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AUTOMATIC TELEPHONE SYSTEM

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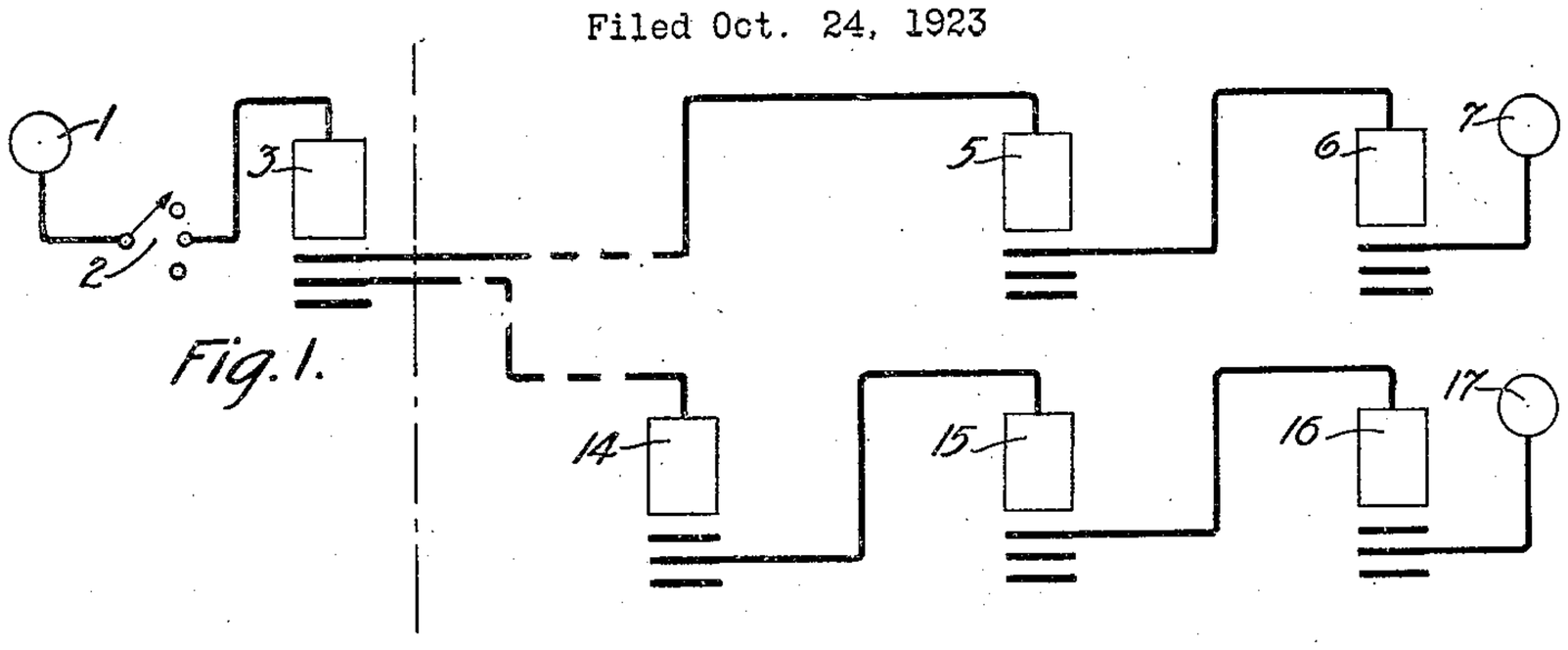
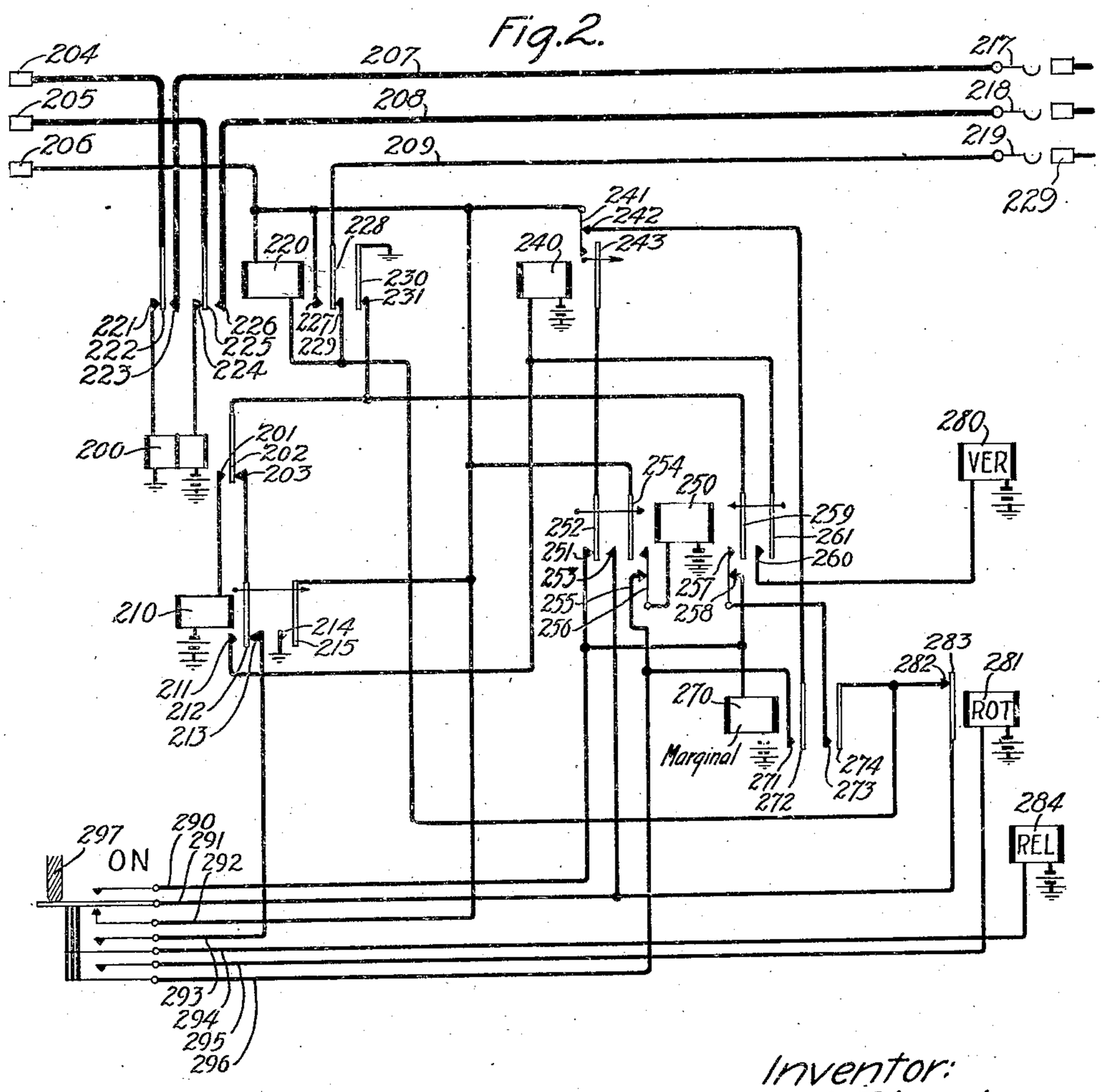


Fig. 1.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SYSTEM.

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This invention relates to automatic telephone systems and more particularly to large multi-office automatic systems.

The object is a new and improved trunking arrangement for systems in which connections are established through the medium of serially related automatic switches, and in which one of the switches in a series belonging to a major group of the system may be omitted for the sake of economy at the initial installation without interfering with the use of a uniform numbering system laid out in accordance with the ultimate capacity.

The invention contemplates a telephone trunking system employing an improved so-called digit absorbing selector switch.

In accordance with the invention, a circuit arrangement is provided whereby the first set of impulses the selector receives does not cause any movement of such selector but prepares the selector to respond to the next set of impulses from the sender, at the termination of which it automatically hunts for an idle trunk. Thus, one of the digits in the telephone number of any line in a given group is eliminated so that the lines in such group may be reached by means of a smaller series of switches than the lines in other groups.

Other features will appear from the detailed description.

In the drawings, Figure 1 is a schematic diagram of the trunking system, and Fig. 2 is a circuit diagram of the digit absorbing selector.

Fig. 1 shows the organization of a trunking system as applied to an automatic telephone system having a capacity of 100,000 lines and using the well-known Strowger vertical and rotary switches operated according to the two-wire system of control. In a system of this size, the lines are usually distributed among a plurality of different offices, and the first selectors, which are the switches which respond to the first digit in called telephone numbers, may function as office selectors. Since there are ten levels in a selector switch, there may be ten different offices and when a calling subscriber operates his dial to call the desired number, the first digit will operate the first or office selector to select the trunk line leading to the proper office, and the remaining digits will operate a second or incoming selector, a third selector and a connector, in the selected office, to complete the connection.

The office which is reached when the digit 2 is dialed (Fig. 1) as well as the other offices in the system with the exception of the one which is reached when the first digit dialed in 3, for example, may be equipped to their full capacity, while, for the purpose of illustration, it will be assumed that the office to which the connection is extended when the first digit dialed is 3, has for the time being, no more than 1,000 telephone lines terminating in it.

In order to point out the trunking arrangement more clearly, it will be assumed that the subscriber at substation 1 desires to call the subscriber at substation 17, in which case the connection may be extended as follows: from the substation 1 by way of the individual line switch 2, first or office selector 3, second or incoming selector 14, third or hundreds selector 15, and the connector 16, to the substation 17. This, it will be noted, is the usual trunking arrangement. Assuming, now that the subscriber at substation 1 calls the subscriber at the substation 7, the connection may be traced as follows: from the substation 1 by way of the individual line switch 2, first or office selector 3, third or incoming selector 5, and the connector 6, to the substation 7. This latter connection extends over a path similar to the one for the substation 17, with the exception that it does not pass through any second or thousands selector. It is obvious in view of the fact that there is only one "thousands" group of lines terminating in that office that no thousands selector is needed. Now it is only necessary to introduce an extra but ineffective digit into the number dialed, to make the telephone numbers in this office have the same number of digits as those in the other offices. This is accomplished in the system disclosed herein, by arranging the selector 5 so that after connection is obtained therewith, it will not make any selective operation when the first digit is dialed, but will operate like a regular selector when the next digit is dialed.

It is desirable to be able not only to assign numbers having the desired number of digits but also to be able to assign numbers that may be retained even after the system has reached its ultimate growth.

As is well-known, a full 100,000 line system, may consist of a main office in which part of the lines terminate, and one or more other offices of probably 1,000 lines each. In the present system this situation does not cause any difficulty to be encountered in numbering for future growth because with the digit absorbing selectors arranged to absorb the "thousands" digit regardless of what that digit is, the numbers may be assigned not only in any particular "thousands" group of lines, but in each and every "thousands" group of lines.

The system having thus been described in a more or less general manner, its operation will now be described in greater detail. For this purpose it will be assumed that the subscriber at substation 1 (Fig. 1) desires to talk with the subscriber at substation 7. When the receiver is removed at substation 1, the individual line switch 2 is operated to extend the connection to an idle first or office selector in the manner well-known in the art. The first selector 3, in turn operates to extend the connection to an idle digit absorbing selector, and assuming that the digit absorbing selector 5 is the one to which the connection is extended, the wipers of the first selector switch 3 will connect with bank contacts 204, 205 and 206, (Fig. 2) and the following circuit is closed to operate relay 200; battery, right-hand winding of relay 200, 224, 225, 205, subscriber's line and substation, 204, 222, 221, left-hand winding of relay 200 to ground. Relay 200 operated, closes the following circuit to operate slow-release relay 210; battery, relay 210, 201, 202, 231, 230 to ground. Relay 210, operated, connects ground to lead 206 to cause the selector to test busy to other first selectors over a circuit as follows: ground 214, 215 to lead 206. The selector switch is now ready to receive the series of impulses ordinarily corresponding to the thousands digit of the number dialed, and when the calling subscriber operates his calling device in accordance with the next digit of the desired number, the circuit of relay 200 is interrupted and relay 200 follows the impulses. When relay 200 releases, a circuit is closed to operate slow relay 240 as follows: battery, relay 240, 211, 212, 203, 202, 231, 230 to ground. Relays 210 and 240 are made slow-to-release to prevent them from releasing when relay 200 opens alternately, their respective holding paths, during the impulse period. When relay 240 operates, a circuit is closed to operate relay 270 as follows: battery, relay 270, 251, 252, 243, 241, 215, 214 to ground. Relay 270 operated locks as follows: battery, relay 270, 258, 257, 273, 274, 282, 283, 291, 292, 215, 214 to ground. When the calling device returns to normal the series of impulses ceases, relay 200 remains operated, and opens at 203, the circuit through slow relay 240 which releases. When relay 240 releases, a circuit is closed as follows to operate slow-to-operate relay 250; battery, relay 250, 256, 255, 271, 272, 242, 241, 215, 214 to ground. Relay 250 operated, opens at its contacts 257 and 258, the circuit through relay 270 which releases. Relay 250 operated, locks over a circuit as follows: battery, relay 250, 256, 254, 215, 214 to ground. Thus, it will be observed that the net result obtained at the end of the first train of impulses is that relay 250 is operated and locked, and the vertical magnet 280 is connected through contacts 260 and 261, in parallel with relay 240, but since no complete circuit has yet been established for the vertical magnet 280, the selector brush rod 297, of which only a part is shown, carrying the brushes 217, 218 and 219, has not moved from the normal position, hence the impulses corresponding to the thousands digit have been received and absorbed without moving the selector switch off normal.

The calling subscriber now operates his calling device, in accordance with the digit of the desired number and the series of impulses corresponding to the hundreds digit of the number is now dialed. Relay 200 follows the impulses as before, and operates slow relay 240 in the manner previously described. The vertical magnet 280 which is in parallel with relay 240 also operates, and follows the impulses set up by relay 200. The first time the vertical magnet operates, it raises the selector rod 297, of which only a part is shown, sufficiently to close the contacts 290 and 291, 293 and 294, 295 and 296, thus closing the circuit to operate relay 270 as follows: battery, relay 270, 290, 291, 253, 252, 243, 241, 215, 214 to ground.

Relay 270 operated, locks as follows: battery, relay 270, 290, 291, 283, 282, 274, 273, 257, 259, 231, 230 to ground. Each time the vertical magnet 280 operates, the selector rod 297 carrying the brushes 217, 218 and 219, advances one step in the manner well-known in the art, until when the impulses cease, the brushes 217, 218 and 219 are in the proper position to engage with the terminals of the first trunk in the selected level, as soon as the rotary magnet 281 operates as hereinafter described. When the series of impulses ceases, relay 240 releases as before, and a circuit is closed to operate the rotary magnet 281 as follows: battery, magnet 281, 295, 296, 271, 272, 242, 241, 215, 214, to ground. Magnet 281 operated, opens at 282 and 283, the circuit through relay 270, and causes the selector rod 297 to rotate and advance the brushes 217, 218 and 219 to the terminals of the first trunk in the level selected. If the first trunk in the group is busy, ground will be connected to the terminal 299 and when the rotary magnet 281

releases, a circuit will be closed to operate relay 270 as follows: battery, relay 270, 290, 291, 283, 282, 229, 228, 209, 219, 299 to ground. Relay 270 operated, closes the circuit previously described to operate magnet 281, thus causing relay 270 to release and the selector rod 297 to rotate another step and carry brushes 217, 218 and 219 to the terminals associated with the next trunk in the group. This cycle of operation continues until an idle trunk is found. When an idle trunk is found, ground will not be connected to its terminal 299, hence relay 270 will not reoperate, but a circuit will be closed to operate relay 220 as follows: battery, relay 270, 290, 291, 283, 282, 220, 215, 214, to ground. Relay 220 has been previously shunted out by ground at 230 or 219. Due to the high resistance of relay 220, relay 270 will not operate. Relay 220 operated, releases relay 200, connects lead 204 to brush 217 by way of 222, 223 and 207, lead 205 to brush 218 by way of 225, 226 and 208, and lead 206 to brush 219 by way of 227, 228 and 209. The calling subscriber's line is now extended by way of brushes 217 and 218 to the connector 6, and ground from the connector circuit is connected to brush 219 to cause the seized trunk to test busy. Relay 220 locks over the following circuit: battery, relay 270, 290, 291, 283, 282, 220, 227, 228, 209, 219 to ground. Relay 250 remains locked in parallel with relay 220 to ground at brush 219. Relay 200 released, releases relay 210, but the latter being slow-to-release will remain operated long enough for relay 220 to lock before its operating circuit is opened at 215 by the release of relay 210.

The circuit will be extended to the called station by means of connector 6 in the manner well-known in the art.

When the calling subscriber's receiver is replaced on the switchhook, ground will be removed from the brush 219, and relays 220 and 250 will release, and the release magnet 284 will operate as follows: battery, release magnet 284, 294, 293, 213, 212, 203, 202, 231, 230, to ground. When the release magnet 284 operates, the selector rod 297 releases and restores to normal, thus opening at 294 the circuit through the release magnet 284, which releases.

While the digit absorbing selector shown in Fig. 2 has, for purposes of illustration, been used as an incoming selector in a 1,000 line office to absorb the thousands digit, it is not so limited, but may be substituted for any selector switch in a series in an automatic telephone system, as conditions may dictate.

What is claimed is:

1. In a digit absorbing selector having a primary movement in response to more than one series of impulses and an automatic secondary movement, means for dissipating the first series of impulses, a relay, a circuit for operating said relay after the first series of impulses received by said selector has been dissipated, a magnet, and a circuit controlled by said relay for closing the circuit of said magnet so that the subsequent series of impulses will initiate the primary movement of the switch.

2. In a telephone system, a subscriber's line having an impulse sender at the substation, a selector, a circuit including said sender leading to the selector, an operating magnet for said selector, means in the selector for absorbing a series of impulses from said sender without operating said magnet to move the selector from normal, a relay, and means responsive to the completion of the absorbed series of impulses for energizing said relay to render said magnet responsive to the next series of impulses.

3. In a telephone system, a telephone line having an impulse sender at the substation thereof, an automatic switch, a circuit including said sender and extending to the automatic switch, an operating magnet for said switch, means in the switch for dissipating a series of impulses transmitted thereto by said sender without operating said magnet to move the switch from its normal position, a relay, means effective at the end of the dissipated series of impulses for closing an energizing circuit for said relay to prepare a circuit for said magnet, and means for operating the magnet in this circuit in response to the next series of impulses.

4. In combination, a subscriber's line having an impulse transmitter at the substation thereof, a selector switch, means for extending said line to said switch, an operating magnet and a control relay for said switch, means in said switch for absorbing the first series of impulses transmitted thereto by said transmitter without operating said magnet to move the switch from normal, means responsive to the completion of the first series for energizing said relay, and means controlled by said relay in its energized condition for rendering said magnet responsive to the next series of impulses.

5. The combination in a telephone system of a telephone line having a sender at the substation, a selector switch, means for extending said line to said switch, an operating magnet for said switch, a control relay, a second relay, means responsive to a series of impulses sent to said selector to operate the control relay without operating said magnet to move the selector, a circuit closed by said control relay responsive to the completion of said series of impulses to cause the operation of said second relay to prepare a circuit for said magnet, and means responsive to the next series of impulses transmitted to the switch for operating said magnet.

6. In a telephone exchange system, a call-

ing line having an impulse sender at the substation thereof, a plurality of groups of called lines, the directory numbers of all said lines having the same number of digits, a series of switches for each group for extending the calling line to a called line therein some of said series having a less number of switches than others, an operating magnet and a control relay for certain of said switches, means in each of said latter switches for absorbing a series of impulses when transmitted thereto by said sender without operating the magnet to move the switch from normal, means for operating the control relay responsive to the completion of the absorbed series to prepare a circuit for the operating magnet, and means responsive to the next series of impulses sent to the switch for actuating the magnet in the prepared circuit to advance the switch.

7. In an exchange system, a calling line, two groups of called lines, all having directory numbers with the same number of digits, a series comprising a certain number of step-by-step switches for extending the calling lines to called lines in one of said groups, a series having a less number of step-by-step switches for extending the calling line to the lines of said other group, a stepping magnet and a control relay for one of said switches, means for transmitting series of impulses, means for dissipating a series of impulses when sent to said last switch without operating the stepping magnet, means responsive to the completion of the dissipated series for energizing said relay to prepare a circuit for said magnet, and means responsive to a subsequent series of impulses for actuating said magnet in the prepared circuit to advance the switch.

In testimony whereof, we have signed our names to this specification this 22 day of October, 1923.

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