March 10, 1931. W. WHITNEY 1,795,813

TELEPHONE SYSTEM

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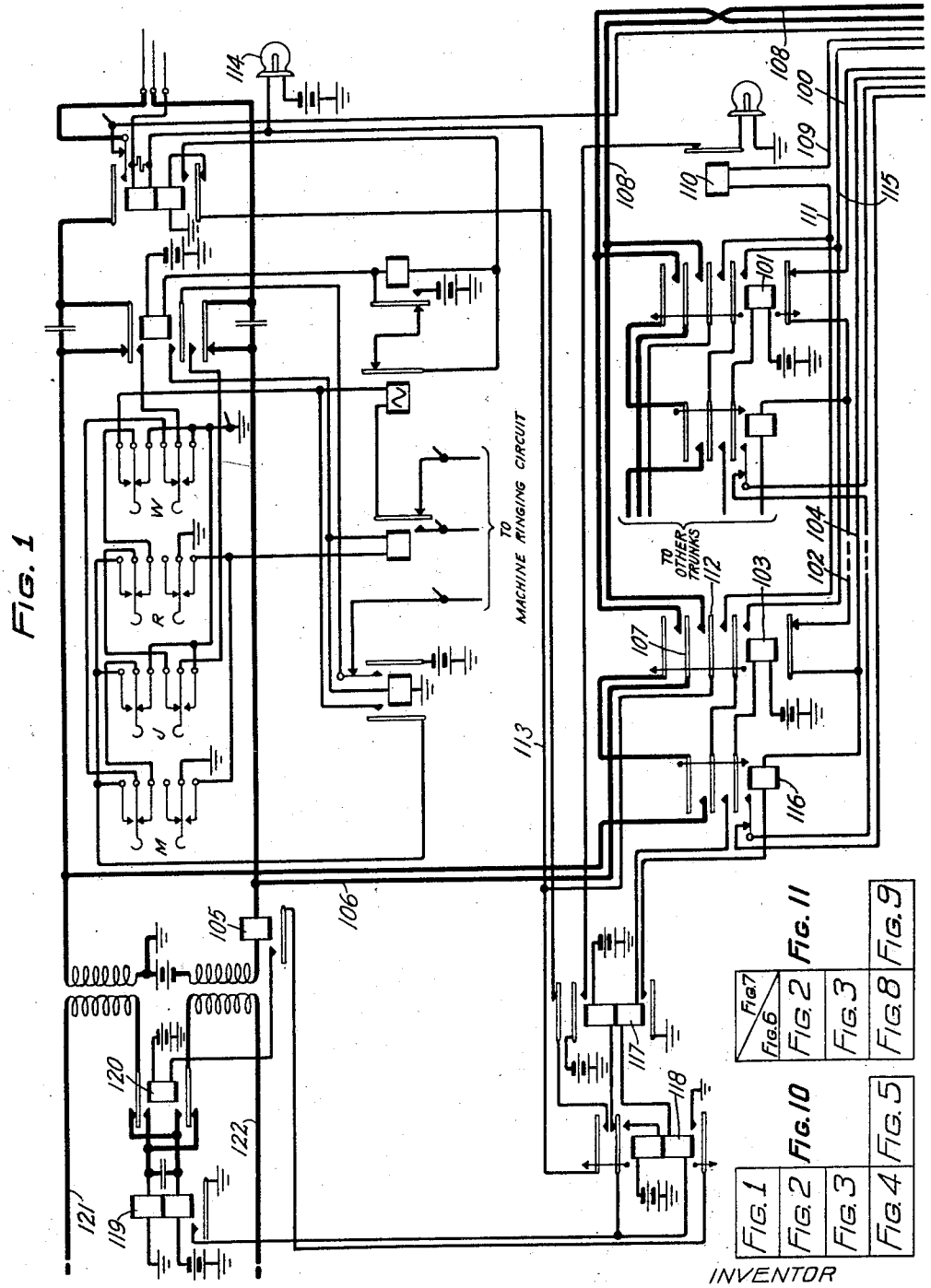

FIG. 1

FIG. 11

Fig.7 / Fig.6	Fig. 2	Fig. 3	Fig. 8

Fig. 9

FIG. 10

Fig. 1	Fig. 2	Fig. 3	Fig. 4

Fig. 5

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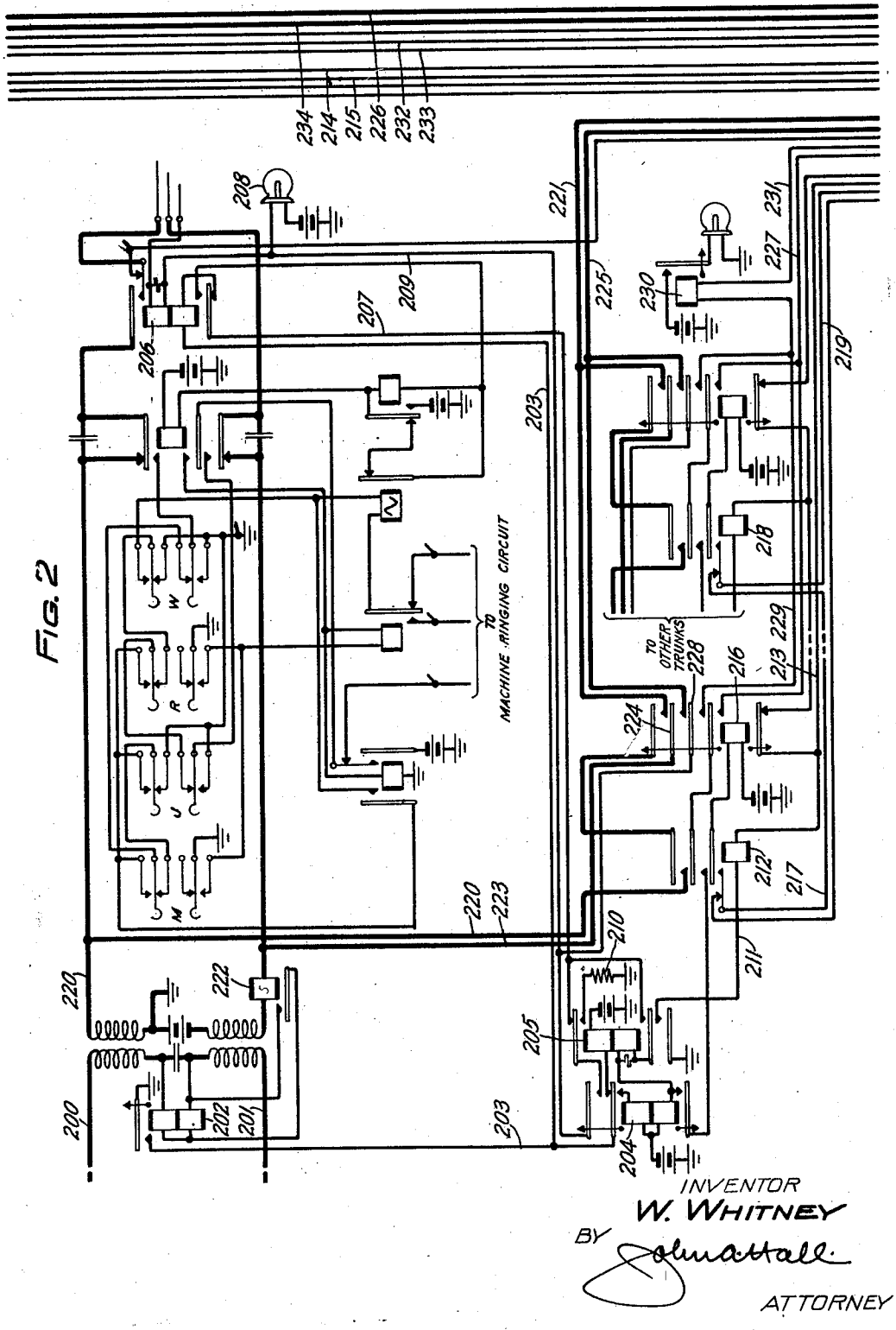

FIG. 2

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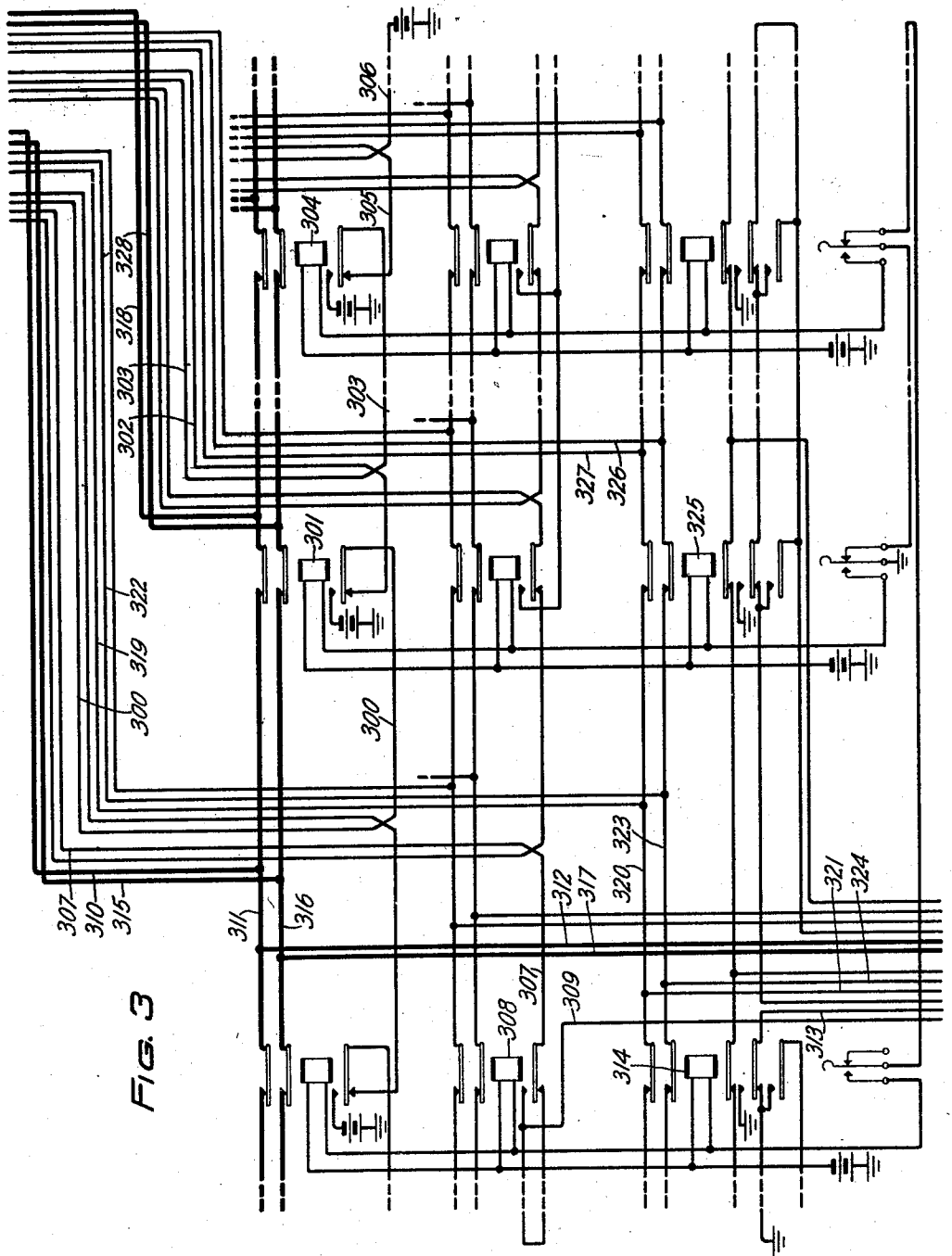

FIG. 3

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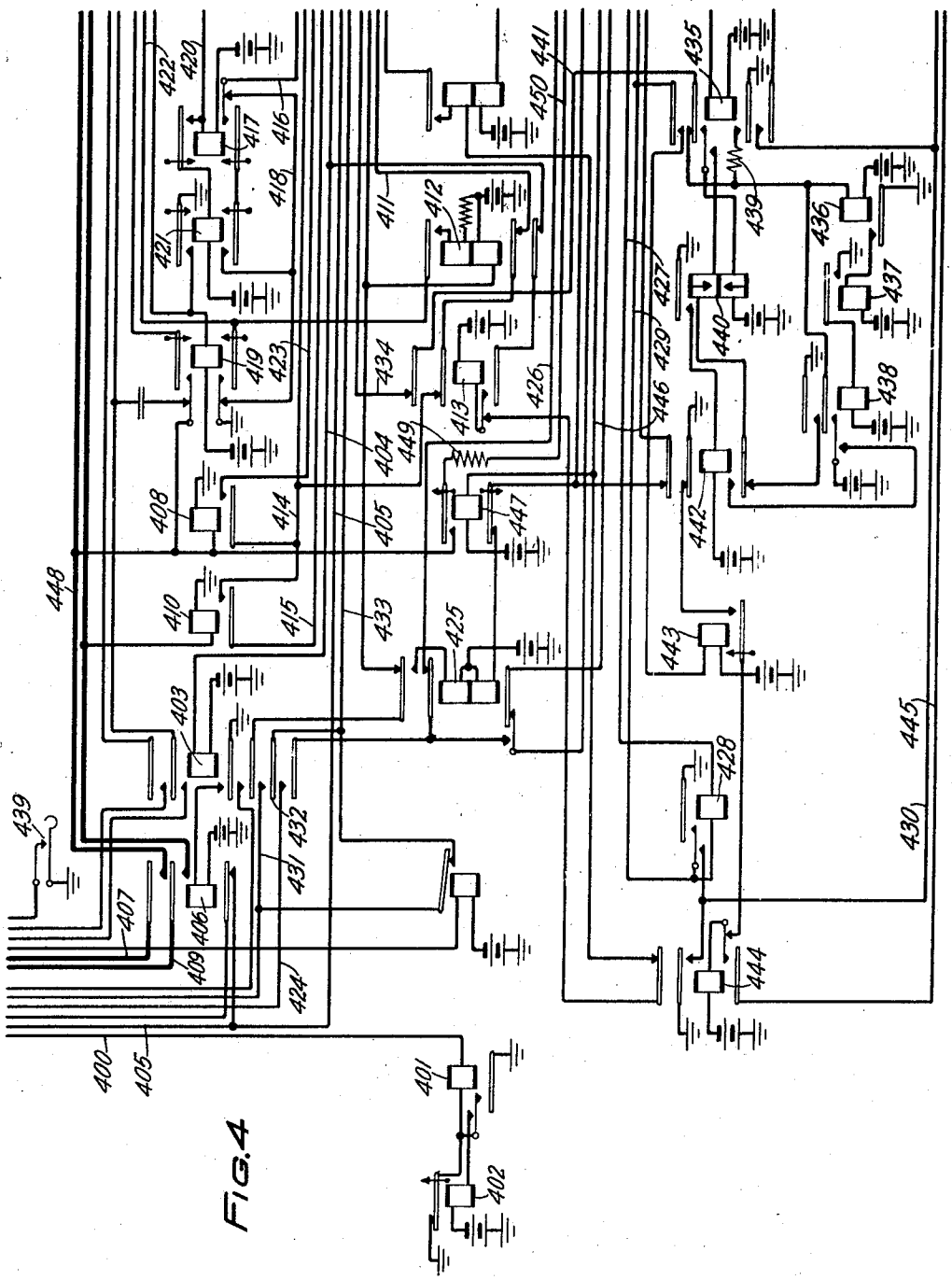

FIG. 4

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TELEPHONE SYSTEM

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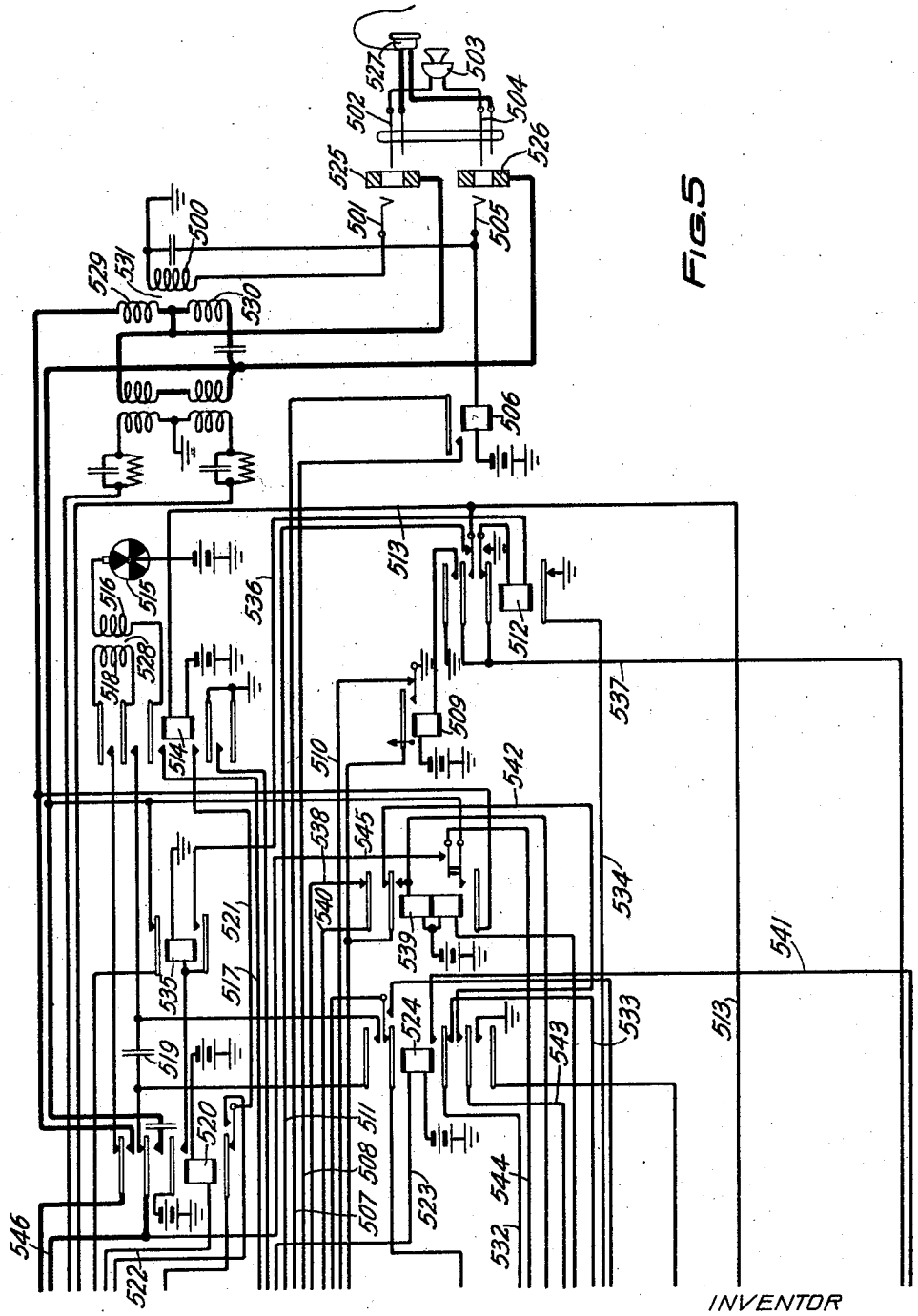

FIG.5

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TELEPHONE SYSTEM

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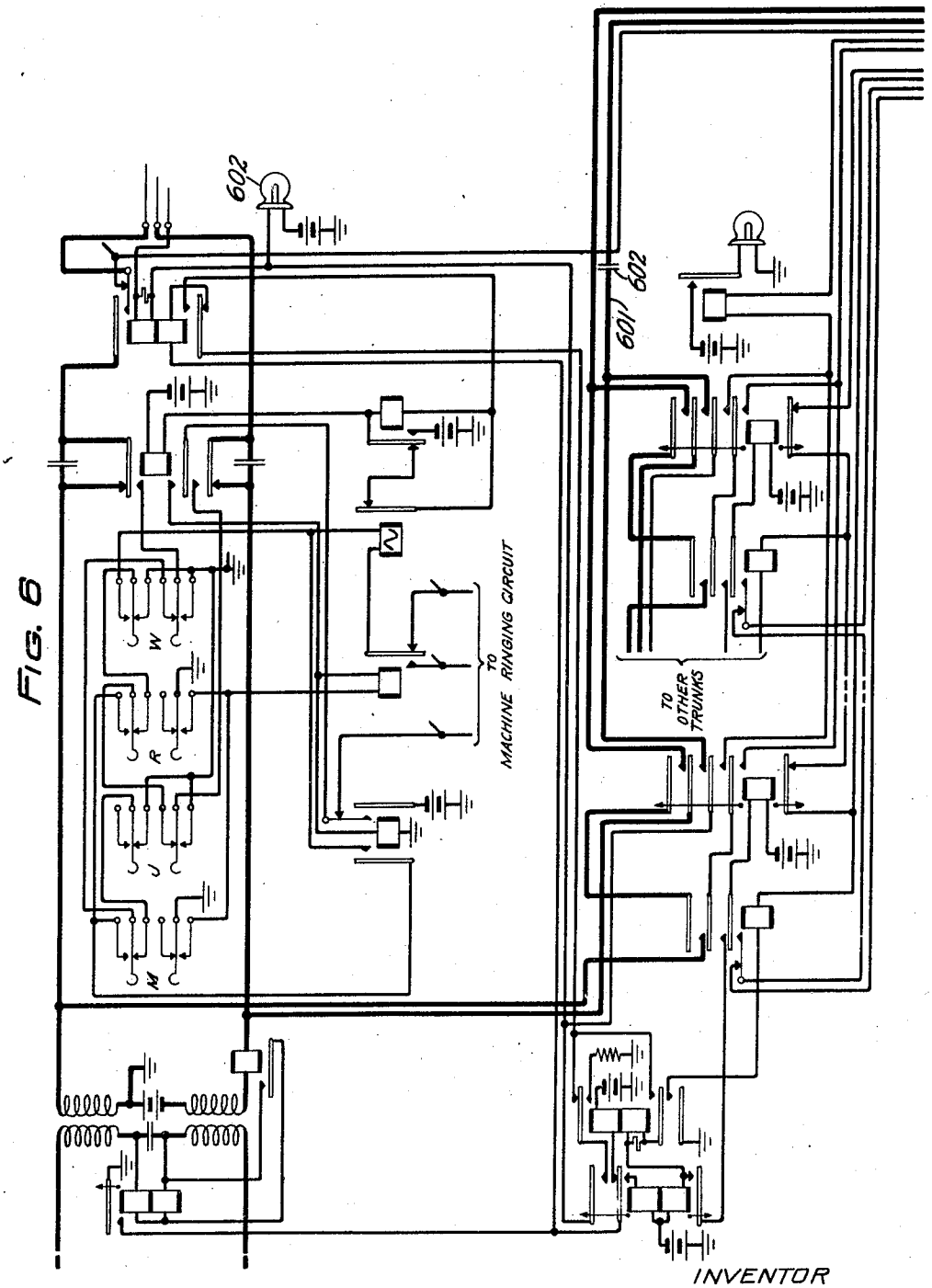

FIG. 6

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TELEPHONE SYSTEM

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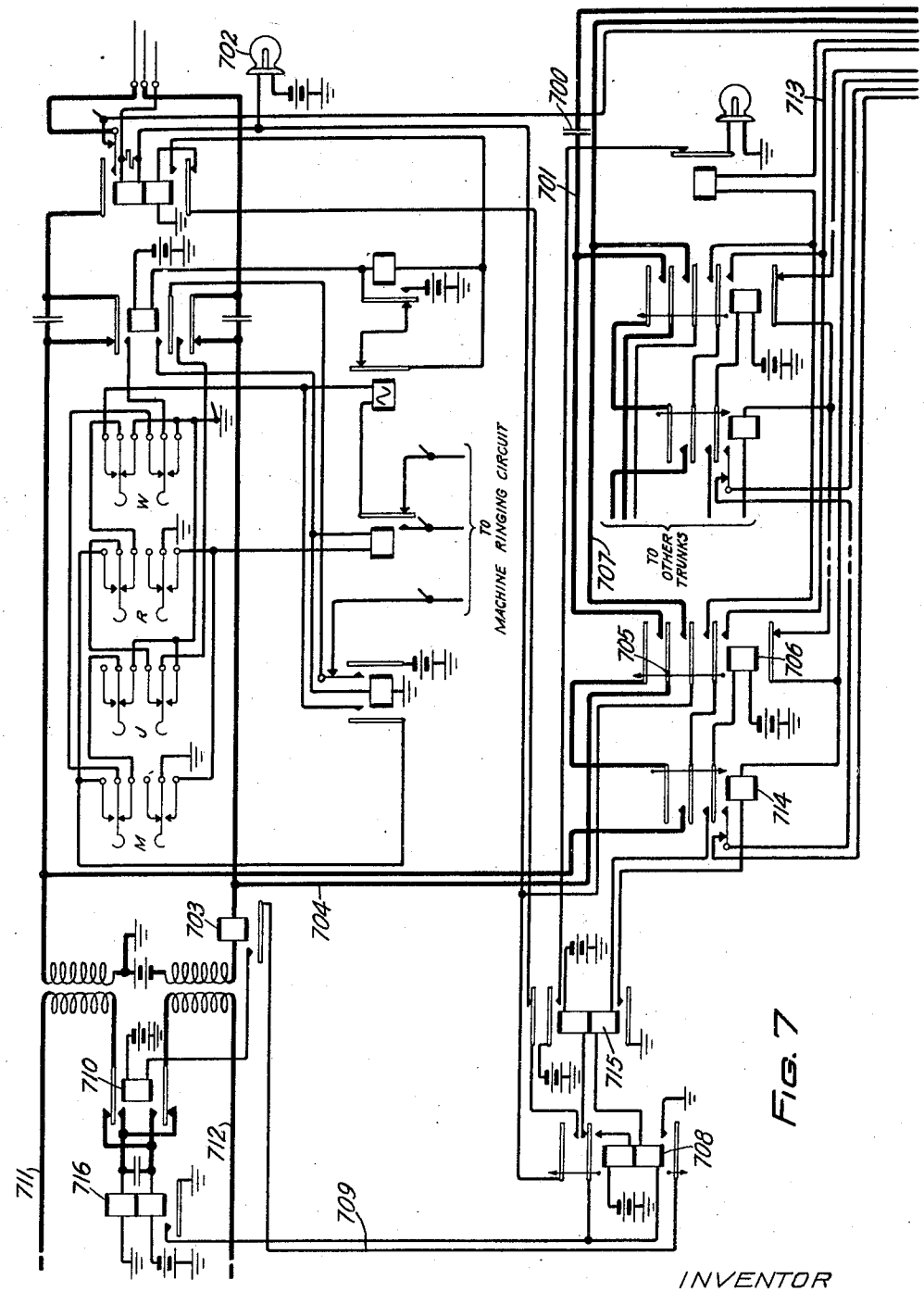

FIG. 7

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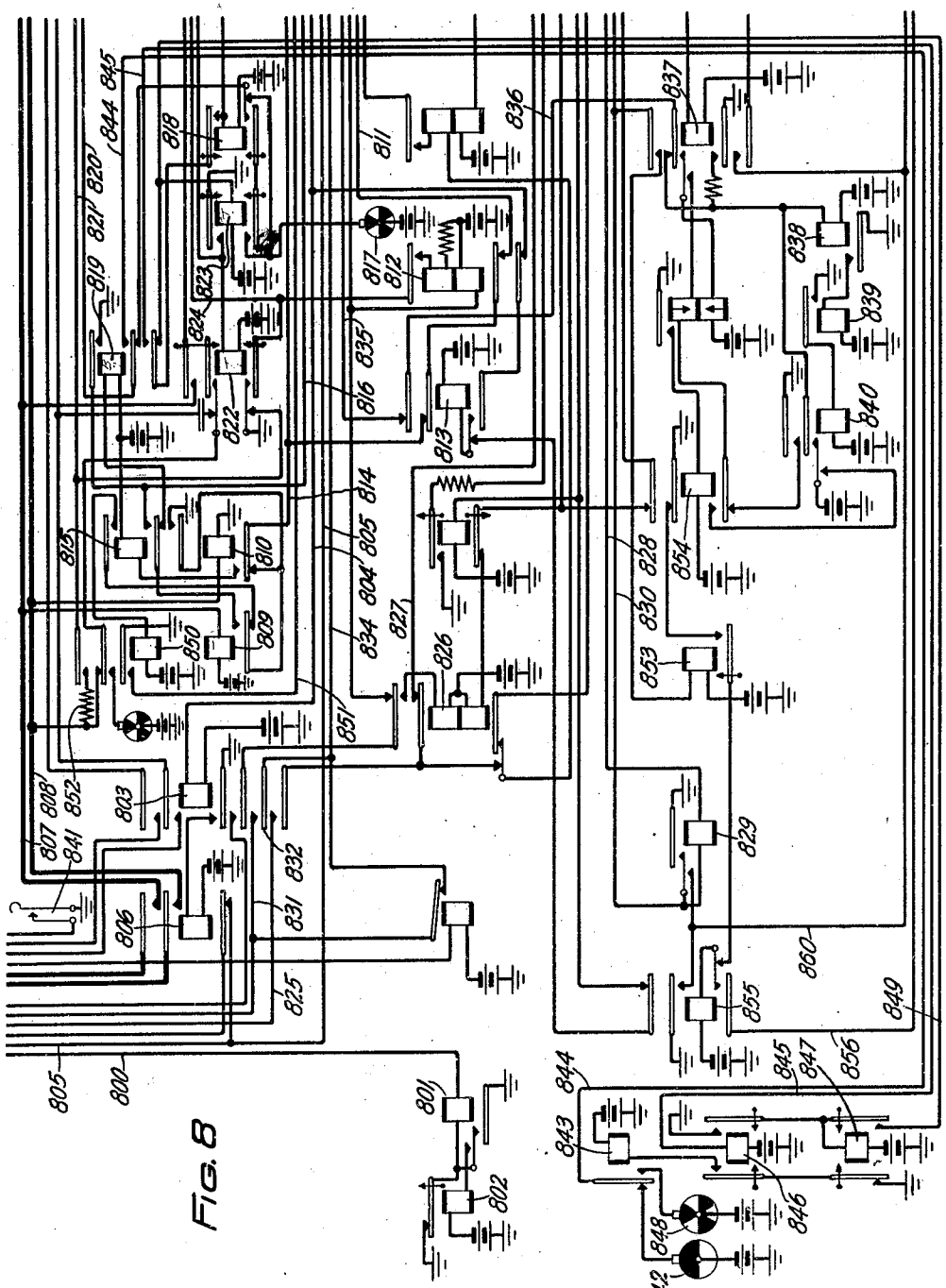

FIG. 8

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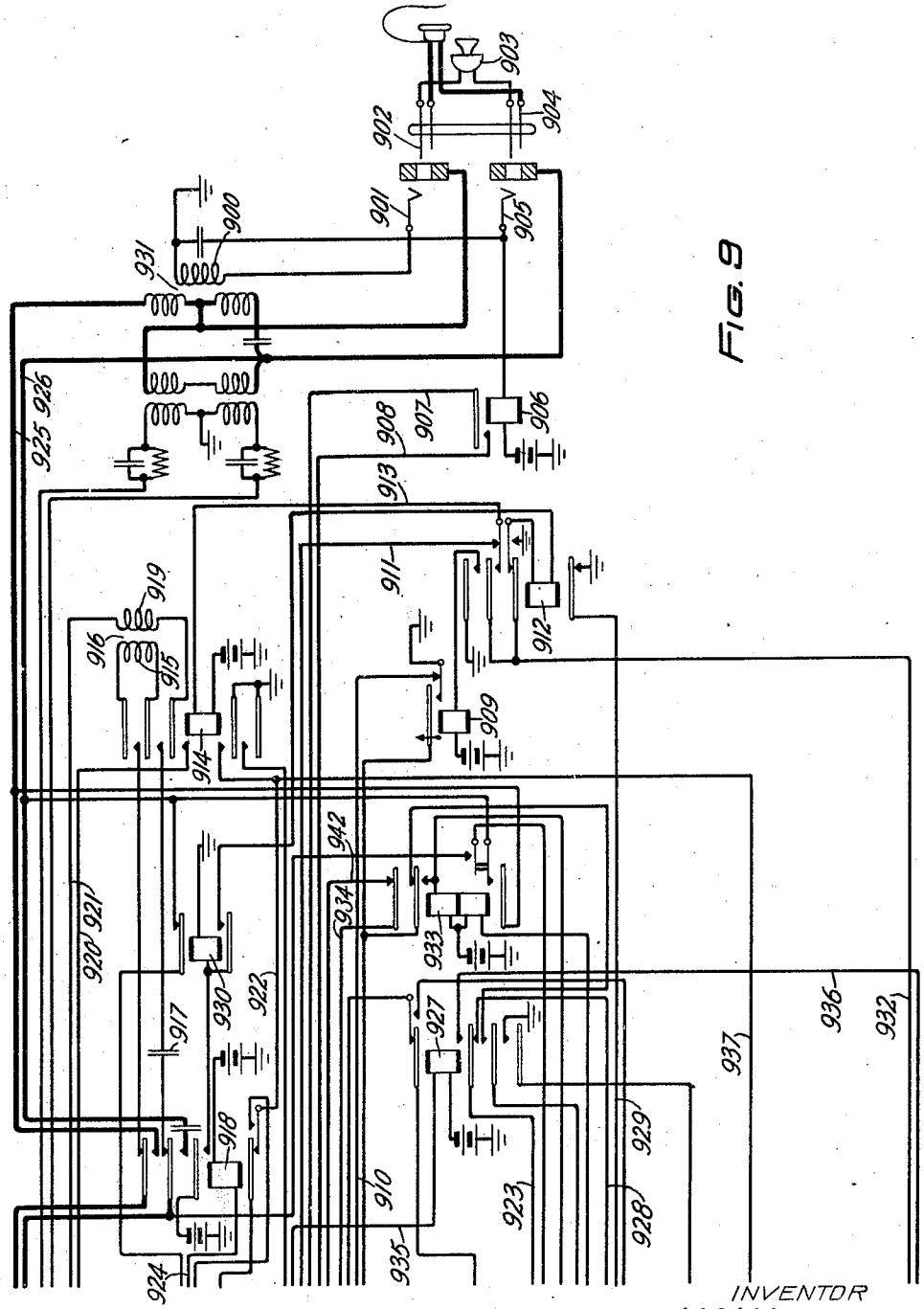

FIG. 9

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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed August 9, 1929. Serial No. 384,619.

This invention relates to telephone systems and particularly to signaling arrangements in trunking systems.

In trunking systems where it is the practice for the originating operator to select an idle outgoing trunk at random, the connection of the incoming operator's set to the seized trunk is made known to the originating operator by the transmission of an "order tone." In other trunking systems where calls are mechanically extended to an incoming operator's position, the connection of the incoming operator's set to the seized trunk is made known to the apparatus at the outgoing end of the seized trunk by the transmission of a signal comparable in function to the "order tone". As a specific example, there are what are known as "call announcer" trunks wherein apparatus at the outgoing end upon receipt of the signal comparable to the "order tone" will mechanically pronounce the information necessary to be imparted to the incoming operator in such a manner that she will hear the spoken words.

For purposes of designation therefore the term "order signal" will be used herein to cover both the "order tone" which is transmitted to the ears of the outgoing operators and the signal which is transmitted to the apparatus of such mechanism as that of the call announcer trunks.

Due to the complexity of the telephone systems in great metropolitan centers it is necessary that different types of order signals be used to transmit proper information in accordance with the type of trunk being used at any given time. For instance it is necessary in one case to import the information that only the name of the office to which the call being handled is directed is to be pronounced; in another case that both the name of the office and the number of the wanted line is to be pronounced; and in a third case that only the number of the wanted line is to be pronounced. In order to secure a standard method of operation, therefore, there must be means for giving an order signal which is distinctive for each such class of service, and usually such means is incorporated in what is known as the operator's control circuit which under the proper conditions operates to connect the incoming operator's set to a seized trunk.

Due also to the complexity of the telephone systems in great metropolitan centers where incoming trunks from a large number of other points have to be served at one point, it is necessary that an incoming operator be able to handle traffic over more than one type of trunk. The present invention therefore contemplates means in the operator's control circuit for automatically distinguishing between the different types of trunks to which it may be connected and for selectively transmitting different types of order signals in accordance therewith.

The drawings consist of nine sheets of circuit diagrams and arranged according to Fig. 10 and Fig. 11, illustrating two forms of the present invention.

Fig. 1 shows a call announcer trunk and its associated sequence circuit;

Fig. 2 shows a straightforward trunk and its associated sequence circuit;

Fig. 3 illustrates a splitting circuit and Figs. 4 and 5 illustrate the operator's control and telephone circuit suitable for cooperating with the particular arrangements of the trunks shown in Figs. 1 and 2;

Fig. 6 shows a straightforward tandem trunk and its associated sequence circuit similar to that shown in Fig. 2;

Fig. 7 shows a call announcer trunk and its associated sequence circuit similar to that shown in Fig. 1;

Figs. 8 and 9 illustrate the operator's control and telephone circuit suitable for cooperation with the particular arrangements of trunks shown in Figs. 1, 6 and 7.

In general the arrangement shown in the drawings, in accordance with Fig. 10, is such that the operator's control circuit automatically differentiates between incoming trunks through the connections of the tip and ring conductors from the sequence circuit to the splitting circuit. If a call comes in over the straightforward trunk of Fig. 2, then due to the fact that the tip and ring conductors are connected straight through from the sequence circuit, the operator's control circuit

will return an order signal in the form of two momentary applications of order tone. If on the other hand a call comes in over the call announcer trunk of Fig. 1, then due to the fact that the tip and ring conductors are reversed between the sequence circuit and the splitting circuit, the operator's control circuit will return an order signal in the form of a direct current which will cause a battery reversal over the trunk.

In the arrangement shown in Fig. 11, when a call comes in over the straightforward trunk of Fig. 2, then due to the fact that the tip and ring conductors are connected straight through from the sequence circuit to the splitting circuit, the operator's control circuit will return an order signal in the form of two momentary applications of order tone both of the same pitch. When a call comes in over the straightforward tandem trunk of Fig. 6, then due to the fact that the ring conductor is blocked by a condenser between the sequence circuit and the splitting circuit, the operator's control circuit will return an order signal in the form of several successive momentary applications of order tone of different pitch. When a call comes in over the call announcer trunk of Fig. 7, then due to the fact that the tip conductor is blocked by a condenser between the sequence circuit and the splitting circuit, the operator's control circuit will return an order signal in the form of a direct current which will cause a battery reversal over the trunk conductors.

A splitting circuit shown in Fig. 3 is that part of the total circuit used for a whole team of operators pertaining to a single position. It will be noted that while this circuit serves three sequence circuits, this is merely representative since the trunks appearing at one position may be divided into more or less than three groups. If the right hand group of relays of the splitting circuit is operated, then the trunks served by the indicated right hand sequence circuit will be handled by the operator to the right. If the middle group of relays of the splitting circuit is operated, then the trunks served by both the middle sequence circuit and the indicated right hand sequence circuit will be handled by the operator to the right. If the left hand group of relays of the splitting circuit is operated, then the trunks served by other sequence circuits to the left are cut off from the position here indicated. When each of the operators has operated the left hand group of splitting relays, then each operator may confine her activities to the trunks normally appearing at her own position. Thus a flexible operating arrangement is provided so that with an operator's control and telephone circuit like that of Figs. 4 and 5 or like that of Figs. 8 and 9, the objects of the present invention may be realized even in the case where all the trunks at one position are of the same nature, but differ from those of adjacent positions.

When the straightforward trunk at Fig. 2 is seized at its outgoing end, battery and ground are placed on the conductors 200 and 201, whereupon current will flow through the two windings of relay 202 in series. Relay 202 becoming energized, places ground on conductor 203, which will extend through the inner, upper armature and back contact of relay 204, the upper winding of relay 205 to battery and ground. Relay 205 becomes operated and completes a connection from the ground on conductor 203 through the lower winding of relay 206, the back contact and lower armature of relay 206, conductor 207, front contact and inner lower armature of relay 205, lower winding of relay 205, lower winding of relay 204 to battery and ground. Relay 204 becomes operated in this circuit in series with the lower winding of relay 205, which now holds through such lower winding. Upon the operation of relay 204, a circuit for signal lamp 208 is established from battery, lamp 208, conductor 209, outer upper armature and front contact of relay 204, upper armature and front contact of relay 205, resistance 210 to ground.

Due to the operation of relay 205 a circuit is now established from ground, lower armature and front contact of relay 205, conductor 211, winding of relay 212, conductor 213, conductor 300, lower armature and back contact of relay 301, conductor 302, conductor 214, conductor 100, back contact and lower armature of relay 101, conductor 102, through the back contacts and lower armatures of other relays of the sequence circuit similar to relay 101, back contact and lower armature of relay 103, conductor 104, conductor 215, conductor 303, lower armature and back contact of relay 304, conductor 305, through the chain circuit of the next indicated sequence circuit, conductor 306 to battery. Relay 212 becomes energized in this circuit and through its inner upper armature connects the winding of relay 216 to conductor 217. Conductor 217 may be traced through a chain of contacts such as the normal contacts of the inner-upper armature of relay 212, and thence through the normal contacts of the inner-upper armature of relay 218, conductor 219, conductor 307, and if we now assume the left hand group of relays of the splitting circuit to be operated, through the lower armature and front contact of relay 308, conductor 309, conductor 400, winding of relay 401, armature and back contact of relay 402 to ground. Providing the various chain circuits above described are closed, which will indicate that a call may be at this time attended to by the operator, relays 216 and 401 will become energized. Relay 401 in operating connects an auxiliary ground through its own armature front contact and winding to conductor

400, and at the same time operates relay 402. Relay 402 opens the original connection to ground, but since ground is supplied by the armature of relay 401, and since such substitute ground was connected to conductor 400 before relay 402 become energized, there will be no break in the continuity of this circuit.

It will be noted at this point that when at some later period, the circuit including conductor 400 is opened and relay 401 becomes deenergized, that during the period between the deenergization of the fast relay 401 and the slowing releasing relay 402, ground will be disconnected from conductor 400 for a predetermined period of time. The purpose of this will be apparent hereinafter.

Upon the energization of relay 216 it will be noted that through its lower armature, the continuity of the first chain circuit described is opened so that no other trunk can advance to the point of cooperation with the operator's control and telephone circuit.

Assuming that the operator's telephone set shown at the right of Fig. 5 has been put in service, a circuit will be established from ground, transformer winding 500, tip 501 of the telephone jack, tip 502 of the operator's telephone plug, transmitter 503, tip 504 of the plug, tip 505 of the jack, winding of relay 506 to battery. So long as the operator has her telephone set plug in its jack, relay 506 will remain operated and will mark this operator's control and telephone circuit as active. A circuit may now be traced from battery, winding of relay 403, conductor 404, conductor 507, armature and front contact of relay 506, conductor 508, conductor 405, conductor 313, middle lower armature and front contact of relay 314 to ground (it has been assumed that the left hand group of splitting circuit relays are operated at this time). With the operation of relay 403, a circuit is established for the operation of relay 406.

A circuit may now be traced from ground in Fig. 2, conductor 220, front contact and upper outer armature of relay 212, upper outer armature and front contact of relay 216, conductor 221, conductor 310, conductor 311, conductor 312, conductor 407, outer upper armature and front contact of relay 406, to the winding of relay 408, but since the other terminal of this relay is also connected to ground, this circuit is ineffective. Another circuit may be traced from battery, winding of supervisory relay 222, conductor 223, armature 224 and its contact of relay 216, conductor 225, conductor 315, conductor 316, conductor 317, conductor 409, inner upper armature and front contact of relay 406, through the winding of relay 410 to ground. Relay 410 being of high resistance becomes energized in this circuit without causing the energization of the supervisory relay 222. Upon the energization of relay 410, a circuit is established from ground, the normal contacts of the armatures of relay 509, conductor 510, conductor 411, back contact and inner lower armature of relay 412, inner upper armature and back contact of relay 413, conductor 414, front contact and armature of relay 410, conductor 415, conductor 511, normal contacts of the middle upper armature of relay 512, conductor 513, winding of relay 514 to battery and ground. Upon the energization of relay 514, a circuit is established from battery, interrupter 515, winding 516 of the order tone transformer 528, inner upper armature and front contact of relay 514, conductor 517, conductor 416, normal contacts of the lower armature of relay 417, conductor 418, normal contacts of the lower armature of relay 419 to ground. The interrupted current flowing through the winding 516 will induce a tone current in winding 518, which through the two outer upper armatures of relay 514 is connected through condenser 519 and the back contacts and two upper outer armatures of relay 520 to the tip and ring conductors 407 and 409, reached through the front contacts and upper armatures of relay 406. The path of this tone current may be traced to conductors 220 and 223, whence by induction it will be transmitted over conductors 200 and 201 to the outgoing end of the trunk circuit.

Condenser 519 prevents a direct current path from being established from conductor 220 to conductor 223 at this time which if it were established would cause the operation of supervisory relay 222.

A circuit may now be traced from battery, winding of relay 417, conductor 420, normal contacts of the lower armature of relay 520, conductor 521, front contact and inner lower armature of relay 514 to ground. Relay 417 becomes energized in this circuit and opens the circuit through the winding 516 and interrupter 515 so that the tone described is only transmitted back to the outgoing end of the circuit during the interval from the energization of relay 514 to the energization of relay 417. Relay 417 being slow to operate measures a predetermined period of time.

Upon the energization of relay 417 ground on conductor 420 is connected through the front contact and upper armature of relay 417, the winding of relay 421 to battery. Relay 421 slowly operates and at the end of the period measured thereby, it reconnects conductor 416 through the front contacts and lower armatures of relays 417 and 421 to conductor 418 so that the winding 516 again becomes effective and a second application of tone current is placed on the trunk conductors. Relay 421 through its upper armature and front contact now causes the energization of relay 419 and this relay becomes operated. Due to its slow operating character-

istics, it measures a similar interval of time as do relays 417 and 421. At the end of this period when the relay 419 has become operated, the circuit through winding 516 is again opened and the transmission of tone is again stopped.

Relay 419 in operating now establishes a circuit from ground, front contact and lower armature of relay 419, conductor 422, conductor 522, winding of relay 520 to battery and ground. Relay 520 opens the tip and ring conductors to the winding 518 and through the alternate contacts of its lower armature, places a ground directly on the winding of relay 419 to maintain this relay operated after relays 417 and 421 have become deenergized. Relay 520 through its two upper outer armatures and front contacts connects the tip and ring conductors to the windings 529 and 530 of the operator's set induction coil 531 and through the sleeves 525 and 526 to the receiver 527. Thus the operator's telephone set is now placed in talking condition since the order signal consisting in this case of two momentary applications of tone current has been transmitted to the outgoing end of the trunk.

At the time when relays 204, 212 and 216 became energized, a circuit was established from battery, lower winding, front contact and lower armature of relay 204, front contact and middle armature of relay 212, innermost upper armature and front contact of relay 216, conductor 227, conductor 319, conductor 320, conductor 321, conductor 424, front contact and outermost lower armature of relay 403, inner upper armature and back contact of relay 425, conductor 426, conductor 532, innermost lower armature and back contact of relay 524, conductor 533, conductor 427, winding of relay 428, conductor 429, conductor 534, lower armature and back contact of relay 512 to ground. Relay 428 is of such a resistance that it does not shunt the lower winding of relay 205 sufficiently to cause its deenergization. Relay 428 becomes operated and through its armature locks itself in this circuit independently of the ground supplied by the lower armature of relay 512.

When relay 520 operates as hereinbefore described, a circuit is established from battery, innermost upper armature and front contact of relay 520, winding of relay 535 to ground. Relay 535 through its armature and front contact extends battery over conductor 536, winding of relay 512, normal contacts of the inner upper armature of relay 512, conductor 537, conductor 430 to the ground supplied by the armature of relay 428. Relay 512 becomes operated in this circuit and locks to the ground supplied by the alternate contacts of its innermost upper armature. Through its lower armature relay 512 opens the ground for the original energizing circuit of relay 428. Through its middle upper armature relay 512 substitutes the ground supplied over conductor 430 and conductor 537, to the winding of relay 514 in place of the ground supplied for the energization of relay 514 originally from the armature and contact of relay 410. Through its outermost upper armature and front contact, relay 512 causes the energization of relay 509. Relay 509 opens the ground connection to the front contact of relay 410.

At this time another circuit is established from ground, resistance 210, front contact and upper armature of relay 205, front contact and outer upper armature of relay 204, armature 228 and its front contact of relay 216, conductor 229, winding of pilot relay 230, conductor 231, conductor 322, conductor 323, conductor 324, conductor 431, front contact and armature 432 of relay 403, conductor 433, conductor 538, back contact and outer upper armature of relay 539, conductor 540, conductor 434, back contact and outer upper armature of relay 413, conductor 441, inner upper armature and back contact of relay 435, winding of relay 436 to battery. Relay 436 becomes energized in this circuit and through its lower armature and front contact causes the energization of relay 437. Relay 437 in turn causes the energization of relay 438. Relay 438 through its front contact and inner armature places a direct battery connection on the winding of relay 436, and causes the shunting of both relay 436 and lamp 208. Relay 436 becoming shunted, releases its armature which in turn releases relay 437 and relay 438. When relay 438 is returned to normal condition, the shunt will be removed from the winding of relay 436 and lamp 208, so that the lamp will again glow and relay 436 will again operate. This series of operations of relays 436, 437 and 438 will continue and cause the lamp 208 to flash periodically, and this condition will be maintained until the operator has communicated with the other operator at the outgoing end of the straightforward trunk of Fig. 2 and has pressed her release key 437 to cause the disconnection of the operator's control and telephone set from the straightforward trunk.

Since the further operations of these circuits have no particular bearing on the present invention further detailed descriptions will not be given.

In a manner which will be readily understood, without further detailed description, when a call is established over the call announcer trunk of Fig. 1 a circuit will be established from battery, winding of supervisory relay 105, conductor 106, armature 107 of relay 103 and its front contact, conductor 108, conductor 226, conductor 318, upper outer armature and back contact of relay 301,

conductor 311, conductor 312, conductor 407, the upper outer armature and front contact of relay 406, and thence through the winding of relay 408 to ground. Relay 408 like relay 410 is of high resistance and becomes energized in this circuit without causing the energization of the supervisory relay 105.

Upon the energization of relay 408, a circuit may be traced from ground, the alternate contacts of the armature of relay 509, conductor 510, conductor 411, back contact and inner lower armature of relay 412, inner upper armature and back contact of relay 413, conductor 414, armature and front contact of relay 408, conductor 423, conductor 523, winding of relay 524, to battery and ground. Relay 524 becomes operated in this circuit.

Upon the operation of relay 524, a circuit is established from ground, front contact and outermost lower armature of relay 524, winding of relay 435 to battery and ground. Relay 435 becomes operated and through its inner lower armature and front contact and through resistance 439 causes the chain of relays 436, 437 and 438 to operate. Through the inner upper armature of relay 435 both windings of relay 440 are connected to conductor 441 which may be traced over the outer upper armature of relay 413 and its back contact, conductor 434, conductor 540, outer upper armature and back contact of relay 539, conductor 538, conductor 433, armature 432 and its front contact of relay 403, conductor 431, conductor 324, conductor 323, front contact and inner upper armature of relay 325, conductor 326, conductor 232, conductor 109, winding of pilot relay 110, conductor 111, front contact and armature 112 of relay 103, conductor 113, to signal lamp 114 and thence to battery. During the periods of energization of relay 438, ground will be connected from the outer upper armature of relay 438 to the back contact of the lower armature of relay 442, to the upper winding of relay 440 and then will cause the signal lamp 114 to glow. During the period of deenergization of relay 438 this ground connection will be cut-off and signal lamp 114 will become dark. Relay 440 does not become energized under the present conditions. For further detailed information as to the action of this circuit, reference is made to the application of William A. Rhodes, Serial Number 203,051, filed June 2, 1927, Patent 1,757,217.

Upon the operation of relay 435 a circuit is established from ground, back contact and lower armature of relay 512, conductor 429 upper armature and front contact of relay 435, winding of relay 443 to battery. Relay 443 establishes a circuit from ground, inner upper armature and back contact of relay 442, front contact and armature of relay 443, normal contacts of the lower armature of relay 444, winding of relay 444, to battery. Relay 444 becomes energized in this circuit and locks in a circuit which may be traced over its front contact and lower armature, conductor 445, conductor 541, front contact and innermost lower armature of relay 524, conductor 532, conductor 426, back contact and inner upper armature of relay 425, outermost lower armature and front contact of relay 403, conductor 424, conductor 321, conductor 320, back contact and outer upper armature of relay 325, conductor 327, conductor 233, conductor 115, innermost upper armature and front contact of relay 103, middle upper armature and front contact of relay 116, lower winding of relay 117, lower winding of relay 118, to battery supplied over the front contact and armature of relay 119.

Relay 444 through its inner upper armature and front contact places ground on conductor 430. A circuit is now established from ground on conductor 430 through the front contact and outer lower armature of relay 435, conductor 513, winding of relay 514 to battery and ground. Relay 514 becoming energized connects the winding 518 through the two outer upper armatures and front contacts of relay 514, over the back contacts and two outer upper armatures of relay 520 to the tip and ring conductors. Since relay 524 is energized at this time, the condenser 519 is short-circuited, and the winding 518 acts as a direct current path across the tip and ring conductors. Under this condition supervisory relay 105 of the call announcer trunk will be operated. Thereupon a circuit will be established from ground, the front contact and lower armature of relay 118, the armature and front contact of relay 105, winding of relay 120 to battery. Relay 120 reverses the connection of the windings of relay 119 to the line conductors 121 and 122. This reversal acts as a signal to the outgong end of the call announcer trunk.

In the manner hereinbefore described relays 417, 421 and 419 will become operated in sequence finally causing the operation of relay 520 whereupon the tip and ring conductors are connected to the operator's telephone circuit so that she may receive the number pronounced by the apparatus at the distant end of the call announcer trunk. The fact that two applications of tone are made to this trunk is immaterial since no operator is at the other end to listen. The connection of coil 518 to the tip and ring conductors during the interval from the operation of relay 514 to the operation of relay 520 forms an order signal in the form of an application of direct current.

No further detailed description of these circuits is believed to be necessary at the present time since the further operations are not concerned with the present invention. In general when the number required over the call announcer trunk has been pro-

nounced, the operator at this point will press the release key 439 which will result in the disconnection of her control and telephone circuit through the trunk of Fig. 1.

In accordance with another form of the invention illustrated by the drawings as arranged in Fig. 11, a call coming in over the straightforward trunk of Fig. 2 will be extended through the sequence circuit of Fig. 2 and the splitting circuit of Fig. 3 in the same manner as hereinbefore described and thence to the operator's control and telephone circuit of Figs. 8 and 9. Conductor 800 and relays 801 and 802 correspond exactly to conductor 400 and relays 401 and 402, so that relay 216 will be energized in the manner hereinbefore described.

When the operator's telephone set is plugged into its jack in Fig. 9, a connection will be established from ground, winding 900 of the operator's telephone set induction coil 931, the tip 901 of the operator's telephone jack, tip of plug 902, transmitter 903, tip of plug 904, tip 905 of the operator's telephone set jack, winding of relay 906 to battery. Upon the operation of relay 906, a connection is established from battery, winding of relay 803, conductor 804, conductor 907, armature and front contact of relay 906, conductor 908, conductor 805, conductor 313, middle lower armature and front contact of relay 314 to ground. Relay 803 becomes operated in this circuit and causes the operation of relay 806.

The tip and ring conductors 220 and 223 are now extended through the upper armatures and front contacts of relay 806 to conductors 807 and 808 respectively. Thus the ground of conductor 220 will be connected over conductor 807 to the winding of relay 809 and thence to battery and ground. Relay 809 becomes energized in this circuit. At the same time battery on conductor 223 will be connected over conductor 808 to the winding of relay 810 and thence to ground. Relay 810 is of high resistance and becomes energized in this circuit without causing the energization of the supervisory relay 222. It should be especially noted that when the straightforward trunk of Fig. 2 in which neither the tip nor ring conductors 221 or 225 is blocked by a condenser is extended to the operator's control and telephone circuit, then both relays 809 and 810 will respond.

A circuit is now established from ground, normal contacts of the armature of relay 909, conductor 910, conductor 811, the back contact and inner lower armature of relay 812, the inner upper armature and back contact of relay 813, conductor 814, armature and front contact of relay 810, winding of relay 815 to battery and ground. Relay 815 becoming energized establishes a circuit from ground, front contact and outer lower armature of relay 815, armature and front contact of relay 809, inner lower armature and front contact of relay 815, conductor 816, conductor 911, normal contacts of the middle upper armature of relay 912, conductor 913, winding of relay 914 to battery. Relay 914 responds in this circuit and through its two outer upper armatures and front contacts connects the secondary winding 915 of the order tone transformer 916, through condenser 917 and the back contacts and two outer upper armatures of relay 918 to tip and ring conductors 807 and 808. A circuit for the primary winding 919 of the transformer 916 is now established from battery, interrupter 817, normal contacts of the lower armature of relay 818, back contact and inner lower armature of relay 819, conductor 820, conductor 920, front contact and inner upper armature of relay 914, winding 919, conductor 921, conductor 821, normal contacts of the lower armature of relay 822 to ground. Through induction the tone generated by the circuit including interrupter 817 is transmitted through the secondary winding 915 to the outgoing end of the trunk circuit.

Relay 914 also establishes a circuit from ground, the inner lower armature and front contact of relay 914, conductor 922, back contact and lower armature of relay 918, winding of relay 818, to battery. Relay 818 after a predetermined interval moves its armatures into their operated position whereupon the circuit for the primary coil 919 is opened and the transmission of tone is stopped.

At the same time relay 818 establishes a circuit from its front contact and upper armature through the outer lower armature and back contact of relay 819, winding of relay 823 to battery. Relay 823 after a predetermined interval moves its armatures into their operating position, whereupon the circuit for the primary winding 919 is completed from the interrupter 817, through the front contact and lower armature of relay 823 and the lower armature and front contact of relay 818 over the circuit hereinbefore described. Relay 823 establishes a circuit for the energization of relay 822, and this relay after a predetermined interval of time moves its armatures into their operated position, whereupon the circuit for the primary coil 919 is opened at the lower armature of relay 822.

At the same time relay 822 establishes a circuit from ground, front contact and lower armature of relay 822, conductor 824, conductor 924, winding of relay 918 to battery. Relay 918 disconnects the tip and ring conductors from the primary coil 915 and transfers them to the operator's telephone set, over conductors 925 and 926.

In the same manner as hereinbefore described, a circuit is established from battery, lower winding of relay 204, front contact and lower armature of relay 204, front contact

and middle armature of relay 212, innermost armature and front contact of relay 216, conductor 227, conductor 319, conductor 320, conductor 321, conductor 825, front contact and the lowermost armature of relay 803, inner upper armature and back contact of relay 826, conductor 827, conductor 923, innermost lower armature and back contact of relay 927, conductor 928, conductor 828, winding of relay 829, conductor 830, conductor 929, lower armature and back contact of relay 912 to ground. Relay 829 again operates in this circuit and by its armature substitutes a local ground for that supplied over the lower armature of relay 912.

Relay 829 also places ground on conductor 830 whereby a circuit is established from battery, innermost upper armature and front contact of relay 918, lower armature and front contact of relay 930, winding of relay 912, back contact and innermost upper armature of relay 912, conductor 932, conductor 830 over the contacts and armature of relay 829 to ground. Relay 912 responds and locks over the alternate contacts of its innermost upper armature. This relay also opens the original ground for the energization of relay 829. Through its outermost upper armature, relay 912 causes the energization of relay 909, and through its middle upper armature it assures the continuous operation of relay 914.

Upon the operation of relays 204, 205, and 206, before described, a circuit is established from ground, resistance 210, front contact and upper armature of relay 205, front contact and outer upper armature of relay 204, armature 228, and its front contact of relay 216, conductor 229, winding of pilot relay 230, conductor 231, conductor 322, conductor 323, conductor 324, conductor 831, front contact and armature 832 of relay 803, conductor 834, conductor 932, back contact and outer upper armature of relay 933, conductor 934, conductor 835, back contact and outer upper armature of relay 813, conductor 836, inner upper armature and back contact of relay 837, winding of relay 838 to battery.

Relay 838 becomes energized and causes the energization in turn of relay 839 and this relay in turn causes the energization of relay 840 which now shunts relay 838 and lamp 208 in a manner hereinbefore described. When relay 838 is shunted it releases its armatures which in turn releases relays 839 and 840. Thereupon this cycle of operation reoccurs, and as a consequence lamp 208 will continue to flash until the operator depresses her release key 841. Further operation of the straightforward trunk of Fig. 2 and the operator's control and telephone circuit will not be described since they have no particular connection with the present invention.

The tandem straightforward trunk shown in Fig. 6 is in all essential details the same as the straightforward trunk shown in Fig. 2. Since this trunk is used for tandem work, however, it is now necessary to give the outgoing operator a different kind of order signal. Therefore a condenser 600 is placed in the ring conductor 601 so as to prevent the operation of relay 810 in the operator's control circuit. Therefore when a tandem straightforward trunk is connected through its sequence circuit and the splitting circuit of Fig. 3 to the operator's circuit of Figs. 8 and 9 only relay 809 will respond.

A circuit is now established from ground, the normal contacts of the armature of relay 909, conductor 910, conductor 811, back contact and inner lower armature of relay 812, inner upper armature and back contact of relay 813, conductor 814, armature and back contact of relay 810, armature and front contact of relay 809, inner lower armature and back contact of relay 815, winding of relay 819 to battery. Relay 819 places a ground on conductor 816 which may be further traced over conductor 911, the normal contacts of the middle upper armature of relay 912, conductor 913, winding of relay 914, to battery and ground. Relay 914 connects the secondary winding 915 of the tone transformer 916 through the upper outer armature of relay 914 and condenser 917 and the back contacts and two upper outer armatures of relay 918 of the tip and ring conductors 807 and 808.

A circuit for the primary coil 919 is now established from battery, low tone interrupter 842, the back contact and armature of relay 843, conductor 844, the front contact and inner lower armature of relay 819, conductor 820, conductor 920, front contact and inner upper armature of relay 914, winding 919 of transformer 916, conductor 921, conductor 821, normal contacts of the lower armature of relay 822 to ground. Through this circuit a low tone is transmitted to the outgoing end of the tandem straightforward trunk of Fig. 6.

Upon the operation of relay 914 a circuit is established from ground, inner lower armature and front contact of relay 914, conductor 922, back contact and lower armature of relay 918, to the winding of relay 818 and thence to battery. Relay 818 becomes energized in this circuit after a predetermined interval of time. Thereupon a circuit is established from ground, front contact and upper armature of relay 818, outer lower armature and front contact of relay 819, conductor 845, winding of relay 846 to battery and ground. Relay 846 slowly attracts its armatures and after a predetermined interval of time establishes a circuit from ground, back contact and right hand armature of relay 847, left hand armature and front contact of relay 846, winding of relay 843 to battery and ground. Relay 843 transfers conductor 844

from connection to the low tone interrupter 842 to connection to the high tone interrupter 848 whereupon the pitch of the tone being transmitted to the outgoing end of the tandem straightforward trunk is changed.

The operation of relay 846 also results in the establishment of a circuit from battery and ground, front contact and right hand armature of relay 846, winding of relay 847 to battery. After a predetermined interval of time, relay 847 attracts its armatures and by opening the circuit of relay 843 again changes the pitch of the tone being transmitted to the outgoing end of the trunk circuit of Fig. 6 to a low tone. Relay 847 also connects ground through its right hand armature and front contact to conductor 849, which extends to the winding of relay 823 and thence to battery. Relay 823 now becomes operated and causes the operation of relay 822 which after an interval opens the circuit of the primary winding 919 to stop the transmission of tone. This signal just described consists of first a low tone, then a high tone and again a low tone and may be termed a "bugle tone", which is different and may be readily distinguished from the two momentary applications of tone applied to the straightforward trunk of Fig. 2.

The other operations of the circuit such as the operation of the chain of relays 838, 839 and 840 which causes the flashing of the signal lamp 602 are the same as hereinbefore described in connection with the straightforward trunk of Fig. 2.

If a call comes in over the call announcer trunk of Fig. 7 then due to the fact that a condenser 700 is placed in the tip conductor 701, relay 809 will fail to operate and relay 810 will become operated. Under these conditions a circuit is established from ground, normal contacts of the armature of relay 909, conductor 910, conductor 811, back contact and inner lower armature of relay 812, inner upper armature and back contact of relay 813, conductor 814, armature and front contact of relay 810, winding of relay 815 to battery and ground. Relay 815 establishes a circuit from ground, front contact and outer lower armature of relay 815, armature and back contact of relay 809, upper armature and front contact of relay 815, winding of relay 850, to battery and ground. Relay 850 becoming operated establishes a circuit from ground, innermost upper armature and front contact of relay 850, conductor 851, conductor 935, winding of relay 927 to battery. Relay 927 becoming operated causes the operation of relay 837 whereupon the relays 838, 839 and 840 are started into operation through the movement of the inner lower armature of relay 837 and the signal lamp 702 is caused to flash in the manner hereinbefore described.

Upon the operation of relay 850 a circuit is established from battery through winding 703 of the supervisory relay of the call announcer trunk of Fig. 7 over the ring conductor 704, armature 705 and its front contact of relay 706, conductor 707, conductor 234, conductor 328, inner upper armature and back contact of relay 301, conductor 316, conductor 317, inner upper armature and front contact of relay 806, conductor 808, resistance 852, front contact and outermost upper armature of relay 850, normal contacts of the lower armature of relay 822 to ground. This causes the energization of supervisory relay 703 whereupon a circuit is established from ground, front contact and lower armature of relay 708, conductor 709, armature and contact of supervisory relay 703, winding of relay 710 to battery which upon operating reverses the current flow in conductors 711 and in 712.

Upon the operation of relay 837 hereinbefore described, a circuit is established from ground, back contact and lower armature of relay 912, conductor 929, conductor 830, outer upper armature and front contact of relay 837, winding of relay 853 to battery. Relay 853 in operating establishes a connection from ground, inner upper armature and back contact of relay 854, front contact and armature of relay 853, normal contacts of the lower armature of relay 855 to battery. Relay 855 locks over conductor 856 through conductor 936, the front contact and innermost lower armature of relay 927, conductor 923, conductor 827, back contact and inner upper armature of relay 826, outermost lower armature and front contact of relay 803, conductor 825, conductor 321, conductor 320, back contact and outer upper armature of relay 325, conductor 327, conductor 233, conductor 713, front contact and innermost upper armature of relay 706, middle armature and front contact of relay 714, lower winding of relay 715, lower winding of relay 708, to ground supplied over the armature of relay 716. Relay 855 through its operation places ground on conductor 830 which is now extended over the front contact and outer lower armature of relay 837, conductor 937, conductor 922, back contact and lower armature of relay 918, winding of relay 818 to battery and ground. Relay 818 becoming energized causes in turn the energization of relay 823 and this in turn causes the energization of relay 822. When relay 822 becomes operated it cuts off the ground for causing the energization of the supervisory relay 703, and by placing a ground on conductor 824 causes the energization of relay 918. Relay 918 connects the tip and ring conductors 807 and 808 to the operator's telephone circuit so that when in response to the reversal of the current flow in the conductors 711 and 712 the apparatus of the call announcer trunk pronounces the number of the wanted line, the operator here will receive the message.

Since further operations in connection with the extension of the call announcer trunk have no particular bearing on the present application, no further detailed description will be given.

What is claimed is:

1. In a telephone system, an operator's control circuit, means in said control circuit for transmitting a plurality of different order signals, and means for selectively operating said last means.

2. In a telephone system, trunks of different character, an operator's control circuit, means in said control circuit for transmitting a plurality of different order signals, and means responsive to the connection of one of said trunks to said control circuit for selectively operating said last means in accordance with the character of the said trunk.

3. In a telephone system, an operator's position, an operator's control circuit thereat, groups of trunks, means responsive to the seizure of one of said trunks for connecting said control circuit to said seized trunk, means effective incident to the connection of said control circuit to said trunk for transmitting an order signal over said trunk, means in said control circuit for distinguishing between said groups of trunks and means responsive thereto for changing the character of the said order signal.

4. In a telephone system, an operator's position, an operator's control circuit thereat, groups of trunks terminating in said position, means responsive to the seizure of one of said trunks for connecting said control circuit to said seized trunk, means effective incident to the connection of said control circuit to said trunk for transmitting an order signal over said trunk, means in said control circuit for distinguishing between said groups of trunks and means responsive thereto for changing the character of the said order signal.

5. In a telephone system, groups of trunks, an operator's control circuit, a circuit individual to each said group of trunks for connecting the trunks of a said group in sequence to said control circuit, means in said control circuit effective incident to the connection of one of said trunks to said control circuit to transmit an order signal over said connected trunk, means in said sequence circuits for characterizing the trunks of the corresponding groups, and means in the said control circuit responsive thereto for changing the character of the said order signal.

6. In a telephone system, groups of trunks, an operator's control circuit, a circuit individual to each said group of trunks for connecting the trunks of a said group in sequence to said control circuit, means in said control circuit effective incident to the connection of one of said trunks to said control circuit to transmit an order signal over said connected trunk, a pair of relays in said control circuit operable in different combinations for correspondingly changing the character of the said order signal, and means for altering the different sequence circuits to cause said relays to operate in different combinations.

7. In a telephone system, groups of trunks, an operator's control circuit, including a tip and a ring conductor, a circuit including a tip and a ring conductor individual to each said group of trunks for connecting the trunks of a said group in sequence to said control circuit, means in said control circuit effective incident to the connection of one of said trunks to said control circuit to transmit an order signal over said connected trunk, a relay connected to the tip conductor and a relay connected to the ring conductor of said control circuit operable in different combinations for correspondingly changing the character of the said order signal, and condensers connected in series with said tip and ring conductors of said sequence circuits in different combinations to control the operation of said relays.

In witness whereof, I hereunto subscribe my name, this 5th day of August, 1929.

WILEY WHITNEY.