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G. E. DUSTIN

AUTOMATIC TELEPHONE SYSTEM

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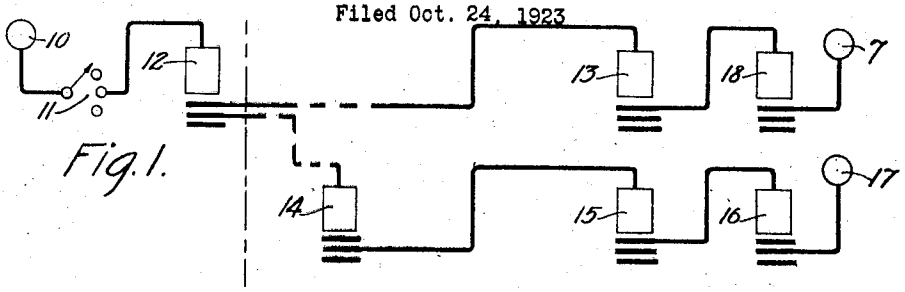


Fig. 1.

Fig. 2.

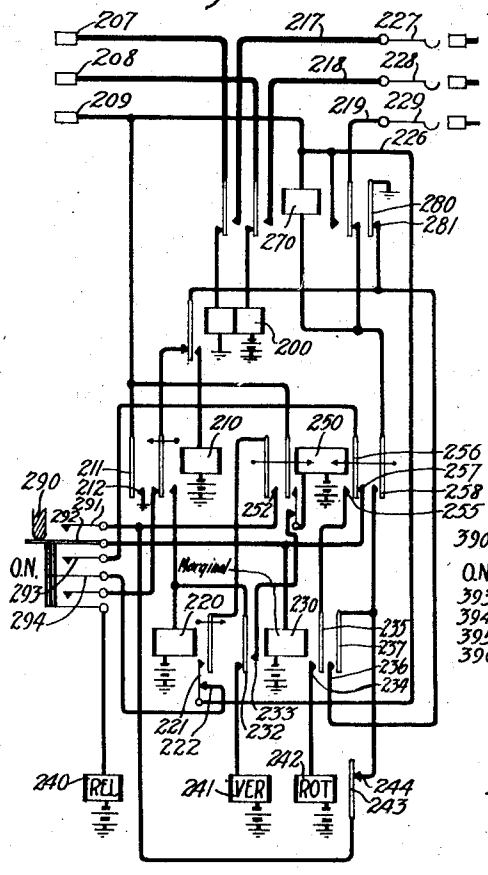
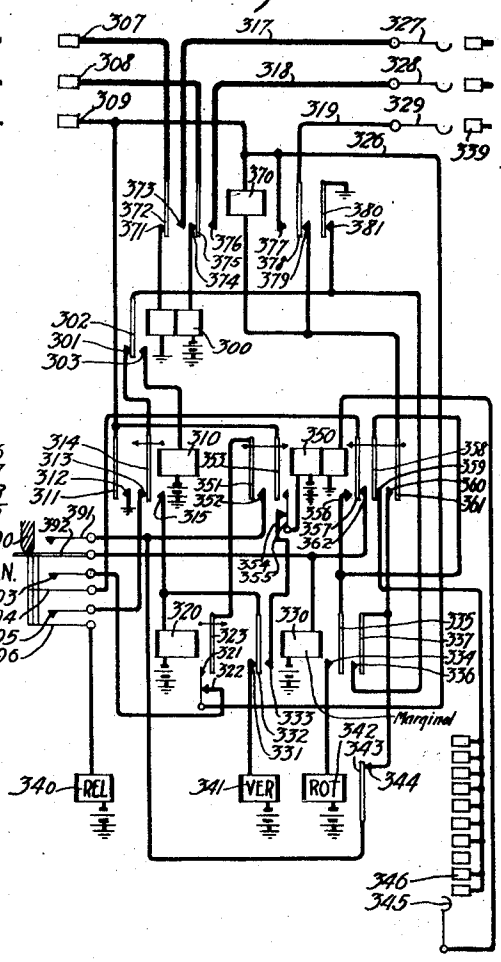


Fig. 3.



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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.

Its object is the provision of an improved trunking arrangement for an automatic telephone system 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.

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

In accordance with this invention, a circuit arrangement is provided whereby the selector responds to the first series of impulses which it receives and is set in its primary direction, and means is provided whereby it remains in this position until after the next set of impulses have been transmitted to this selector whereupon it automatically hunts for an idle trunk. Thus, the lines in a given 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; Fig. 2 is a circuit diagram of a selector arranged to absorb the second digit dialed into it irrespective of the level selected, and Fig. 3 is a circuit diagram of a selector arranged to absorb the second digit dialed into it on certain specified levels only.

Fig. 1 shows the organization of a trunking system as applied to an automatic telephone system having an ultimate capacity of one hundred thousand lines. 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 14, a third selector 15, and a connector 16, in the selected office, to complete the connection.

Considering Fig. 1 in conjunction with Fig. 3, the office which is reached when the first digit dialed is 2 as well as the other offices in the system with the exception of the one which is reached when the first digit dialed is 3, 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 3 is the first digit dialed, has for the time being no more than one thousand telephone lines terminating in it.

In order to point out the trunking arrangement more clearly, it will be assumed that the subscriber at substation 10 (Fig. 1) desires to call the subscriber at substation 17, in which case, the connection may be extended as follows: from the substation 10 by way of the individual line switch 11, first or office selector 12, 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 10 calls the subscriber at the substation 7, the connection may be traced as follows: from the substation 10 by way of the individual line switch 11, first selector 12, third or incoming selector 13, and the connector 18, to the substation 7. This latter connection extends over a path similar to the one for the substation 17, except that it does not pass through any second or thousands selector such as 14. 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 12 so that it will not commence to trunk hunt after initiating the primary or vertical movement when the first digit dialed is 3 until after the second digit irrespective of what it may be, is dialed and cancelled, when the selector 12 proceeds to trunk hunt in the manner well-known in the art.

The apparatus having been thus described in a more or less general manner, its opera-

tion will now be described in greater detail. For this purpose it will be assumed that the subscriber at substation 10 (Fig. 1) desires to talk with the subscriber at substation 7, in which case, the second digit will need to be absorbed. When the receiver is removed at substation 10, the individual line switch 11 is operated to extend the connection to an idle first or office selector 12 in the manner well-known in the art. Assuming that a digit absorbing selector of the type shown in Fig. 3 is the selector 12 in Fig. 1 to which the connection is extended, the following circuit is closed to operate relay 300: battery, right winding of relay 300, 374, 375, 308, subscriber's line and instrument, 307, 372, 371, left winding of relay 300 to ground. Relay 300 operates and closes a circuit to operate relay 310 as follows: battery, relay 310, 303, 302, 381, 380 to ground. Relay 310 connects ground to lead 309, to cause the selector to test busy to other line switches over a circuit as follows: ground 312, 311 to lead 309. The selector switch is now ready to receive the first series of impulses set up by the subscriber's calling device, which series ordinarily in a multi-office district, corresponds to the office code of the number dialed, and relay 300 follows the impulses. When relay 300 releases on the first break in the line, a circuit is closed to operate relay 320 as follows: battery, relay 320, 315, 314, 301, 302, 381, 380 to ground. The primary or vertical magnet 341 also operates in parallel with relay 320 by way of 331 and 332. Relays 310 and 320 are made slow-to-release, to prevent them from releasing when relay 300 opens alternately, their respective holding paths during the impulse period, but the vertical magnet 341 follows the impulses set up by relay 300. The first time the vertical magnet 341 operates it raises the selector rod 390 of which only a part is shown, sufficiently to close the contacts 391 and 392, 393 and 394, and 395 and 396, thus preparing a circuit whose function is hereinafter described. Each time the vertical magnet 341 operates, the selector rod 390 carrying the brushes 327, 328 and 329 is raised one step in the manner well-known in the art, until, when the impulses cease the brushes 327, 328 and 329 are in the proper position to engage with the terminals of the first trunk in the selected level, as soon as the rotary magnet 342 operates as hereinafter described. When the series of impulses ceases relay 300 remains energized and opens at 302 the circuit through relay 320 which releases. When relay 320 releases a circuit is closed to operate relay 330 as follows: battery, relay 330, 362, 357, 394, 393, 322, 321, 326, 311, 312 to ground. Relay 330 operated, locks as follows: battery, relay 330, 392, 391, 343, 344, 337, 336, 381, 380 to ground. Relay 330 operated, disconnects at 331 the vertical magnet 341 from the circuit. The selector switch is now ready to receive the series of impulses ordinarily corresponding to the thousands digit of the number dialed, but which, in the present case, will be absorbed.

The next series of impulses, 3 in number, corresponding to the thousands digit is now dialed and relay 300 follows the impulses as before, operating relay 320 in the manner previously described. Relay 350 also operates in parallel with relay 320 over a circuit as follows: battery, left winding of relay 350, 355, 354, 333, 332, 315, 314, 301, 302, 381, 380 to ground. Relay 350 operated locks as follows: battery, left winding of relay 350, 355, 353, 311, 312 to ground. Relay 320 operates before relay 350, thus disconnecting the rotary magnet 342 from the circuit to prevent it from operating prematurely. Since the relay 320 remains operated during the impulse period and since the rotary magnet 342 cannot operate while relay 320 is operated, the second series of impulses will be dissipated before relay 320 releases and it is therefore apparent, that the second series of impulses will be rendered ineffective before relay 320 releases and permits the rotary magnet 342 to trunk hunt. When the second series of impulses ceases, relay 320 releases as previously described and closes a circuit to operate the rotary magnet 342 as follows: battery, rotary magnet 342, 334, 335, 356, 357, 394, 393, 322, 321, 326, 311, 312 to ground. The rotary magnet 342 operated opens at 343 the holding circuit through relay 330, and causes the selector rod 390 to rotate and advance the brushes 327, 328 and 329, to the terminals of the first trunk in the level selected. If the first trunk in the group selected is busy, ground will be present on terminal 339, and when the rotary magnet 342 releases, a circuit will be closed to re-operate relay 330 as follows: battery, relay 330, 392, 391, 343, 344, 360, 361, 379, 378, 319, 329 to ground. Relay 330 operated, closes the circuit previously described to operate rotary magnet 342, thus causing relay 330 to release and the selector rod 390 to rotate another step and carry brushes 327, 328 and 329 to the terminals associated with the next trunk in the group. This cycle of operations continues until an idle trunk is found. When an idle trunk is found, ground will not be connected to brush 329. Hence, relay 330 will not operate, but a circuit will be closed to operate relay 370 as follows: battery, relay 330, 392, 391, 343, 344, 360, 361, 370, 311, 312 to ground. Relay 370 has been previously shunted out by ground at 329 or 380. Due to the high resistance of relay 370 relay 330 will not operate. Relay 370 operated releases relay 300; connects lead 307 to brush 327 by way of 372, 373, and 317; lead 308 to brush 328

by way of 375, 376, and 318; and lead 309 to brush 329 by way of 377, 378 and 319. The calling subscriber's line is now extended by way of brushes 327 and 328 to a selector such as the selector 13 shown in Figure 1, and ground from selector 13 is connected to brush 329 by way of terminal 339. Relay 370 now locks over the following circuit: battery, relay 330, 392, 391, 343, 344, 360, 361, 370, 377, 378, 319, 329 to ground. Relay 350 remains locked in parallel with relay 370 over a circuit as follows: battery, left winding of relay 350, 355, 353, 377, 378, 319 to ground at brush 329. Relay 300 released, releases relay 310 but the latter being slow-to-release, will remain operated long enough for relay 370 to lock before its operating circuit is opened at 311 by the release of relay 310.

The circuit will be extended to the called station 7 (Fig. 1) by means of other selector switches such as the selector 13 and connector 18 in the manner well-known in the art.

When the receiver is replaced on the switchhook at the calling subscriber's station, ground will be removed from the brush 329 and relays 350 and 370 will release and the release magnet 340 will operate as follows: battery, release magnet 340, 396, 395, 313, 314, 301, 302, 381, 380 to ground. When the release magnet 340 operates the selector rod 390 releases and restores to normal, thus opening at 396 the circuit through the release magnet 340 which releases.

It will now be assumed that the subscriber at substation 10 (Fig. 1) desires to talk with the subscriber at substation 17, in which case the first digit dialed is the digit 2 and the second digit dialed must not be absorbed.

When the receiver is removed at substation 10 (Fig. 1), the individual line switch 11 is operated to extend the connection to the selector switch 12 as before. The first series of impulses is dialed, and relays 300, 310, 320 and the vertical magnet 341, operate and function in the manner previously described. When the first series of impulses ceases, relay 320 releases, and closes the circuits previously described, to operate and lock relay 330. Assuming that the digit 2 was the first digit dialed, the vertical magnet 341 will have operated twice and raised the selector rod 390 carrying the brushes 327, 328, 329 and 345 two steps, so that the brushes 327, 328 and 329 will be in a position to engage the terminals of the first trunk in the second level, when the rotary magnet 342 operates, as hereinafter described. The brush 345 will also be resting upon contact 346 of the commutator. A circuit will now be closed as follows to operate relay 350: battery, rotary magnet 342, 334, 335, 358, 359, 346, 345, left winding of relay 350 to ground. Due to the high resistance of the winding of relay 350, the rotary magnet will not operate over this circuit. Relay 350 operated locks and from this point the selector switch immediately hunts for an idle trunk and functions in the manner previously described to extend the circuit to the called line 17 by way of the selector switches 14 and 15 and the connector 16.

Thus it is apparent that since the selector switch commences to trunk hunt after the first series of impulses ceases, and before the second digit is dialed, the selector switch is in effect under these conditions, merely performing the function required of the standard selector ordinarily used in the Strowger system, and is not called upon to cancel the second digit by rendering it ineffective.

The selector switch shown in Fig. 2 is a modification of the circuit shown in Fig. 3. This selector switch absorbs the second digit dialed into it irrespective of its character. In a system such as is shown in Fig. 1 if a digit absorbing selector of this type were used it would necessarily be substituted for the selector switch 13, and a standard selector switch would in such case be used in place of the first or office selector 12.

Considering Fig. 2 in conjunction with Fig. 1 let us assume that the calling subscriber's station 10 (Fig. 1) desires to call the substation 7, then when the circuit from the calling station 10 is extended by way of the line switch 11, and a standard selector, to the digit absorbing selector 13 (Fig. 2), a circuit to operate relay 200 will be closed over leads 207 and 208. Relay 210 will operate and connect ground to lead 209 by way of 211 and 212, to cause the selector to test busy to other first selectors. Slow relay 220 and the vertical magnet 241 being in parallel, will operate when relay 200 releases during the impulse period, and the selector rod 290 carrying the brushes 227, 228 and 229, will advance until the brushes are opposite the level selected. When the impulses cease relay 220 releases, closing the circuit to operate relay 230 as follows: battery, relay 230, 257, 256, 293, 294, 222, 221, 226, 211, 212 to ground. Relay 230 operated locks as follows: battery, relay 230, 292, 291, 243, 244, 237, 236, 281, 280 to ground. Relay 250 is now connected in parallel with relay 220, by way of 233 and 232 so that when the next series of impulses is dialed and relay 200 periodically releases, relays 220 and 250 will both operate. Relay 250 operated, locks to ground at 211 and 212. The circuit to operate the rotary magnet 242 is opened at 222 as long as relay 220 is operated, but as soon as relay 220 releases at the end of the second series of impulses a circuit is closed to operate the rotary magnet 242 as follows: battery, rotary magnet 242, 234, 235, 255, 256, 293, 294, 222, 221, 226, 211, 212 to ground. Thus it is evident that

since the rotary magnet 242 was prevented from operating until after the impulses corresponding to the second digit dialed into the selector had ceased, such second digit was rendered ineffective and thereby cancelled.

From this point the selector will hunt for an idle trunk as described in connection with Fig. 3. The connection will be extended to the connector 18 and substation 7 in the manner well-known in the art. When the calling station receiver is replaced on the switchhook, relay 270 releases, closing the circuit to operate the release magnet 240 and the selector switch is restored to normal in the well-known manner.

While the digit absorbing selectors shown in Figs. 2 and 3, have for purposes of illustration, been respectively used as an incoming selector and an office selector, they are not so limited but may be substituted for any selector switch of a series in an automatic telephone system as conditions may dictate.

What is claimed is:

1. In combination, a telephone line, an automatic switch, means for extending the line to said switch, means for sending a series of impulses to operate said switch to further extend said line, and means in said switch for absorbing the next series of impulses transmitted thereto.

2. In combination, an automatic selector switch, trunks terminating therein, an impulse sender, a circuit including said switch and sender for directively operating said switch in accordance with a series of impulses, means in said switch for rendering ineffective the next set of impulses while maintaining said switch in its set position, and means thereupon automatically operated for causing said switch to select an idle trunk.

3. In an automatic telephone system, a calling line equipped with a calling device, a first selector, second selectors, and connectors responsive to impulses set up by said calling device, each selector switch having both a primary and a secondary movement, groups of telephone lines, one of said groups being reached from said first line via said first selector a second selector and a connector, certain others of said groups being reached from said first line via said first selector, a second selector, a third selector and a connector, all of the lines aforesaid being designated by telephone numbers having the same number of digits, and means for preventing said first selector from moving off normal in a secondary movement until after receiving a second series of impulses dialed into it from said calling device whenever a telephone line reached via said first mentioned second selector is called.

4. In a multi-office automatic telephone system, a calling line equipped with a calling device terminating in a first office, a second telephone line terminating in a second office, a third telephone line terminating in a third office, all of said telephone lines being designated by telephone numbers having the same number of digits, a first selector in said first office, a series of switches in the second office operable to connect said calling telephone line with the said second line via said first selector, another series of switches in the third office operable to connect said calling line with the third telephone line via said first selector, said latter series of switches being greater by one than the former series, each selector switch having both a primary and secondary movement, and means for preventing said first selector from moving off normal in a secondary movement until after receiving a second series of impulses dialed into it from said calling device whenever a telephone line in said second office is called.

5. In a digit absorbing selector having a primary movement in response to a series of impulses, and an automatic secondary movement, an off-normal spring, an impulse relay, a fast relay, a slow to operate relay, a slow release relay, and an electromagnet in combination, a circuit to operate said fast relay under control of said contact spring and said slow release relay, a circuit to operate said slow to operate relay under control of said fast relay and said impulse relay, and a circuit controlling said electromagnet under control of said fast relay and said slow to operate relay to prevent said electromagnet from initiating the secondary movement of said selector switch until after a second series of impulses has been received.

6. In a telephone system, a selector switch, means responsive to impulses for operating the same, said switch having primary and secondary selecting movements, an electromagnet, a double wound relay, a slow relay energized during the first impulse period and deenergized at the completion thereof to energize said double wound relay at the completion of the first impulse period on certain levels, and during the second impulse period on other levels, and a circuit controlled by said double wound relay for energizing said electromagnet to initiate the secondary movement of said selector switch, in order to absorb or utilize at will a particular series of impulses.

7. In a telephone system, a selector switch responsive to impulses, said switch having primary and secondary selective movements, a fast relay, a slow release delay energized during the primary movement and deenergized on the completion thereof to operate said fast relay, a slow to operate relay under control of said fast relay in combination with said slow release relay, an electromag-

net, and a circuit for said electromagnet so controlled by the relays aforesaid in combination as to prevent said electromagnet from initiating the secondary movement of said selector switch until a second series of impulses have been received, in order to cancel one of the digits in the number without releasing the selector switch.

8. In a telephone system, serially related groups of automatic switches responsive to impulses, and means comprising circuit arrangements in each switch of one or more groups for preventing a secondary movement of said switch on one or more levels until after a second series of impulses has been received by said switch.

9. In combination, a telephone line, a series of automatic switches, means for extending the line to said switches, means for sending a series of impulses to operate a certain one of said switches for the purpose of further extending said line to the succeeding switch, means in said certain switch for absorbing the next series of impulses transmitted thereto, and means effective following the absorption of said series of impulses for transmitting succeeding series of impulses to operate the succeeding switches.

In testimony whereof, I have signed my name to this specification this 22nd day of October 1923.

GEORGE E. DUSTIN.