C. L. GOODRUM.

MESSAGE REGISTER CIRCUITS FOR MACHINE SWITCHING TELEPHONE EXCHANGE SYSTEMS.

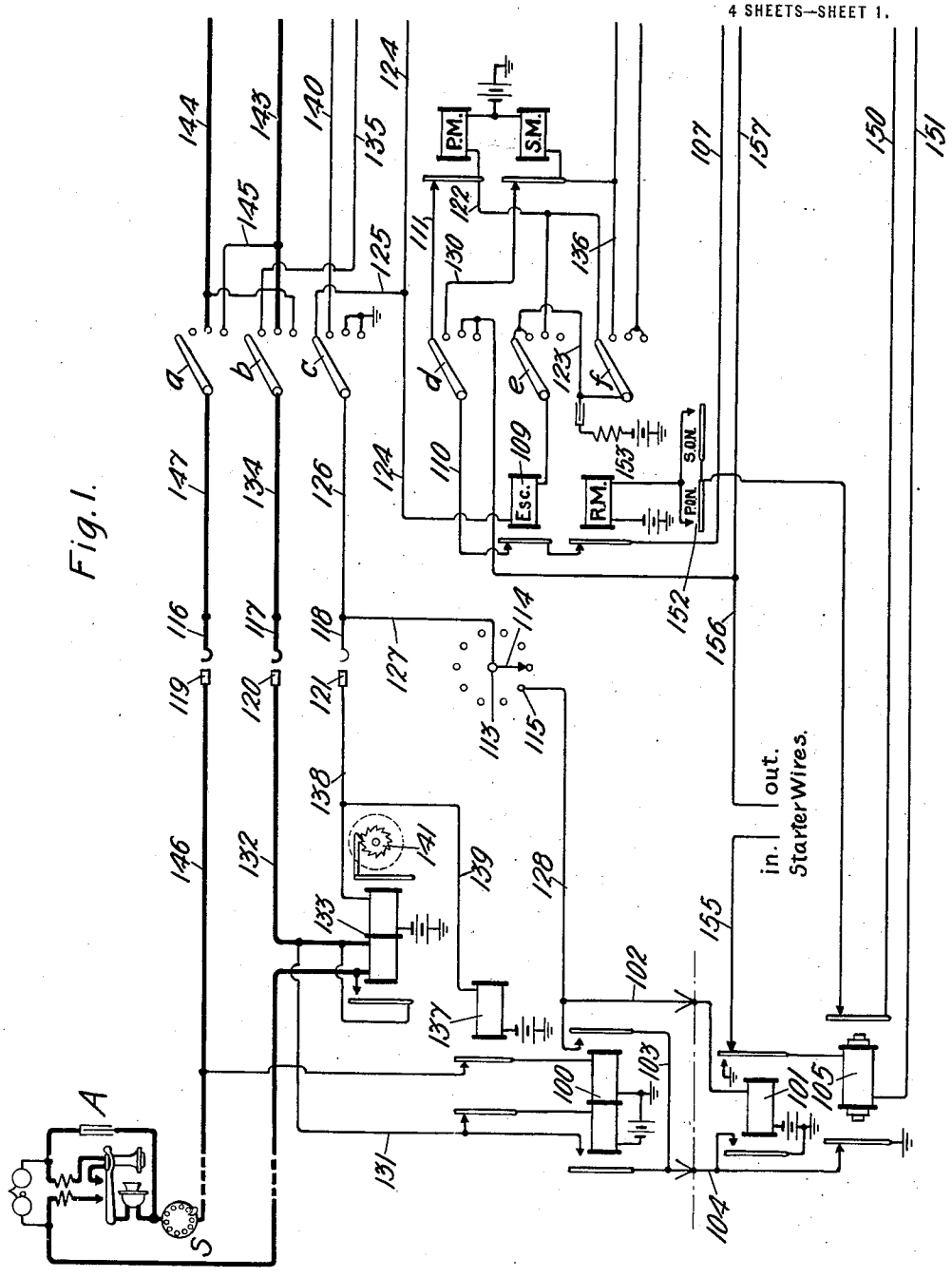
APPLICATION FILED JUNE 15, 1916.

1,269,702.

Patented June 18, 1918.

4 SHEETS—SHEET 1.

Fig. 1.



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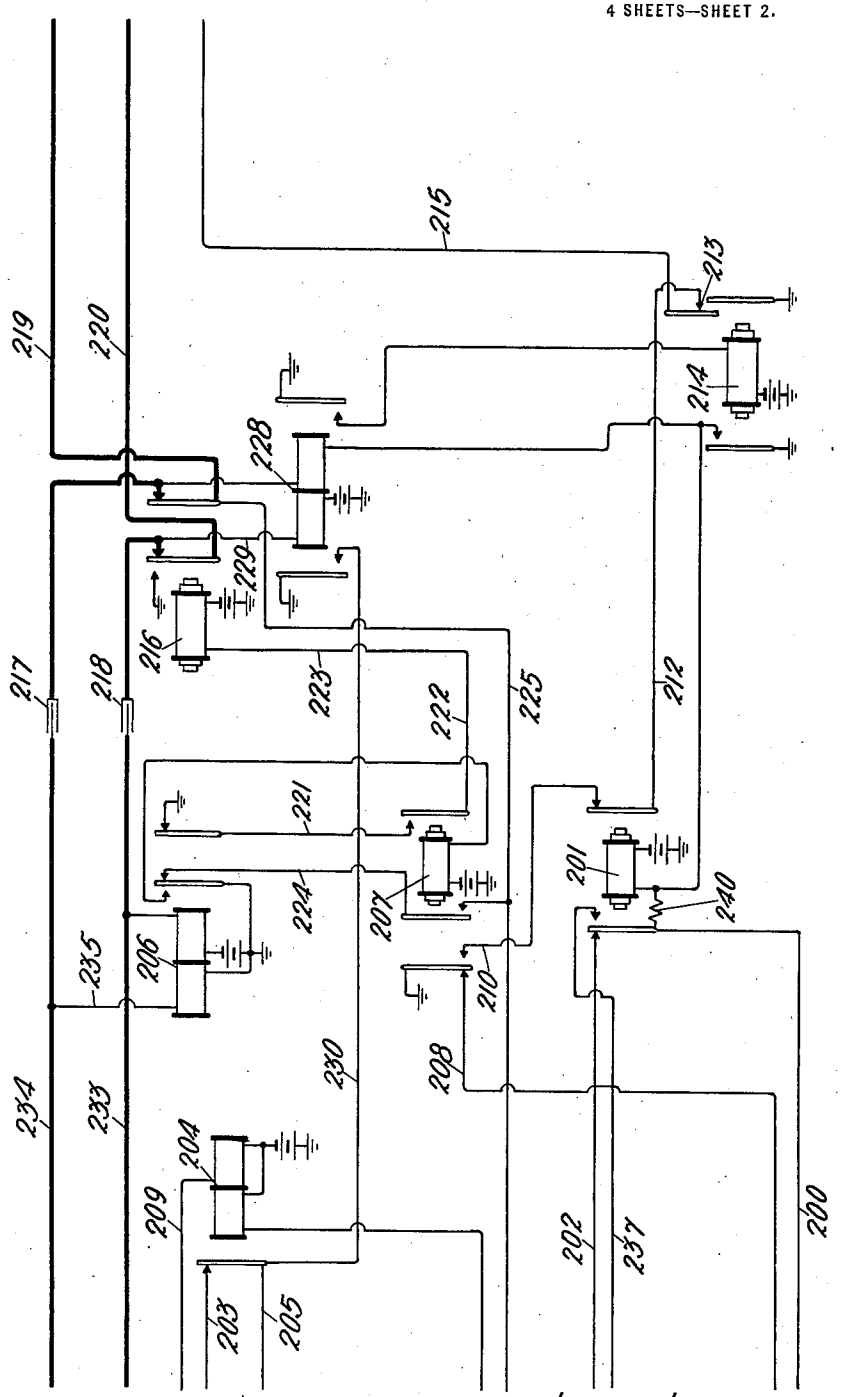
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4 SHEETS—SHEET 2.

Fig. 2.



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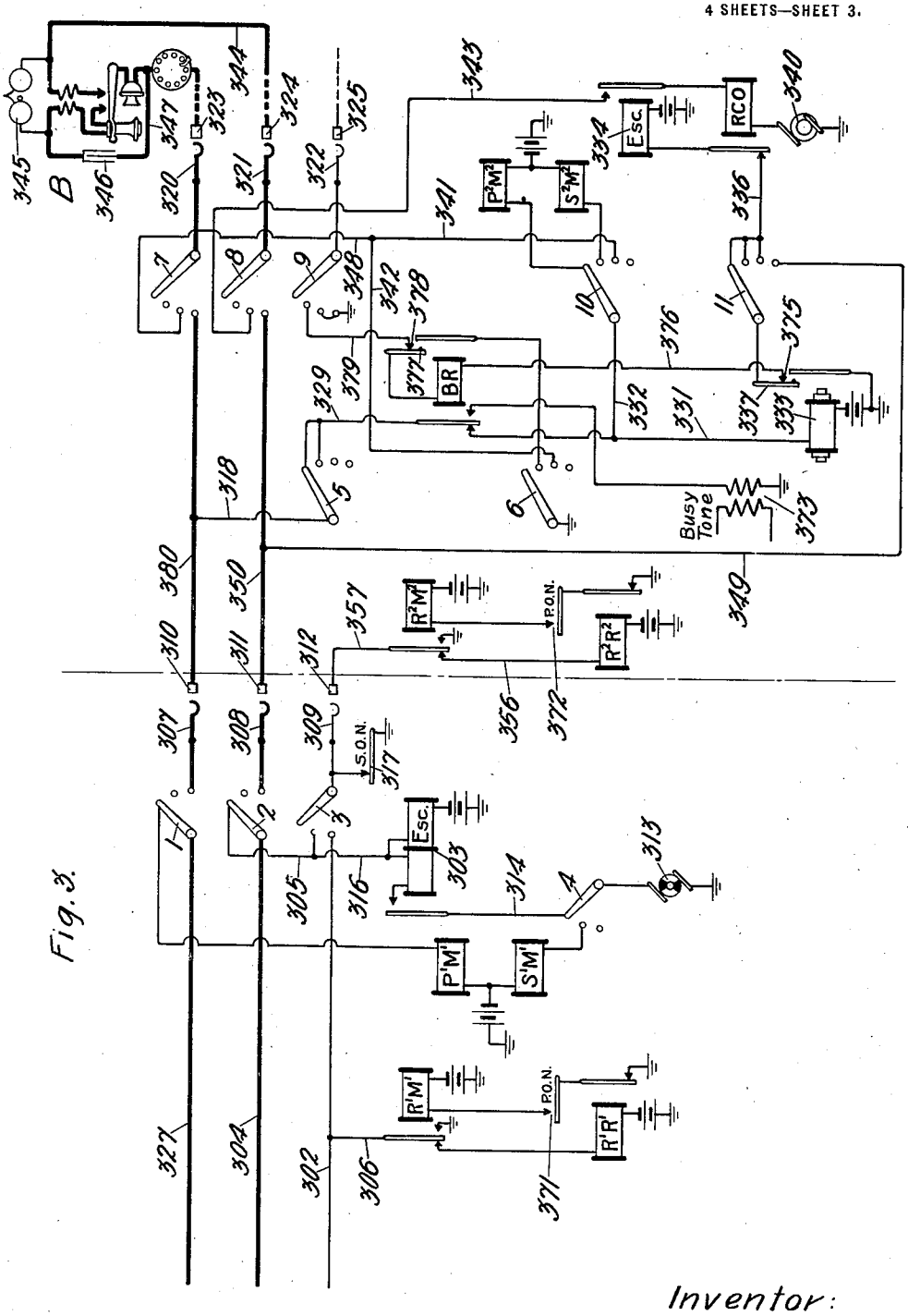


Fig. 3.

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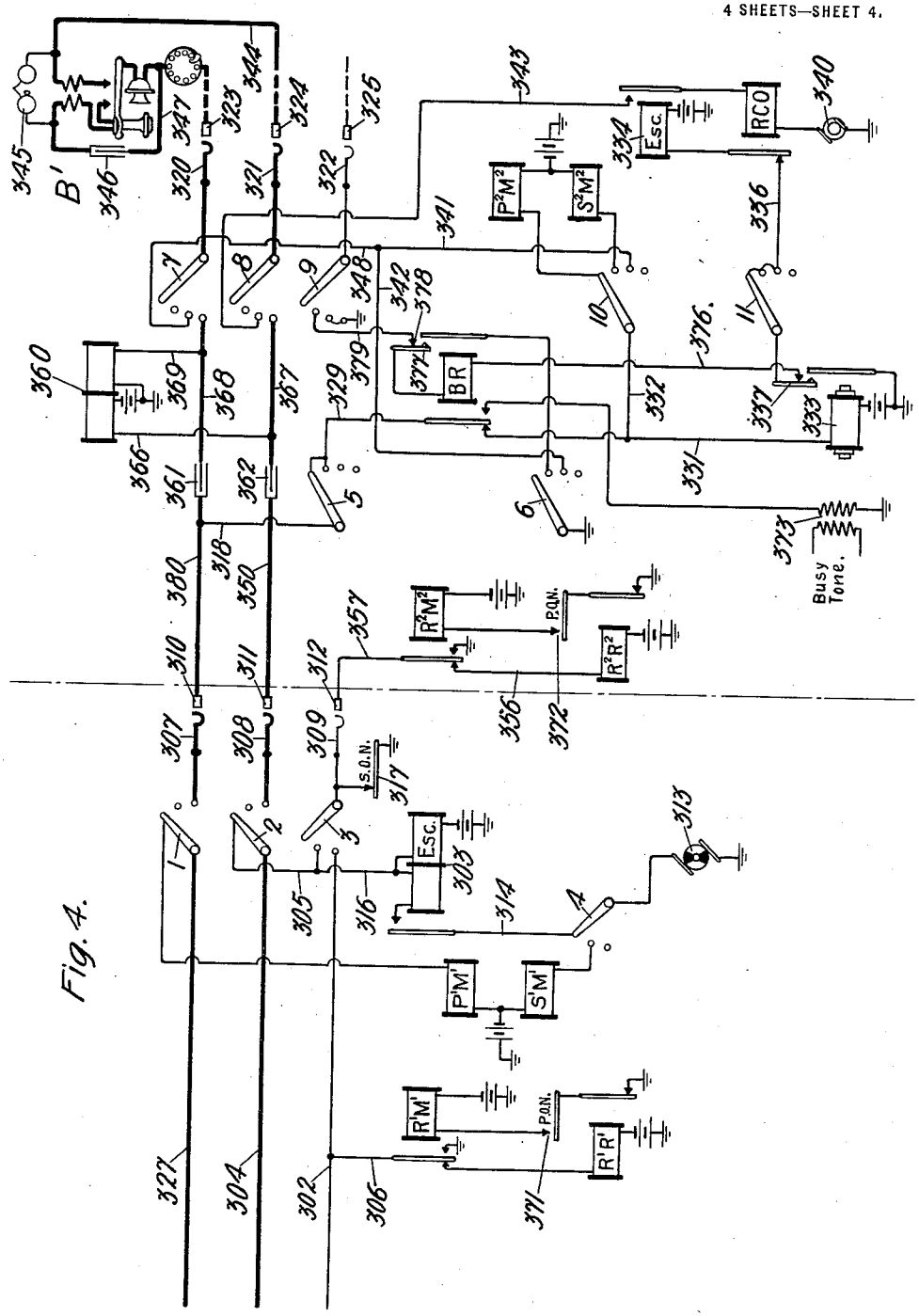


Fig. 4.

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UNITED STATES PATENT OFFICE.

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MESSAGE-REGISTER CIRCUITS FOR MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEMS.

1,269,702. Specification of Letters Patent. Patented June 18, 1918.

Application filed June 15, 1916. Serial No. 103,855.

To all whom it may concern:

Be it known that I, CHARLES L. GOODRUM, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Message-Register Circuits for Machine-Switching Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems employing machine switching wherein a set of repeating relays is located before the first of a train of automatic switches, said relays being adapted to be operated by the sender to transmit impulses to the stepping magnets of such switches, talking current being fed both to the calling and called parties from relays of such set. In metering arrangements for machine switching telephone systems, the meter is usually actuated to count a call upon the operation of the called subscriber's supervisory relay, which occurs when the called party removes his receiver. It is desirable that the meter of the calling party be not actuated when certain numbers are called. Inasmuch, however, as the called supervisory relay is located at the repeating relay set before the first selector, and is therefore used in connections passing through any connector, this relay cannot discriminate between the calls.

The present invention provides for both kinds of service in a system of this character by segregating desired numbers on special groups of connectors and by employing controlling devices operable in response to the called subscriber's substation apparatus to discriminate between the classes of calls and to effect the registration of desired classes of calls.

Referring to the drawings, Figure 1 shows the finder circuit; Fig. 2 shows the control circuit for the switches; Fig. 3 shows a group selector and an ordinary connector used when a number is called for which the calling party's meter is to be operated; and Fig. 4 shows a group selector and the special connector which is used when a number is called for which the calling party's meter is not to be operated.

It is thought that the invention will be most readily understood from a detailed description of the operations involved in setting up both kinds of connections. A connection involving a number for which the calling party's meter is operated will first be described.

Upon the removal of the receiver at substation A, line relay 100 is energized over the following circuit: free pole of battery, left winding of relay 100, outer armature and back contact of cutoff relay 137, conductor 131, left winding of meter magnet 133, the telephonic apparatus at substation A, inner armature and back contact of relay 137, right winding of relay 100, to ground. Magnet 133 does not energize in this circuit. Relay 100, in attracting its right armature, closes the following circuit for a starting relay 101, common to the group of lines to which sub-station A belongs: free pole of battery, relay 101, conductor 102, right armature and front contact of relay 100, conductor 103, conductor 104, left armature and back contact of slow relay 105, to ground. Relay 101, in attracting its left armature, applies ground to the multiples 120 of the finders in which said line appears, and to the multiple commutator segments of the calling group in such finders. This relay also closes a locking circuit for itself, independently of the left armature and back contact of relay 105, and in attracting its right armature, closes the following circuit to initiate the primary movement of the line finder: ground, right armature and front contact of relay 101, slow relay 105, conductor 151, conductor 200, left armature and back contact of slow relay 201, conductor 202, conductor 107, armatures and back contacts of release and escapement magnets RM, 109, conductor 110, finder side-switch arm *d* and its first contact, conductor 111, armature and back contact of the primary magnet PM of the finder, winding of magnet PM, free pole of battery. Although relay 201 is in parallel with magnet PM in this circuit, it does not become sufficiently magnetized to attract its armatures due to resistance 240. This magnet, by making and breaking the circuit traced, rotates the finder brush shaft 113, until the commutator brush 114 thereon engages the commutator multiple segment 115 of the calling group, which is now grounded at the left armature and front

contact of relay 101, at which time a set of brushes 116, 117 and 118 on the finder brush shaft 113 are in operative relation to the group of multiples containing those of the calling line 119, 120 and 121. The engagement of commutator brush 114 with grounded commutator segment 115 closes a circuit for the escape magnet 109 to stop the finder. The magnet 109 is constructed to release the side switch upon its energization. The circuit for magnet 109 is as follows: free pole of battery, magnet PM, conductor 122, arm *f* and its first contact, conductor 123, arm *e* and its first contact, escape magnet 109, conductor 124, conductor 125, arm *c* and its first contact, conductors 126, 127, commutator brush 114, commutator segment 115, conductor 128, right armature and front contact of relay 100, conductor 104, left armature and front contact of relay 101 to ground. The closure of the circuit just traced for the escapement magnet holds the primary magnet PM energized until the side-switch arms leave position 1, thus positively positioning the brush shaft and preventing overthrow. In position 2, the following circuit is closed for the secondary magnet SM, to step the positioned set of brushes 116, 117, 118 over the section containing multiples of the calling line 119, 120, 121: free pole of battery, magnet SM, its armature and back contact, conductor 130, arm *d* and its second contact, conductor 110, armatures and back contacts of escape and release magnets 109, RM, conductors 107, 202, left armature and back contact of relay 201, conductors 200, 151, relay 105, right armature and front contact of relay 101 to ground. When the brush 117 reaches the grounded terminal 120, the following circuit is closed to stop the finder: ground, left armature and front contact of relay 101, conductor 104, left armature and front contact of relay 100, conductors 131, 132, multiple 120, brush 117, conductor 134, arm *b* and its second contact, conductors 135, 203, armature and back contact of relay 204, conductors 205, 124, escape magnet 109, arm *e* and its second contact, conductor 123, arm *f* and its second contact, conductor 136, magnet SM, free pole of battery. The escape magnet 109 energizes in this circuit, and the magnet SM remains energized. This circuit is opened as the side switch moves into position 3.

In position 3, arm *c* closes the following circuit to energize cut-off relay 137 of the calling line: arm *c* and its grounded third contact, conductor 126, brush 118, terminal 121, conductors 138, 139, cut-off relay 137, to free pole of battery. Relay 137, in operating, deënergizes the line relay 100, which, in retracting its left armature, removes the calling condition from the multiples 120 of the calling line, and in retracting its right armature, opens the locking circuit of group relay 101 and removes the calling condition from the multiple commutator segments 115. In retracting its right armature, relay 101 deënergizes slow relay 105. Before the right armature of slow relay 105 closes its back contact, however, the calling supervisory relay 206 (Fig. 2) becomes energized over the calling line circuit as finder side-switch arms *a*, *b*, (Fig. 1) move into their third position. Relay 206, in attracting its inner armature, energizes a slow relay 207. This relay 207, in attracting its outer left armature, removes ground from conductor 208 before the right armature of relay 105 (Fig. 1) is fully retracted, thus preventing the closure of a circuit for the finder release magnet RM during this change-over operation.

In parallel with the circuit traced for the cut-off relay 137, a circuit was closed for the right winding of register magnet 133. This magnet is so wound that it will not pull up unless current is flowing in both windings simultaneously in such a manner as to make the magnetizing effect cumulative. In position 3 of the finder side switch, the magnetic effect of the current flow through the left winding of magnet 133 is neutralized by the current flow through the right winding.

If during the secondary movement of the finder brushes 116, 117, 118 over the multiples of the calling line group, multiples of a line engaged in conversation are encountered, the finder brushes will not stop on such multiples due to the opening of the circuit for escape magnet 109 by a relay 204 which responds when such lines are reached. Considering this feature more in detail, it will be remembered that the circuit for energizing the escape magnet 109 to pass the side switch from positions 2 to 3, led over the armature and back contact of relay 204. This relay 204 has its left winding in parallel with the secondary magnet SM, and as such magnet vibrates, making and breaking its own circuit and stepping the finder shaft 113, the relay 204 vibrates synchronously therewith. As the finder brush 118 engages the multiple 121 of a line which is engaged in conversation, which multiple is grounded by the side-switch arm *c* and its third or fourth contact of another finder, or the side-switch arm 9 and its third or fourth contact of a connector (Fig. 3), a circuit is closed to hold up relay 204 over its right winding to maintain a break in the circuit of escape magnet 109 to prevent the same from energizing over a circuit including such busy line and the left winding of relay 206 of the connecting circuit associated with such line. The said holding circuit for relay 204 is as follows: free pole of battery, right winding of relay 204, conductor 209, conductor 140, arm *c* and its second contact, conductor 126, brush 118, to grounded multi-

ple 121 of the busy line. Consequently, as the brush 118 engages multiples 121 of busy lines, the escape magnet 109 cannot energize to pass the side switch from position 2 to position 3, due to the fact that its circuit is opened at the armature and back contact of relay 204.

The finder having found the calling line A, the party thereat operates his sender S to transmit the first digit of the wanted number, which sender interrupts the line circuit in the well-known manner, causing the relay 206 to vibrate. Although the sender interrupts the circuit through the left winding of register magnet 133, this magnet will not attract its armature since it is wound so as not to be energized by either winding alone. Relay 207 is slow and remains energized as the sender operates. This relay, in attracting its outer left armature, closes the following circuit for the release relay R'R' (Fig. 3) of the first selector to interpose a break in the circuit of the release magnet R'M' thereof: ground, outer left armature and front contact of relay 207, conductors 210, right armature and back contact of relay 201, conductor 212, contact 213 of slow relay 214, conductor 215, conductors 302, 306, armature and back contact of magnet R'M', relay R'R', free pole of battery.

Upon the first retraction of the outer armature of relay 206, the following circuit is closed for a slow relay 216, which opens the connection of condensers 217, 218, with conductors 219, 220 to prevent the discharge of such condensers from affecting the setting operation of the first selector (Fig. 3); ground, outer armature and back contact of relay 206, conductor 221, right armature and front contact of slow relay 207, conductors 222, 223, slow relay 216, free pole of battery. Relay 216, in attracting its inner armature, grounds conductor 220, thus closing the following circuit for the escapement magnet 303 of the first selector (Fig. 3): ground, inner armature and front contact of relay 216, conductors 220, 304, first selector side-switch arm 2 and its first contact, conductors 305, 316, right winding of magnet 303, to free pole of battery. The escape magnet 303 is constructed to release the side switch from position to position upon its deenergization. Each time the inner armature of relay 206 is retracted, an impulse is sent over the following circuit to the primary stepping magnet P'M' of the first selector: ground, inner armature and back contact of relay 206, conductor 224, inner left armature and front contact of relay 207, conductors 225, 219, 327, first selector side-switch arm 1 and its first contact, magnet P'M' to free pole of battery. Magnet P'M' imparts a primary movement to the first selector brush shaft (not shown) to position a set of brushes 307, 308, 309 thereon in operative relation to the group of trunk multiples 310, 311, 312, terminating in connectors having access to the wanted line.

When the sender S restores and maintains the line circuit closed, relay 206 remains energized, whereupon relay 216, after an interval, retracts its armatures. The retraction of the inner armature removes ground from the lower talking conductor 220, whereupon the escape magnet 303 of the first selector passes the side-switch arms to the second position, in which arm 4 connects the secondary magnet S'M' in circuit with an interrupter 313 to step the positioned brushes 307, 308, 309 over the multiples 310, 311, 312 of the selected group of trunks.

If, when ground is removed from the lower talking conductor by the deënergization of relay 216, the interrupter 313 is on a metallic segment, the escape magnet 303 does not release due to the closure of the following circuit: free pole of battery, right and left windings of escape magnet 303 in series, armature and front contact of said magnet, conductor 314, arm 4 and its first contact, interrupter 313 to ground. When, however, the brushes of the interrupter 313 pass onto an insulated segment of the interrupter, the escape magnet becomes deënergized, releasing the side-switch arms into position 2. This arrangement insures that the first impulse to the secondary magnet S'M' will be a full one.

In position 2, arm 3 energizes the escape magnet over the following circuit: free pole of battery, right winding of escape magnet 303, conductor 316, arm 3 and its second contact, secondary off-normal contact 317, normally closed, to ground. Contact 317 opens on the first secondary step of the brush shaft. Busy trunks are those whose multiples 312 are grounded, as will be hereinafter described. Consequently, as long as busy trunks are encountered, escape magnet 303 remains energized over its right winding and side-switch arm 3. When an ungrounded terminal 312 is reached, magnet 303 becomes inert, releasing the side switch into position 3. Arm 4 in moving off its second contact, opens the circuit of the stepping magnet S'M', thus stopping the brushes 307, 308, 309 upon the multiples 310, 311, 312 of the seized trunk.

Arm 3, in moving into position 3, energizes release relay R^2R^2 over the following circuit to interpose a break in the circuit of connector release magnet R^2M^2: free pole of battery, relay R^2R^2, conductor 356, armature and back contact of magnet R^2M^2, conductor 357, terminal 312, brush 309, arm 3 and its third contact, conductor 302 to ground at the outer left armature and front contact of relay 207.

The calling party at substation A now

operates his sender to transmit the tens digit of the wanted number. Upon the first retraction of the outer armature of relay 206, slow relay 216 energizes as before. The following circuit is established for the primary magnet P^2M^2 to position the connector brushes in operative relation to the group of multiples containing those of the wanted line 323, 324, 325: ground, inner armature and back contact of relay 206, inner left armature and front contact of relay 207, conductors 225, 219, 327, selector side-switch arm 1 and its third contact, brush 307, terminal 310, conductors 380, 318, arm 5 and its first contact, conductor 329, left armature and back contact of busy relay BR, conductors 331, 332, arm 10 and its first contact, magnet P^2M^2, free pole of battery. In parallel with the circuit just traced, a slow relay 333 is energized. This relay, in attracting its armature, closes the following circuit to energize the escapement magnet 334 of the connector: free pole of battery, magnet 334, armature and back contact of ringing cutoff relay RCO, conductor 336, arm 11 and its first contact, spring 337 and armature of relay 333 to ground. The escape magnet 334 is arranged to release the side switch from position to position upon its deënergization.

When the sender S restores and maintains the line circuit closed, relay 206, in holding its armatures attracted, causes the deënergization of the slow relay 216, which in turn opens the circuit of relay 333 at the connector, which, in releasing its armature, opens the circuit of escape magnet 334, which, in deënergizing, passes the connector side switch to position 2. Arm 10, in position 2, substitutes the secondary stepping magnet S^2M^2 for the primary stepping magnet P^2M^2 in the stepping circuit.

The calling party now operates his sender S to transmit the units digit of the wanted number. Each time the relay 206 deënergizes, an impulse is sent to the secondary stepping magnet S^2M^2 to step the connector brushes 320, 321, 322 into engagement with multiples 323, 324, 325 of the wanted line. This circuit is the same as that traced for the primary magnet P^2M^2 up to the side-switch arm 10, from whence it passes over the second contact of such arm, magnet S^2M^2 to the free pole of battery. As before, the slow relay 333 is energized in parallel with magnet S^2M^2 while the impulses are being transmitted. When the sender S restores, relay 333 becomes deënergized as before, opening the circuit of escape magnet 334, which, in deënergizing, passes the side switch to position 3.

In position 3, the following circuit is closed to again energize slow relay 333 to prepare the ringing circuit: free pole of battery, relay 333, conductors 331, 332, arm 10 and its third contact, conductors 341, 342, arm 6 and its third contact to ground. Relay 333, in attracting its armatures, again energizes escape magnet 334, which, in attracting its armature, closes the ringing circuit as follows: free pole of generator 340, ringing cutoff relay RCO, armature and front contact of magnet 334, conductor 343, arm 8 and its third contact, brush 321, terminal 324, conductor 344, bell 345, condenser 346, conductor 347, terminal 323, brush 320, arm 7 and its third contact, conductors 348, 342, arm 6 and its third contact to ground.

When the called party, in responding, removes his receiver, ringing cut-off relay RCO operates, opening the circuit of escapement magnet 334 which passes the side switch into position 4. Relay 333, being slow to release, holds its armature attracted for an instant after side-switch arm 11 reaches its fourth position. An impulse is thus transmitted over the following circuit to operate the called supervisory relay 228, which is adapted to transfer the control of the release of the first selector and connector to the called party and to operate the finder escape magnet 109 to cause the reversal of the direction of current flow in the calling line to register the call: ground, armature and spring 337 of relay 333, arm 11 and its fourth contact, conductors 349, 350, terminal 311, brush 308, arm 2 and its third contact, conductors 304, 220, inner armature and back contact of relay 216, conductor 229, left winding of relay 228 to free pole of battery. Relay 228, in attracting its right armature, energizes a slow relay 214. Relay 214, in attracting its right armature, opens the connection of ground from the outer left armature and front contact of relay 207 to conductor 215, and substitutes therefor ground over said right armature, and since the relay 214 is now controlled by the called party, the release of the selector and connector is dependent upon the replacement of the receiver by the called party.

Relay 228, in attracting its left armature, closes the following circuit for the escapement magnet 109 of the finder side switch to energize the same to pass the side switch from position 3 to position 4: ground, left armature and front contact of relay 228, conductors 230, 205, 124, magnet 109, arm *e* and its third contact, magnet PM, free pole of battery. Magnet PM does not energize in this circuit. Arms *a* and *b*, in moving from position 3 to position 4, reverse the direction of the flow of current in the calling line. The direction of current flow in the left winding of magnet 133 now is such as to aid that in the right winding, whereupon the magnet becomes energized and advances the counting train 141 one step. In attracting its armature, it short-circuits its left

winding, thus removing it from the talking circuit. Arm *c*, in position 4 of the finder side switch, maintains the cut-off relay 137 and magnet 133 energized.

When the calling party restores his receiver, relay 206 becomes deënergized, and in retracting its inner armature, opens the circuit of relay 207, which, after an interval, retracts its armature. The retraction of the outer left armature of this relay closes the circuit of release magnet RM of the finder as follows: ground, outer armature and back contact of relay 207, conductor 208, conductor 150, right armature and back contact of slow relay 105, primary off-normal contact 152, conductor 153, release magnet RM, to free pole of battery.

When the called party replaces his receiver, relay 228 becomes deënergized, and, in retracting its right armature, opens the circuit of slow relay 214. This relay, after an interval, retracts its armatures. The retraction of the right armature removes ground from conductor 215, which has been maintaining energized the release relays R′R′ and R^2R^2 of the selector and connector, respectively, whereupon these relays retract their armatures and close the circuits of the associated release magnets R′M′, R^2M^2, respectively. These magnets R′M′ and R^2M^2, in operating, restore the side switches in the well-known manner, and when the primary off-normal contacts 371, 372 open as the shafts reach their normal positions, such magnets are deënergized.

The operations involved in tracing a charged call having been described, the operation of the system in calling a "free" number will now be described, referring to Figs. 1, 2 and 4.

It will be noted that Fig. 4 is similar to Fig. 3, except that the conductor 349, connected between the fourth contact of the connector side-switch arm 11 and conductor 350 is omitted, and a relay 360 and a pair of condensers 361, 362 are added. The talking battery for the called substation B is fed over the windings of this relay 360 instead of from the relay 228, (Fig. 2) of the repeating relay set as in the case of a "charged" call. The "free" numbers are segregated upon connectors of the type shown in Fig. 4, and in calling a "free" number, the operation of the system is the same as that described in calling a "charged" number up to the point when the called party responds by removing his receiver from the switch hook at substation B′. It will be remembered that in the circuit arrangement of Fig. 3 the slow relay 333 is energized at this time over the following circuit: free pole of battery, slow relay 333, conductors 331, 332, arm 10 and its third contact, conductors 341, 342, arm 6 and its third contact to ground, and that this slow relay in holding its armature attracted for an interval after side-switch arm 11 reaches its fourth contact, transmits an impulse (Figs. 3 and 2) to relay 228, which, in operating, energizes the escapement magnet 109 of the finder to pass the finder side switch to position 4 to reverse the direction of current flow in the calling line to cause the meter magnet 133 to operate. In the special connectors shown in Fig. 4, conductor 349 is omitted. This impulse is therefore not passed to the relay 228 and the direction of current flow in the calling line is not reversed, since the side switch of the finder stays in the third position. Position 3, in such event, is the talking position of the finder side switch instead of position 4. The circuit for feeding battery to the calling party then leads as follows: free pole of battery, right winding of relay 206 (Fig. 2) conductors 233, 143, arm *b* and its third contact, conductor 134, brush 117, terminal 120, conductor 132, left winding of register magnet 133, through the telephonic apparatus at substation A, conductor 146, terminal 119, brush 116, conductor 147, arm *a* and its third contact, conductor 144, conductors 234, 235, left winding of relay 206 to ground. Talking current is fed to the called party over the following circuit (Fig. 4): free pole of battery, left winding of relay 360, conductors 366, 367, arm 8 and its fourth contact, brush 321, terminal 324, conductor 344, telephonic apparatus at substation B, conductor 347, terminal 323, brush 320, arm 7 and its fourth contact, conductors 368, 369, right winding of relay 360 to ground. Condensers 361, 362, (Fig. 4) and 217, 218, (Fig. 2), conductively separate the calling and called ends of the connecting circuit, and inductively unite the same.

When the calling party restores his receiver upon the termination of the conversation, relay 206 becomes deënergized, and, in retracting its inner armature, opens the circuit of relay 207, which, after an interval, retracts its armatures. The retraction of the outer left armature of this relay closes the circuit for release magnet RM of the finder as previously traced. The retraction of the outer left armature of relay 207 removes ground from the third or test conductor 302 (Fig. 3) which deënergizes release relays R′R′ and R^2R^2 of the selector and connector, respectively, which, in falling back, close the circuits of release magnets R′M′ and R^2M^2, respectively, of such switches, whereupon the same are released.

Referring back to that point in the operation where the finder side switch goes into position 3, upon the finding of the line, arm *d* of the finder side switch in this position extends the in-starter wire 155 to the out-starter wire 156 leading to the next idle finder. If, now, the in-starter wire is

grounded by reason of the initiation of a call, and the finder restores, arm *d*, in moving back to its first contact, would disrupt the starting circuit operating such idle finder. In order to prevent this, a slow relay 201 is provided, which relay is energized when relay 214 operates upon the response of the called party. If, now, conductor 151 is grounded, by reason of the initiation of a call in the group to which substation A belongs, or from a group beyond, from which in-starter wire 155 leads, relay 201 will be maintained excited as long as this ground remains on conductor 151, and maintains conductor 151 connected over conductor 200, the left armature and front contact of relay 201, conductors 237, 157, directly to the out-starter wire 156. Thus, even though the arm *d* does move back to position 1 by the release of the finder when the calling party hangs up, it will not disrupt the starting circuit. When the starting ground is removed from conductor 151, relay 201 falls back, provided relay 214 is deënergized.

The right armature and associated contact of slow relay 201 comes into play when the called party is the first to hang up his receiver upon the termination of the conversation. Considered more in detail, the replacement of the receiver by the called party deënergized relay 228, which, in releasing its right armature, deënergized slow relay 214. Although relay 207 is at this time energized, and at its outer left armature is maintaining ground upon conductor 210, this ground is not transmitted to conductor 212, since relay 201, being slow, holds its right armature attracted for an interval after its circuit is opened by the retraction of the left armature of slow relay 214. Thus there is a sufficient interval between the retraction of the right armature of relay 214 and the retraction of the right armature of relay 201 for release relays $R'R'$, R^2R^2 of the selector and connector, respectively, to deënergize and restore such switches.

In case the called line is busy, the test multiples 325 thereof are grounded over arm 9 and its third or fourth contact of the connector connected to such line, or over the finder side-switch arm *c* and the third or fourth contact thereof, dependent upon whether the line is busy as a called or a calling line. In such event, the busy relay BR energizes from the ground on such test multiples, and locks up, preventing the side switch from going into the ringing position, and applies a busy signal to the calling line from a busy tone apparatus 373. Considered more in detail, it will be remembered that slow relay 333 is energized in parallel with the secondary stepping magnet S^2M^2 when the sender is transmitting the units digit of the wanted number. This relay is provided with a spring 337 which is adapted to engage contact 375 before breaking contact with the armature of such relay. Consequently, if ground is present upon the test multiples 325 of the selected line, the following circuit is closed to hold the escape magnet 334 in position 2: free pole of battery, escape magnet 334, armature and back contact of ringing cut-off relay RCO, conductor 336, arm 11 and its second contact, spring 337, contact 375, conductor 376, busy relay BR, spring 377 thereof, contact 378, conductor 379, arm 9 and its second contact, brush 322, grounded test multiple 325. Relay BR, in attracting its right armature, locks itself to ground over side-switch arm 6, and in attracting its left armature connects the busy tone apparatus 373 over side-switch arm 5 and its second contact to the upper talking conductor 380, and thence to the calling line. The release of the switches takes place upon the replacement of the receiver by the calling party, as hereinbefore described.

What is claimed is:

1. In a telephone exchange system, the combination with telephone lines of different classes, senders therein, message registers associated therewith, selector switches, two groups of connector switches, and finder switches for connecting said lines to the selector switches, said lines being grouped as called lines on said connectors according to the class to which they belong, control circuits adapted to coöperate in the setting of said switches by said senders, a relay associated with each control circuit and with each of the connectors of one group, means for operating either the relay in the control circuit or the relay in the connector upon the response of the called party, dependent upon the character of the called line, and means including the finder switch operated when the control circuit relay is operated to actuate the calling line message register.

2. In a telephone exchange system, the combination with telephone lines of different classes, senders therein, connecting circuits including selector and connector switches, said connector switches being divided into two groups and the lines being grouped as called lines therein according to the class to which they belong, non-numerical switches for associating said lines with said connecting circuits, a message register magnet for each line having two windings, one included in the line circuit and the other in the test wire of said non-numerical switch, said windings being differential when said line is extended to a connecting circuit, control circuits adapted to coöperate in the setting of said switches by said senders, a relay associated with each control circuit and with each of the connectors of one group, means for operating either the relay in the control

circuit or the relay in the connector upon the response of the called party, dependent upon the character of the called line, and means permanently associated with the non-numerical switch actuated by the operation of said control circuit relay for reversing the flow of current in the calling line to operate said register.

3. In a telephone exchange system, the combination with telephone lines of different classes, connecting circuits including a selector and connector switches, said connector switches being divided into two groups and the lines being grouped as called lines therein according to the class to which they belong, senders, finders for associating said lines with said connecting circuits, side switches for controlling said finders, a message register magnet for each line having two windings, one included in the line circuit and the other in the test wire of said finder, said windings being differential when said line is extended to a connecting circuit by a finder, control circuits adapted to cooperate in the setting of said switches by said senders, a relay associated with each control circuit and with each of the connectors of one group, means for operating either the relay in the control circuit or the relay in the connector upon the response of the called party, dependent upon the character of the called line, and means for advancing the finder side switch upon the operation of said control circuit relay to reverse the direction of current flow in the calling line to operate the message register.

4. In a telephone exchange system, the combination with telephone lines of different classes, message registers therefor, selector switches and two groups of connector switches, said lines being grouped as called lines on said connectors according to the class to which they belong, senders, finders having side switches for associating the lines with said switches, control circuits adapted to coöperate in the setting of said switches by said senders, a relay associated with each control circuit and with each connector of one group of connectors, means for operating either the relay in the control circuit or the relay in the connector upon the response of the called party, dependent upon the character of the called line, and means including the side switch of the finder operated when the control circuit relay is operated to actuate the calling line message register.

5. In a telephone exchange system, the combination with telephone lines of different classes, senders therein, message registers associated therewith, selector switches and two groups of connector switches, finders having side switches adapted to associate the lines with said switches, said lines being grouped as called lines on said connectors according to the class to which they belong, control circuits adapted to coöperate in the setting of said switches by said senders, a relay associated with each control circuit and with each of the connectors of one group, means for operating either the relay in the control circuit or the relay in the connector upon the response of the called party, dependent upon the character of the called line, and means controlled by the operation of the finder side switch for actuating the calling line register dependent upon the relay operated.

6. In a telephone system, a calling line, connecting circuits, an automatic switch for extending said line to one of said connecting circuits, called lines of different classes, selectively operable switches for extending a connecting circuit to a called line, a particular class of called lines being segregated at a particular selective switch, means for operating said selective switches, means to release said selective switches, said release means being under the control of the calling line while the selective switches are being operated, a message register associated with the calling line, a controlling device associated with each of said connecting circuits effective when a called party answers to operate said register and to place said release means under the control of the called line, said controlling device further serving to feed battery current to the called line, and means associated with said particular selective switch which may be substituted for the controlling device to supply current to a line which is ineffective in call registration.

7. In a telephone exchange system, selector switches, a plurality of connector switches, calling lines, called lines of different classes, a particular class of called lines being segregated on a particular connector switch, a plurality of connecting circuits terminating in said switches, means for extending calling lines to said connecting circuits, a group of repeating relays adapted to transmit impulses directly to the operating magnets of said switches, one of the relays being effective both in the establishment of a telephone connection and in its registration, and a controlling device associated with each of the particular connector switches and which may be substituted for said last mentioned relay in the establishment of a call which is ineffective in call registration.

8. In a telephone system, a calling line, a connecting circuit, selectively operable switches, an automatic switch for connecting the calling line to said connecting circuit, an auxiliary switch for controlling the operation of the automatic switch, called lines of different classes, a particular class of said lines being segregated at a particular selective switch, means for actuating the selective switches to extend said connecting

circuit to any one of the called lines, release means for said switches, said release means being under the control of the calling line while a connection is being extended, a message register associated with the calling line, said register responsive to the actuation of the auxiliary switch, a line relay in said connecting circuit for supplying talking current to a called line, means controlled by a called line for operating said relay to actuate said auxiliary switch and to remove the control of said release means from the calling to the called line, and a line relay associated with said particular switch which may be substituted for said first relay to supply talking current when a connection is extended to a line of said particular class of lines.

In witness whereof, I hereunto subscribe my name this 14th day of June, A. D. 1916.

CHARLES L. GOODRUM.