carried by said bar, said resilient member being normally movable by the rotation of said bar in a path wherein it does not engage the recess of said operating element, and means selectively operable to flex said resilient member during its movement from normal into engagement with the recess of said operating element to effect interengagement of said active contacts with said passive contacts.

12. In a switch structure, a row of contact sets, operating means common to said row, a plurality of other operating means individual to said contact sets, said common operating means and one of said individual operating means being jointly operable to operate one of said contact sets, said common operating means being subsequently operable to participate in the operation of others of said contact sets during the continued operation of the first operated contact set, said operated contact set being maintained independently of said common operating means, whereby the load on said common operating means is substantially uniform regardless of the number of its associated contact sets which may be operated.

13. In a switch structure, a row of contact sets, an operating bar common to said row, other operating bars individual to said contact sets, said common operating bar and one of said individual operating bars being jointly operable to operate one of said contact sets, said common operating bar being subsequently operable to participate in the operation of others of said contact sets during the continued operation of the first operated contact set, the load on said common operating bar being substantially uniform regardless of the number of its associated contact sets which may be operated.

In witness whereof, we hereunto subscribe our names this 30th day of December A. D., 1921.

CHARLES J. HENDRICKSON.
VICTOR F. MILLER.