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TELEPHONE SYSTEM

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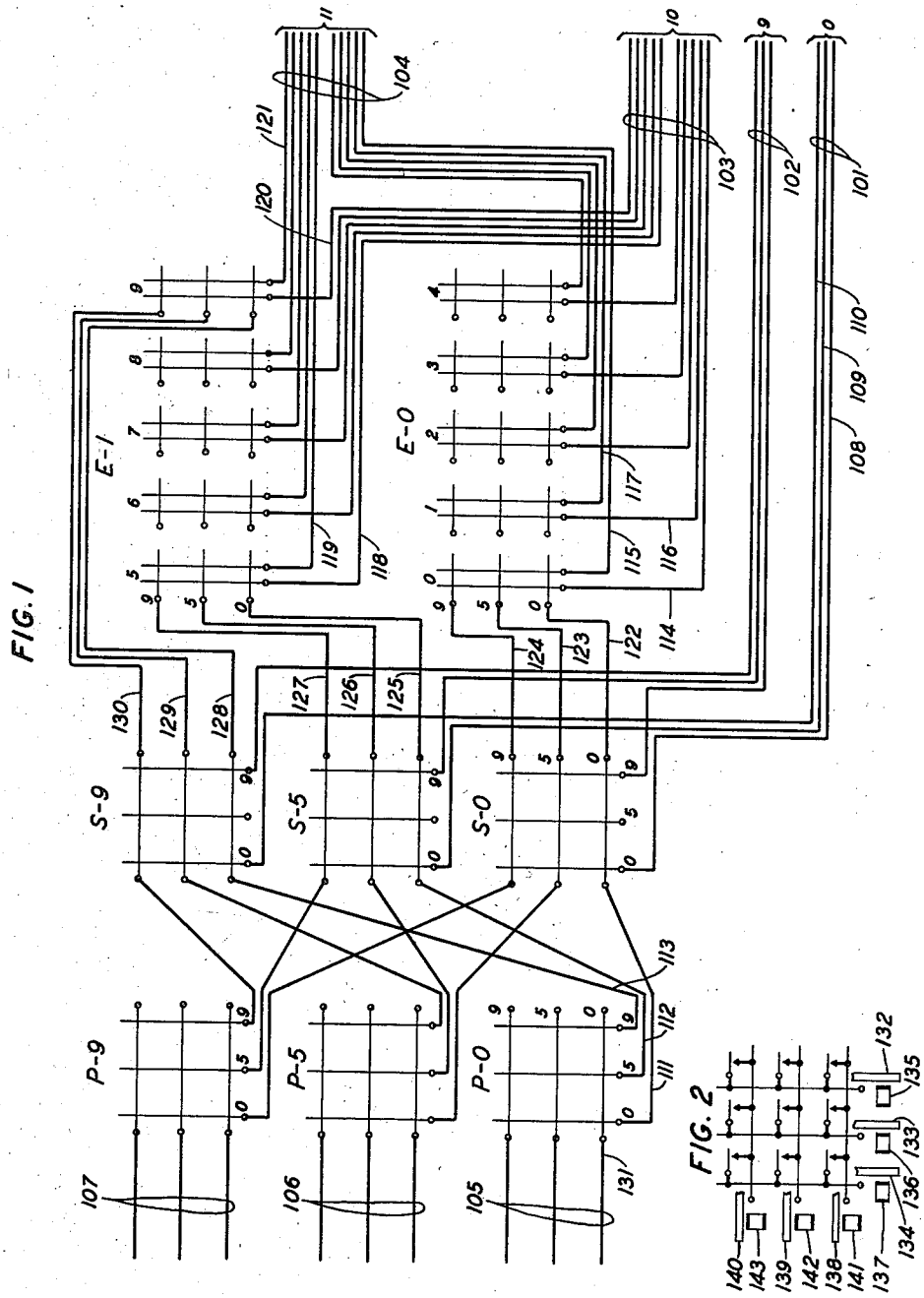

FIG. 1

FIG. 2

INVENTOR
W. W. CARPENTER
BY M. P. McKenney
ATTORNEY

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TELEPHONE SYSTEM

Warren W. Carpenter, Garden City, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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7 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to those in which automatic switching equipment is used for extending connections.

The objects of this invention are to enable an increase in the number of lines or trunks available for extending calls through a switching stage without altering the physical capacity of switches; to enable the addition of further outgoing lines or trunks to a group and at the same time to insure full accessibility for all incoming lines to all lines of such group; and otherwise to improve the flexibility and efficiency of trunking and switching systems.

A feature of the invention is a switching system in which the lines incoming to a switching stage have access through respective switches to a given number of outgoing lines, the number of outgoing lines that any incoming line may reach through a switch depending on the capacity of the switch, and in which the number of outgoing lines may be increased without altering the size of the switches by providing extension switches, each of which is common to a number of the main switches and is divided in sections to provide a plurality of additional outgoing lines for the lines incoming to each of the main switches.

The invention is particularly applicable to switches of the cross-bar type having a plurality of horizontal circuits intersecting a plurality of vertical circuits. A group of lines incoming, for example, to the horizontal circuits of a switch have access to all the lines outgoing from the vertical circuits of such switch. Since the size of the switch is limited to a given number of outgoing circuits and since it may be desirable to give the lines incoming to a switch access to more outgoing circuits than this size permits, an extension switch is, according to the present invention, provided in common to a plurality of the main switches. This extension switch has its contact field divided into several portions, each portion serving as an extension of the lines incoming to a particular one of the main switches. Each such portion of the extension switch has access to a number of additional outgoing lines. Thus the number of outgoing lines that may be reached by the lines incoming to any main switch are increased beyond the capacity of the main switch by the number of additional outgoing lines that appear in the portion of the extension switch assigned to such main switch.

Other features of this invention will be described in detail in the following specification, which should be taken in conjunction with the accompanying drawing, and also in the appended claims.

Referring to the drawing: Fig. 1 illustrates diagrammatically a switching stage comprising a number of main switches of the cross-bar type, together with cross-bar extension switches serving said main switches; and Fig. 2 is a diagram of one of the cross-bar switches illustrating the coordinate contact rows and the operating bars and magnets.

The switching stage shown in Fig. 1 serves to connect the incoming lines, which are arranged in groups, such as groups 105, 106, 107 to the outgoing lines, which are divided into groups, such as groups 101, 102, 103 and 104. For this purpose a switching stage comprises a plurality of primary cross-bar switches P and a plurality of secondary cross-bar switches S. Although the number of these switches may vary under different conditions, the drawing illustrates a switching stage having ten primary switches P and ten secondary switches S. Only three of the ten primary switches, P—0, P—5 and P—9, are shown, and the same is true with respect to the secondary switches. Each of the primary and secondary switches comprises a number of horizontal rows of contacts and a number of vertical rows of contacts. And while the capacity of one of these switches may be varied to suit the particular conditions under which it is used, it has been found convenient to provide ten horizontal rows and ten vertical rows of contacts in each switch. For simplicity each of the switches P and S is illustrated with only three horizontal rows and three vertical rows of contacts. In all cases the three rows of contacts, both horizontal and vertical, are the first or No. 0 row, the sixth or No. 5 row, and the tenth or No. 9 row.

With the foregoing assumption of ten primary switches each having ten rows of contacts in either direction, there are, therefore, a total of one hundred incoming lines terminating in these primary switches. These lines appear in the horizontal rows of contacts of the primary switches, and the total one hundred lines are subdivided into ten groups of ten each. Three of these groups 105, 106, and 107 are shown.

The outgoing lines comprise a variable number of groups depending on the number of extension switches used. Ten of these groups, each including ten lines, are reached directly from the secondary switches S. Only the first and last of these ten groups 101 and 102 are

illustrated. Each of the secondary switches has access to one line in each of the ten groups. For example, the lines 108, 109, and 110 of the group 101 appear respectively in the No. 0 vertical rows of secondary switch S—0, S—5 and S—9. In a similar manner, the other seven lines of group 101, which are not shown, appear in the No. 0 vertical rows of contacts of the corresponding secondary switches, not shown. Likewise, the No. 9 group 102 has its ten lines appearing respectively in the No. 9 vertical rows of contacts in the secondary switches S—0 to S—9. And the remaining eight groups of lines between the No. 0 and the No. 9 groups 101 and 102 appear in a corresponding manner in the vertical rows of contacts of the secondary switches S—0 to S—9.

In order that any incoming line may have access to any outgoing line, the primary and secondary switches are interconnected in the manner shown by link circuits. For example, the ten vertical rows of contacts of primary switch P—0 are connected through links to the horizontal rows of contacts in the ten secondary switches S—0 to S—9. More specifically the No. 0 vertical row of primary switch P—0 is connected by link 111 to the zero horizontal row in secondary switch S—0; the No. 5 vertical row of switch P—0 is connected through link 112 to the zero horizontal row of secondary switch S—5; and the No. 9 vertical row of switch P—0 is connected through link 113 to the zero horizontal row of switch S—9. Likewise the other vertical rows of switch P—0, not shown, are connected respectively to the zero rows of the corresponding secondary switches, not illustrated. The ten vertical rows of primary switch P—5 are connected through ten link circuits to the No. 5 horizontal rows of contacts in the ten corresponding secondary switches S. The ten vertical rows of contacts of primary switch P—9 are connected through ten links to the No. 9 horizontal rows in the corresponding secondary switch S. And the same is true with respect to each of the other primary switches not shown. With this arrangement of connecting the primary and secondary switches by link circuits, any incoming line at a primary switch has access over at least one link to any secondary switch, which secondary switch has access to at least one outgoing line in any one of the ten groups 101, 102.

It is sometimes desirable to give the incoming lines access to more outgoing lines than can be reached through secondary switches having a capacity for ten outgoing circuits each. To accomplish this the switching stage comprising the ten primary and ten secondary cross-bar switches is equipped with a number of common extension switches. In the drawing two of these extension switches E—0 and E—1 are shown, although any suitable number may be employed. Each of these extension switches, like the primary and secondary switches, has ten horizontal rows of contacts and ten vertical rows of contacts. The horizontal rows, however, are divided in five portions, the horizontal circuits in each portion having access to two vertical rows of contacts. For instance, the extension switch E—0 has its horizontal multiple divided in five portions or sections 0, 1, 2, 3, and 4. The No. 0 section has two vertical rows of contacts giving access to two outgoing lines 114 and 115. The No. 1 section also has two outgoing lines 116, and 117, and, similarly, the remaining sections 2, 3 and 4 of switch E—0 have two outgoing lines per section. In like manner the extension switch E—1 is divided into five portions or sections 5, 6, 7, 8 and 9, and each of these has two outgoing lines appearing in the vertical contact rows. For example, section No. 5 has two outgoing lines 118 and 119, and section No. 9 has two outgoing lines 120 and 121. By taking the first outgoing line in each of the five sections of both switches E—0 and E—1, such as lines 114, 116, 118 and 120, an additional group of ten outgoing lines 103 is obtained. Similarly, by taking the second outgoing line of each of the ten sections of the switches E—0 and E—1, such as lines 115, 117, 119 and 121, a second group of ten outgoing lines 104 is obtained.

In order that the incoming lines may have access to these additional groups of outgoing lines 103 and 104 through the extension switches E—0 and E—1, the ten secondary switches are connected to the extension switches by link circuits. For example, the ten horizontal rows of contacts in the switch S—0 are connected by ten links 122, 123, 124 to the corresponding ten horizontal rows in the section 0 of the extension switch E—0. Similarly, the ten horizontal rows in each of the next four secondary switches (not shown) are connected by links to the horizontal rows in each of the respective sections 1, 2, 3, and 4 of the extension switch E—0. The ten horizontal rows of secondary switch S—5 are connected through links 125, 126, 127 to the corresponding horizontal rows in section 5 of the extension switch E—1. The ten horizontal rows of the secondary switch S—9 are connected through links 128, 129 and 130 to the corresponding horizontal rows of section 9 of switch E—1. Likewise, the horizontal rows of the No. 6, No. 7 and No. 8 secondary switches (not shown in the drawing) are connected to the corresponding sections 6, 7 and 8 of the extension switch E—1.

With the arrangement above described, a call over one of the incoming lines, such as line 131, may be extended over any one of the ten links interconnecting the primary switch P—0 and any one of the ten secondary switches. From any one of the secondary switches the call may be further extended over any one of the ten outgoing groups of lines 101 to 102 without utilizing the extension switches. However, if all of the lines in the groups 101 to 102 are busy, the call may be extended from any one of the secondary switches through either of the extension switches E—0 and E—1 to a line in the group 103 or the group 104. The additional groups 103 and 104 may serve as over-flow circuits or they may be numerically equivalent to the other ten groups of lines 101 to 102.

The switching stage illustrated in Fig. 1 may be any stage in a dial telephone system where it is necessary to connect incoming lines or trunks to outgoing lines or trunks. Any suitable equipment may be used in connection with the switches of this stage for testing the various links and lines or trunks, for determining the path over which a connection is to be extended, and for operating the switches and holding them in operated condition during the existence of the connection. For a comprehensive understanding of control and testing mechanism suitable for use in connection with a switching stage of this kind reference is made to the copending application of W. W. Carpenter Serial No. 27,305, filed June 19, 1935.

Although described in connection with cross-bar switches, the invention is not so limited but may be embodied in systems using other types of switches, such as the progressively movable switch. The cross-bar switches referred to herein may be of any suitable construction, many variations of which are well-known in the art. In Fig. 2 for example, a cross-bar switch is illustrated having a number of vertical rows of contacts and a number of horizontal rows of contacts. Each vertical row is equipped with an operating bar, such as the bars 132, 133, and 134, these bars being operated respectively by the magnets 135, 136, and 137. Also the switch has horizontal bars for each of the horizontal rows. Three of these, 138, 139, and 140, are illustrated together with their operating magnets 141, 142, and 143. For a more detailed disclosure of a switch suitable for use in the system above described, reference is made to the copending application of J. N. Reynolds, Serial No. 702,453, filed December 15, 1933, granted as Patent 2,021,329, Nov. 19, 1935.

What is claimed is:

1. In a telephone system, a plurality of selective switches, lines incoming to each of said switches, a plurality of lines outgoing from each switch, and an auxiliary switch having its terminals divided in portions, said portions serving respectively the different selective switches, outgoing lines appearing in the several portions of said auxiliary switch, and means for connecting a line incoming to one of said selective switches to any outgoing line appearing in such selective switch or to any outgoing line appearing in the corresponding portion of the auxiliary switch.

2. In a telephone system, a plurality of selective switches, a plurality of lines incoming to each of said switches, a plurality of lines outgoing from each of said switches, an extension switch having its circuit making contacts divided in groups, said groups of contacts serving respectively the different selective switches, outgoing lines appearing in the different groups of said extension switch, means for connecting a line incoming to one of said selective switches to any outgoing line appearing in such selective switch, and means for connecting a line incoming to one of said selective switches to an outgoing line appearing in the corresponding contact group of said extension switch.

3. In a telephone system, a number of selector switches, lines incoming to each of said switches, a plurality of lines outgoing from each switch, an extension switch having a field of circuit making contacts, said contacts being divided in portions, said portions associated respectively with the different selector switches, additional outgoing lines, each of which appears in only one of the contact portions of said extension switch, and means for connecting a line incoming to any one of said selector switches to any line outgoing from said switch or to any line outgoing from the corresponding contact portion of the extension switch.

4. 'In a telephone system, a plurality of main switches, an auxiliary switch common to said main switches, the terminals of said auxiliary switch being divided in portions, one for each of said main switches, a plurality of groups of incoming lines, each appearing in only one of the main switches and in the corresponding portion of the auxiliary switch, outgoing lines appearing in the main switches and in the contact portions of the auxiliary switch, each outgoing line has only one such appearance, and means for connecting the incoming lines to the outgoing lines.

5. In a telephone system, a plurality of selective switches, lines incoming to each of said switches, a plurality of lines outgoing from each switch, an extension switch having its terminals divided in portions, said portions serving respectively the different selective switches, outgoing lines appearing in the different portions of said extension switch, and conjointly acting switching members for operating said switches to connect a line incoming to any one of said selective switches to any outgoing line appearing therein or to any outgoing line appearing in the corresponding portion of said extension switch.

6. In a telephone system, a plurality of cross-bar selector switches, incoming lines appearing in said switches, a plurality of lines outgoing from each switch, an extension cross-bar switch having its field of circuit making contacts divided into a number of portions, said portions individual respectively to said selector switches, outgoing lines appearing in the different contact portions of said extension switch, means including a pair of coordinate bars for connecting a line incoming to one of said selector switches to any line outgoing therefrom, and means including a pair of coordinate bars for connecting said incoming line to an outgoing line appearing in the corresponding portion of said extension switch.

7. In a telephone system, a plurality of primary and a plurality of secondary switches each having vertical and horizontal rows of contacts, an auxiliary switch having vertical and horizontal rows of contacts and having said vertical rows divided into a plurality of sections, said sections serving respectively said secondary switches, lines incoming to said primary switches, links interconnecting the vertical rows of said primary switches and the horizontal rows of said secondary switches, groups of links interconnecting respectively said secondary switches and the corresponding sections of said auxiliary switch, outgoing lines appearing in said secondary switches, outgoing lines appearing in the different sections of said auxiliary switch, and means for operating said switches to connect an incoming line either to an outgoing line in one of said secondary switches or to an outgoing line in said auxiliary switch.

WARREN W. CARPENTER.