

July 23, 1929.

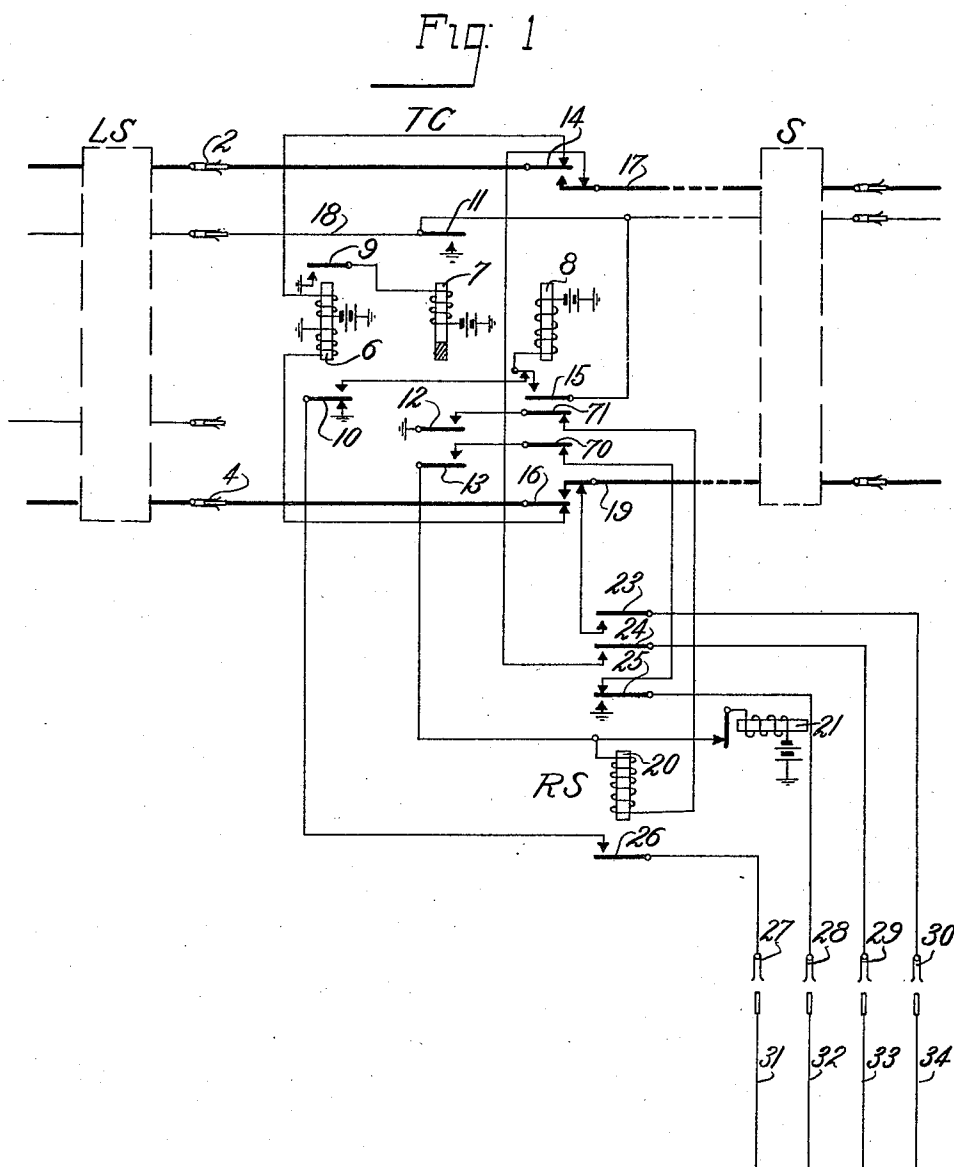
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TELEPHONE SYSTEM

Original Filed Aug. 28, 1925

4 Sheets-Sheet 1

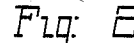


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TELEPHONE SYSTEM

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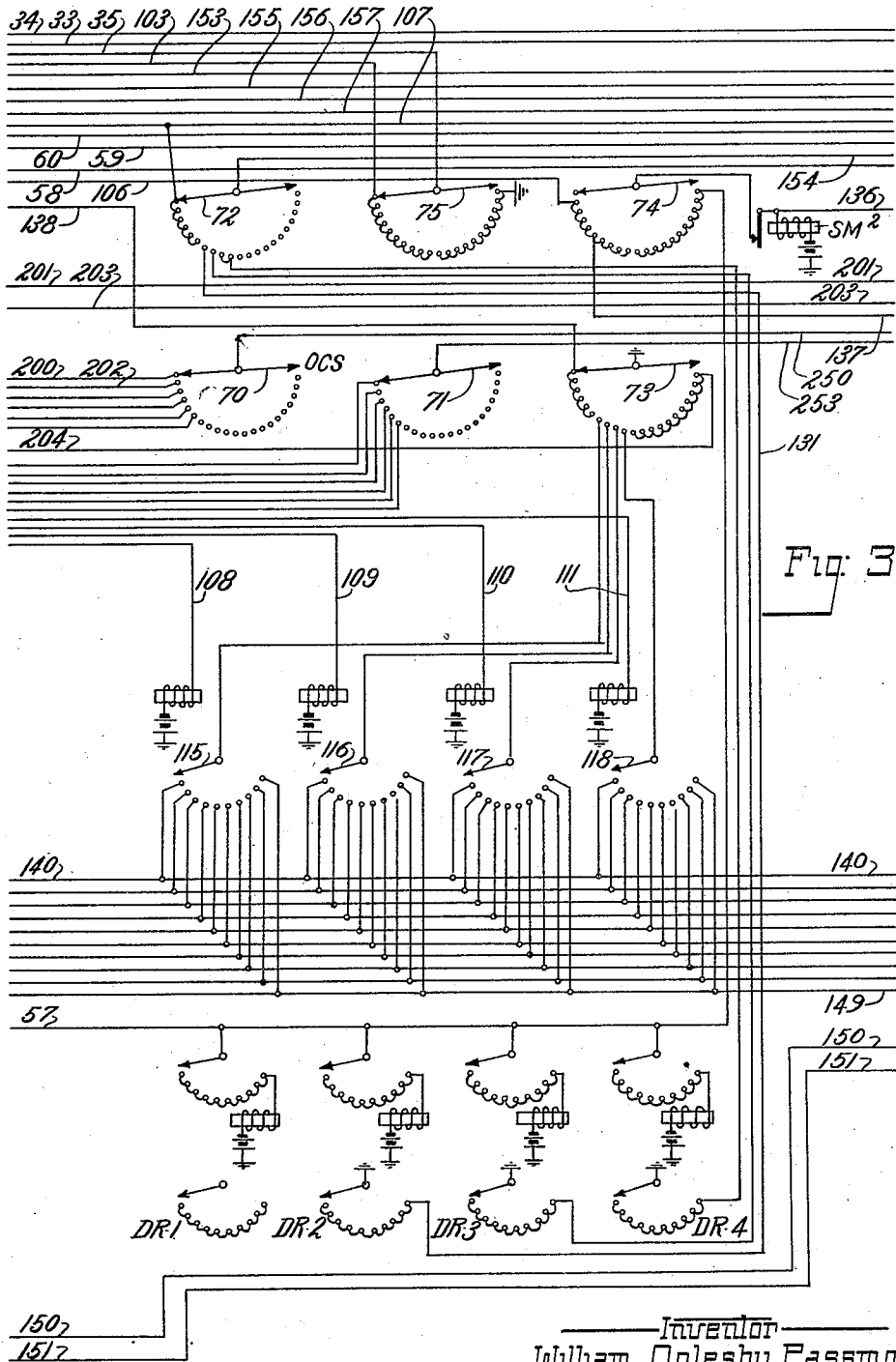


Fig. 3

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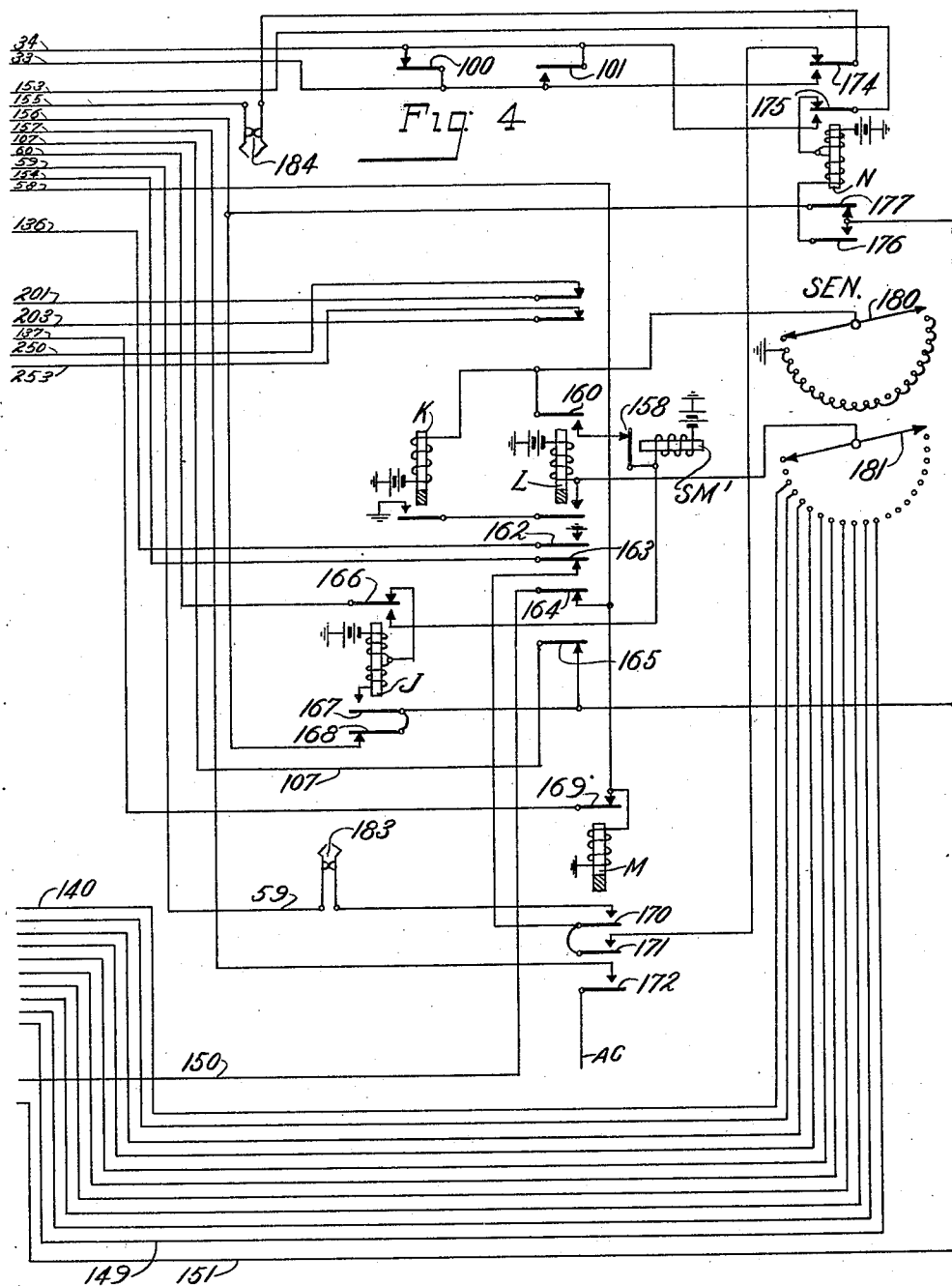
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TELEPHONE SYSTEM

Original Filed Aug. 28, 1925

4 Sheets-Sheet 4



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TELEPHONE SYSTEM.

Application filed August 28, 1925, Serial No. 53,041, and in Great Britain May 21, 1925. Renewed January 19, 1929.

This invention relates to automatic or semi-automatic telephone systems and is an improvement in or modification of that set forth in the copending application of Richardson et al, filed February 25, 1924, Serial No. 694,842. In that application a telephone system is described employing register controllers of the code translating type in which a distributing frame is provided common to a plurality of register controllers instead of being individual as described in the British Patents 193,694 and 194,580 of 1923. In the above application the code register switches are of special construction which necessitates an additional controlling magnet and special construction of the contact banks.

The object of the present invention is to employ a common distributing frame and use standard type of switches in the register controller from the bank contacts of which leads are connected to the distributing frame in order to determine the translation required.

According to the present invention, one side of the common distributing frame is provided with a plurality of bus-bars or the like each connected up in a different manner, while the other side is provided with a plurality of contacts which are multiplied to the bank contacts of a plurality of register switches, the wipers of the register switch which records code digits being connected successively to a set of storage relays which are operated according to connections made at the common distributing frame to cause the impulse sending apparatus to transmit successive series of impulses as predetermined by the operation of one or more of the storage relays.

In order that the invention may be clearly understood and readily carried into effect, a telephone system in accordance with the invention will now be more fully described with reference to the annexed drawings comprising Figures 1-4 inclusive.

The apparatus shown in Fig. 1 comprises a portion of a trunk circuit TC which is inserted in the trunk leading from the bank contacts of the line switch LS to the selector S, and the register selector RS individual to the trunk circuit TC.

The apparatus shown in Figs. 2, 3, and 4,

comprises one of the register controllers accessible to the register selector RS together with the distributing frame DF, which is common to this register controller and a plurality of others.

Regarding the apparatus shown the line switch LS, the trunk circuit TC, the register selector RS, and the selector S, may be of the type shown in the above British patents. The input control switch ICS, Fig. 2, is a simple step by step switch having wipers 55 and 56 which are advanced in a forward direction by stepping magnet SM and which are restored to normal position under the control of release magnet REL2 whose circuit passes through off normal contacts 54 and is therefore opened when the wipers reach their normal position. The input control switch distributes the incoming impulse conductor 31 to the various operating magnets of the register controller, the output control switch OCS is mechanically similar to the switch LS and the register selector RS, and its function is to bring about the transmission of the various series of impulses in their proper order, and to connect up the translating relays TR-1-TR-4 inclusive, Fig. 2 to the wipers of the code switches CS and CS1.

The code switches CS and CS1, Fig. 2, are mechanically well known Strowger switches, and their function is to register the office digits in any called number, preparatory to the transmission of the necessary code digits to route the call to the desired office.

The digit registers DR1-DR4, inclusive, Fig. 3, are each similar mechanically, to the input control switch ICS and their function is to register the four subscriber digits of any number.

The sending switch SEN, Fig. 4, is similar mechanically, to the output control switch OCS, and its function is to count off the impulses as they are being transmitted.

The distributing frame DF, Fig. 2, is connected between the multiplied bank contacts of the code switches, such as the code switch CS and CS' and the three bus-bars E, B and EB, so that the office codes may be readily changed and so that the changing of jumpers at one point changes the office codes of a plurality of register controllers. The bus-bar E

is connected to earth potential, the bus-bar B to battery potential and the bus-bar EB to battery, and earth alternately by means of the interrupter 1.

5 The apparatus having been described generally a detailed description will now be given of its operation in recording and retransmitting a wanted number. For this purpose it is assumed that a calling party dials the number 336453 and that the number is reached
10 by the digits 196453.

When the receiver is removed at the calling station the line switch LS operates in known manner to find an idle trunk circuit. Assuming that the trunk circuit TC is the first one found idle line relay 6 will energize over bank contacts 2 and 4 and the calling party's loop. Relay 6, upon energizing, closes at armature 9 a circuit for slow release relay 7 which energizes and earths the release trunk conductor 18 at armature 11, thereby completing the usual holding circuit for the switching relay of the line switch LS. Relay 7 also completes at armature 12 a circuit for switching relay 20 in series with stepping magnet 21 of the register selector RS and connects at armature 13 test wiper 28 to the junction of switching relay 20 and stepping magnet 21. Accordingly, the register selector RS operates in known manner to select an idle register controller. When an idle register controller is found, switching relay 20 energizes; opens the test circuit and earths the test wiper 28 at armature 25, thereby earthing conductor 32 of the seized register controller; connects up the impulsing conductor 31 at armature 26; and at armatures 23 and 24 connects the conductors 17 and 19 leading to the selector S over wipers 29 and 30 to a normally closed loop in the register controller including conductors 33 and 34 and armatures 100 and 101 in parallel of relays K and L respectively, Figure 4. Accordingly, the line relay (not shown) of the selector
45 S, Fig. 1 energizes and prepares the switch for operation in the usual manner.

In the register controller Fig. 2 release relay 38 energizes over the circuit: earth 25, 28, 32, 35, 102, 103, 38, battery, responsive to earth being connected to conductor 32 by the switching relay 20 of the register selector RS.

Release relay 38, upon energizing, removes earth potential from the restoring conductor 57 and 106 at the back contact of armatures 43 and 45 respectively, and the front contact of armature 43 earths the holding conductor 107; and at 44 prepares the incoming impulse circuit.

The above operations have all taken place responsive to the removal of the receiver at the calling station and the circuits are now in readiness for the first digit in the wanted number to be dialled. Accordingly, the calling party dials the first digit three and the
65 line relay 6 transmits three impulses to the

vertical magnet VM of the code switch CS over the following circuit: earth 10, 26, 27, 31, 36, 44, 56, VM battery. The vertical magnet VM responds to these impulses and raises its wipers *a, b, c, d, e* and *f* opposite to the third level of bank contacts. Slow relay 36, is energized in series with the vertical magnet VM upon the first impulse being transmitted to the latter, and, being slow to release, maintains its armature attracted through the series of impulses. At armature 40, relay 36 closes a circuit for slow release relay 37 which energizes and prepares at armature 42 a circuit for magnet SM of the input control switch ICS. Accordingly when series relay 36 deenergizes at the end of the series of impulses, an impulse of current is transmitted to magnet SM during the interval required for relay 37 to fall back after its circuit is opened by relay 36. Magnet SM thereupon energizes and advances wipers 55 and 56 into engagement with the second set of bank contacts.

When the calling party dials the second digit this series of impulses is transmitted over the previously traced circuit and wiper 56 of the switch ICS in second position to the rotary magnet RM of the code switch CS. The wipers *a, b, c, d, e* and *f*, are now rotated into engagement with the third set of bank contacts in the third level, which contacts are assumed to be the contacts 61-66 inclusive. Since relay 36 is again energized during the transmission of this series of impulses, magnet 52 will be operated again and wipers 55 and 56 will be advanced to third position. Wiper 55, upon coming into engagement with the third associated bank contact, completes a circuit for relay 39 which initiates the sending operation, and the sender SEN, Fig. 4, starts to send out the first of the office code digits, as will be subsequently explained.

Responsive to the four remaining series of impulses comprising six, four, five and three impulses, respectively, the digit registers DR1-DR4 inclusive, Fig. 3, are operated over conductors 108-111 respectively, the wipers 55 and 56 of the switch ICS being advanced one step at the end of each series of impulses as previously described.

Considering now the code switch CS, it will be remembered that the wipers *a, b, c, d, e*, and *f* are in engagement with the bank contacts 61-66 respectively, and it may be pointed out here that the subsequent description will show how the wipers *a-f* control the value and number of the code digits in accordance with the cross connections made at the distributing frame DF of the conductors associated with the contacts upon which these wipers are standing. It will be noted that the bank contact 61 is connected to the earthed bus-bar E and the bank contact 64 to the earth and battery bus-bar EB and that the contacts 62, 63, 65 and 66 are not connected to any of the bus-
130

bars. Accordingly, as will be described hereinafter, two code digits 1 and 9 will be transmitted owing to the connections made to these bus-bars.

5 Returning now to the point at which wipers 55 and 56 of the input control switch ICS were advanced into engagement with the third set of bank contacts immediately following the termination of the rotary movement of the code switch CS, Fig. 2, wiper 55 completes the following energizing circuit for relay 39; earthed holding conductor 107, wiper 55 in third position, relay 39 to battery. Relay 39, upon energizing, closes the following circuits: At armature 48 closes the circuit for slow release relay M: battery *r*, 48, 58, M, earth; at armature 49 prepares a circuit for the two-step start relay J, at armature 50 closes one point in an alarm circuit; at armature 51, prepares a circuit for the two step relay N; at armature 46', 46, 47' and 47 prepares circuits for the translating relays TR1 to TR4 respectively and at armature 52 extends ground from the bank of wipers 73 to conductor 150 by way of armatures 91-94, normal, thereby shunting relay M through armature 164 of relay L, preventing the operation of relay M for the time being.

Referring now to the distributing frame DF it will be seen that earth is place on wiper *a* and that battery and earth is placed alternately on wiper *d*. Responsive to earth being connected to wiper *a* the following circuit is completed for the translating relay TR-1: earth, bus-bar E, jumper and bank contact 61, wiper *a*, conductor 200, first contact in the bank of wiper 70 of the output control switch OCS, wiper 70, conductor 250, armature 251 and its resting contact, conductor 201, working contact and armature 46', armature 80 and its resting contact to the lower winding of relay TR-1 and battery. Relay TR-1 upon energizing first operates its armature 84 thereby completing the following locking circuit for itself: battery, upper winding of relay TR-1, working contact and armature 84, conductor 151, resting contact and armature 165 to the earthed holding conductor 107. Relay TR-1 now fully operates and at armature 80 opens its initial energizing circuit and at armature 91 removes the shunt from around relay M and earths the first impulse stop conductor 140 in the bank of wiper 181 of the sending switch SEN over the following circuit: earth, wiper 73, of the output control switch in normal position, conductor 138, working contact and armature 52, armature 91 and its working contact, armatures 88, 89, and 90 and their resting contacts to the first impulse stop conductor 140. Relay M, upon energizing responsive to the said removal of the shunt from around its winding, completes the following circuit for the two-step relay J: earthed holding conductor 107, Fig. 3, wiper 72 of the out-

put control switch OCS in normal position, conductor 154, normal 163, operated 170, pulse springs 183, conductor 59, operated 49, conductor 60, normal 166, upper winding of relay J to battery. The first earth pulse to relay J will cause it to operate its contacts 167 only, but immediately this earth pulse ceases (i. e., the pulse springs 183 open) relay J fully operates over both its windings in series and locks up to the holding conductor 107 over contacts 165 of stop relay L.

The next pulse will now operate the stepping magnets SMI of the sending switch SEN over the operated contact 166 of relay J. The operation of the sender will however be explained later.

Relay M also completes at armature 171 the following circuit for the two step relay N: battery, upper winding of relay N, normal 175, conductor 153, operated 51, conductor 155, loop pulse springs 184, normal 174, operated 171, normal 163, conductor 154, wiper 72 to the earthed holding conductor 107. The first pulse to relay N causes it to close its contacts 176 only, but immediately the loop pulse springs 184 open, relay N fully operates over both its windings in series and locks up to the earthed holding conductor 107 over armature 165 of stop relay L. The complete operation of relay N places the loop pulse springs 184 across the conductors 33 and 34 in readiness for the operation of the selector S, Fig. 1. The further operation of the loop pulse springs will not have any effect at this stage upon the selector S as they are short circuited at armature 100 of start relay K. The rotary magnet SM of the sending switch was set in motion as previously explained and steps its wipers 180 and 181 on one step. Immediately wiper 180 makes one step it completes the following circuit for start relay K: battery K, 180, earth. Start relay K upon energizing removes at armature 100 the short circuit about the loop impulse springs 184 and the line relay of the selector S is thus held over the loop pulse spring 184. The next operation of the earth pulse springs 183 operates the sending switch one more step and simultaneously the loop pulse springs transmit one impulse to the line relay of the selector S, thus causing it to step up, hunt, and switch on to the first level.

Immediately wiper 181 of the sending switch engages the first impulse stop conductor 140, a circuit is completed for stop relay L, the first impulse stop conductor 140 being earthed by the operation of translating relay TR-1 as previously explained. Stop relay L upon energizing, short circuits the loop impulse springs 184 at armature 101 thus preventing impulses being transmitted to the switch seized by the selector S and holding the same. Relay L at armature 163 disconnects holding earth from the translating relays TR-1-TR-4 inclusive, thus allowing

those held (relay TR—1 in the present case) to restore to normal in readiness to be set again for the next digit upon the deenergization of relay L.

5 Relay L at armature 162 transmits an impulse to the stepping magnet SM2 of the output control switch OCS over conductor 136 thus preparing it to advance its wipers 70–75 inclusive, when the sending switch is restored and stop relay L released. At armature 165
10 relay L opens the locking circuit for relays J and N which deenergize and open the earth pulse circuit to the sending switch magnet SM1 and the loop pulse circuit respectively.
15 Relay L also closes at armature 160 the following circuit for restoring the sending switch to normal position: earthed bank contacts in the bank of wiper 180 of the sending switch SEN, wiper 180, armature 160 and its
20 working contact, interrupter contacts 158, stepping magnet SM1 to battery.

When the sending switch SEN is in home position wiper 180 opens the circuit for start relay K which deenergizes and opens the
25 circuit of stop relay L which also deenergizes. The sending switch is thus in its original condition and prepares to send the next series of impulses.

Immediately stop relay L restores, the stepping magnet SM2 of the output control switch OCS releases and steps the switch to second position, where it prepares the circuits to send the second digit. As soon as the output control switch sets its wipers in its second
30 position a fresh set up of the translating relays TR—1—TR—4 inclusive occurs as follows: The manner in which the register controller sends the second code digit is identical with that described for the first code digit,
35 with the following exceptions: earth and battery is connected to the code switch wiper *d* by means of the interrupter I and the translating relays TR—3 and TR—4 are energized as follows: earth from interrupter I, bus-bar EB,
40 jumper to bank contact 64, wiper *d*, conductor 202, output control switch wiper 71 in second position, conductor 253, resting contact and armature 252, conductor 203, working contact and armature 47', armature 82 and its resting
45 contact, lower winding of relay TR—3 to battery. Relay TR—3 operates its armature 86 in this circuit which completes a locking circuit for its upper winding whereupon relay TR—3 fully energizes. The energizing circuit for relay TR—4 is as follows: battery from interrupter I, bus-bar EB, jumper to bank contact 64, wiper *d*, output control switch
50 wiper 71 in second position, conductor 253, resting contact and armature 252, conductor 203, working contact and armature 47, armature 83 and its resting contact to the lower winding of relay TR—4 and earth. Relay TR—4 operates its armature 89 in this circuit which
55 completes a locking circuit for its upper winding, whereupon relay TR—4 fully energizes.

With translating relays TR—3 and TR—4 energized the ninth impulse stop conductor 148 is earthed over the following circuit: earth, output control switch wiper 73, conductor 138, working contact and armature 52,
60 armature 91 and its resting contact, armature 92 and its resting contact, armature 93 and its working contact, armature 96 and its working contact to the ninth impulse stop conductor 148. The stepping magnet SM1 of the
65 sending switch SEN, being again operated under the control of the earth pulse springs 183 send out nine impulses over the output control circuit 33, 34, and restores to its home position as already described the output control
70 switch OCS being stepped into its third position. As there are no cross connections between the bus-bars E, B and EB and the bank contacts upon which the wipers *b*, *c*, *e* and *f* are resting, due to the fact that only
75 two code digits are to be sent out, the following operations take place:

All the translating relays being now in normal position, relay M is shunted as before and falls back to disconnect relays J and N
80 to prevent further impulses being sent and also to extend the shunting ground potential to the rotary magnet SM2 of the switch OCS: through the resting contact and armature 169, conductor 137, wiper 74 in third position,
85 interrupter contacts and stepping magnet SM2 to battery.

The output control switch is thus stepped until it reaches the seventh contact where its stepping circuit is opened and as relay M
90 now energizes due to earth being removed from conductor 137 by wiper 74 in seventh position, the circuits in the register controller are now in readiness to send the first numerical digit. It may be pointed out here that
95 since relay M is slow to release it will not deenergize during the short period required by the translating relays TR—1—TR—4 to be reset, when they restore between code digits. As the output control switch OCS is now in
100 the seventh position, earth at wiper 73 is extended over wiper 115 of the thousands digit register DR—1 to the sixth impulse stop conductor 145. If the hundreds digit 4 has been transmitted to the hundreds digit register
105 DR—2 the sending switch is started over the circuit: earth, wiper 128 of DR2, conductor 131, seventh contact in the bank of wiper 72, conductor 154, armature 163, armature 170 and its working contact, earth pulse springs
110 183, conductor 59, working contact and armature 49, conductor 60, armature 166 to relay J and battery. Relay J as before completes a circuit at 166 for the stepping magnet SM1 of the sending switch SEN. Under
115 these circumstances the subsequent operations of the sending switch are identical with those explained for the sending of the code digits. The impulses of the first numerical digit are thus transmitted over the output
120
125
130

control circuit 35, 34 to the switches taken into use. At the end of the transmission of this series of impulses the output control switch is advanced to eight position whereupon earth at wiper 73 is extended over wiper 116 of the hundreds digit register DR—2 to the fourth impulse stop conductor 143, and if the tens digit has been recorded on the register DR—3 four impulses will be transmitted by the sending switch. The tens and units digits are transmitted in a similar manner to the thousands and hundreds digits.

Immediately the last digit has been sent, the output control switch will advance to the eleventh position due to the stop relay L restoring. In position eleven the circuit for release relay 38 is opened and this relay therefore deenergizes. In the eleventh to twenty-fifth positions of wiper 75 earth potential is connected over conductor 35 and 32 to the test bank contact of the register selector RS in order to guard the register controller until its switches have fully returned to normal.

Release relay 38 upon deenergizing performs the following functions: connects earth at armature 43 to the restoring conductors 57 and 105 thereby completing energizing circuits for the release magnets of the code switches CS and CS1, the digit registers DR—1 to DR—4 and the release magnet of the input control switch ICS, these switches are accordingly restored to normal and as is usual open their energizing circuits in normal position. Relay 38 also at armature 43 connects earth from the holding conductor 107 thus releasing all operated relays in the register controller at armature 44 completes the following circuit for switching relay 8 of the trunk circuit TC: battery, relay 8, normally closed contacts controlled by armature 15, working contact and armature 26, wiper 27, pulse conductor 31, relay 36, armature 44 and its resting contact, conductor 204 to wiper 73 of the output control switch OCS and earth. Relay 38 also connects earth at armature 45 to the seventh, eighth, ninth and tenth contacts in the bank of wiper 74 of the switch OCS. This connection has no effect in the present case, but would serve to restore the output control switch to normal in the event of the calling party abandoning the call after dialling the exchange code and before completely dialling the numerical digits.

Switching relay 8, upon energizing, locks up to the release trunk 18, at armature 15, and at armatures 14 and 16 switches the calling side of the trunk circuit TC through to the connection set up by the register controller at armatures 70 and 71 disconnects the register selector RS, whereupon switching relay 20 deenergizes and renders the register controller free to take another call.

In the foregoing description only two exchange code digits were sent out and attention is drawn to the fact with the apparatus shown

it is possible to send out any number of codes up to six. The code switch CS will take care of any three codes and the code switch CS—1 will take care of a like number by means of its six wipers *g, h, i, j, k, and l*.

Referring now to the translating relays TR—1 to TR—4 it will be seen that with relay TR—1 energized alone that the first impulse stop conductor 140 is earthed; with relays TR—1 and TR—2 the second impulse stop conductor 141; TR—1 and TR—3 the third impulse stop conductor 142; TR—1 and TR—4 the fourth impulse stop conductor 143; TR—2 the fifth impulse stop conductor 144; TR—2 and TR—3 the sixth impulse stop conductor 145; TR—2 and TR—4 the seventh impulse stop conductor 146; TR—3 the eighth impulse stop conductor 147; TR—3 and TR—4 the ninth impulse stop conductor 148; TR—4 the tenth impulse stop conductor 149, a further combination is obtained when all the relays are in normal position. By the use of the bus-bars earth, battery and battery and earth alternately it is possible to energize relays TR—1—TR—3 together, TR—1, TR—2 and TR—4 together, TR—2—TR—4 together, TR—1, TR—3, TR—4 together and TR—2, TR—1, TR—4 together, thus obtaining sixteen combinations over the two wipers 70 and 71. One of these combinations TR—1—TR—3 is made use of to cancel all numerical digits by operating the switching relay 8 at the end of an exchange code for example, when a toll operator is called. Assuming that the code required to route a call to an operator is 78 then the bank contacts engaged by wipers *a* and *b* will be connected to bus-bar B in order to energize relays TR—2 and TR—4 to bring about the transmission of eight impulses. The bank contact engaged by wiper *d* will be connected to bus-bar E in order to energize relay TR—3 to bring about the transmission of seven impulses. Now in order to bring about the operation of switching relay 8 after the reception of the code digits 78, the translating relays TR—1, TR—2 and TR—3 must be energized with the output control switch wipers 70, 71, in third position. Accordingly the bank contacts engaged by wipers *e* and *f* are connected to bus-bars EB and E respectively. With relays TR—1, TR—2 and TR—3 energized earth is connected to conductor 205 and switching relay 8 energizes as before over conductor 31 to switch the calling party through to the operator and to bring about the release of the register controller.

It will be appreciated by those skilled in the art that with the additional combinations possible with the translating relays that the switching relay may be energized after the register controller has sent out one or more numerical digits and consequently the register controller may be taken into use for setting up connections to exchanges having

a varying number of digits in the subscribers' telephone numbers. Moreover in case a calling party dials a dead number the calling party may be switched through to an operator's position and the register controller released by making the necessary cross connections between dead numbers and the bus-bars on the common distributing frame.

Referring to the two step relays J and N, Figure 3, these relays are provided to ensure that a correct impulse will always be delivered to the rotary magnet of the sending switch and to the automatic switches taken into use to establish the connection.

In case either the earth pulse springs 183 or the loop pulse springs 184 fail to function correctly due to being short circuited or disconnected, the relay J or the relay N as the case may be will not be fully operated and an alarm circuit will be completed over either the bank contact 168 of relay J or the bank contact 177 of relay N. The alarm circuit for relay N may be traced as follows: earthed holding conductor 107, armature 165 and its back contact, back contact and armature 177, conductor 156, armature 50 and its working contact, relay 39, Fig. 2, conductor 157, working contact and armature 172 to the alarm circuit conductor AC. The alarm circuit for relay J is as follows: earthed holding conductor 107, armature 165 and its back contact, armature 168 and its back contact, conductor 156, armature 50 and its working contact of relay 39, Fig. 2, conductor 157, working contact and armature 172 of relay M to the alarm circuit conductor AC.

In order to ensure that no impulse will be transmitted during the change from the transmission of the code digits to the transmission of numerical digits, relay M is arranged to be energized at this time and as this relay not only drives the output control switch OCS into its correct position, but also disconnects both the earth impulse springs 183 and the loop impulse springs 184, the sender cannot operate and no loop impulses can be transmitted during this period.

In case the calling party abandons the call at any stage of a connection, release relay 38 will deenergize and all operated relays and switches in the register controller will be restored to normal.

What is claimed is:

1. In a telephone system employing automatic switches for setting up connections, directors including registering, translating and retransmitting apparatus, a distributing frame common to a plurality of said directors, an office register in each director having a plurality of wiper sets, means for operating the retransmitting means a plurality of times in accordance with the set position of the office register and in accordance with connections made at said distributing frame, the last named means including a set of storage relays

interposed between said office register and the retransmitting means, and means advanced once for each operation of the retransmitting means for associating said storage relays with said wiper sets successively.

2. In a director, a sender including a counting switch, a set of permutational relays for controlling said switch, a plurality of circuit combinations for setting and resetting said relays, an office register for selecting a plurality of said circuit combinations, and a sequence switch for associating said circuit combinations with said relays successively.

3. In a director, a sender including a counting switch, a set of permutational relays for controlling said switch, a plurality of circuit combinations for setting and resetting said relays, an office register for selecting a plurality of said circuit combinations, a sequence switch for associating said circuit combinations with said relays successively, and a distributing frame for facilitating changes in said circuit combinations.

4. In a director, a sender including a counting switch, a set of relays controlling said switch, a distributing frame comprising a plurality of sets of contacts and means by which any desired contacts of each set are connected to the central office battery, and a sequence switch for associating said relays with a plurality of contact sets successively.

5. In a register sender, a pair of relays arranged to control the sender, said relays being connected in series with each other and in series with a source of current and arranged so as not to operate in series with each other, and means including the registering portion of said register sender for shunting either of said relays to permit the other to operate.

6. In a telephone system, a sender including a counting device, a pair of relays for controlling said device, a current source, said relays being connected in series across the two poles of said current source and arranged not to operate in series with each other, a control conductor extending from the junction of said relays, a secondary control conductor connected to one pole of said current source, a secondary control conductor connected to the other pole of said current source, a third secondary control conductor, means for connecting said third secondary control conductor to the two poles of said current source alternately, and means including a register for connecting the first named control conductor with either of the said secondary control conductors.

7. In combination, a first control conductor, a second control conductor, and a third control conductor, a source of current, the first and second control conductors being connected to the two poles respectively of said current source, a device for connecting the third control conductor alternately to the two poles of said current source, a secondary con-

trol conductor, means for connecting said secondary control conductor with either of the first mentioned control conductors, and a sending device variably operable according to which of the first mentioned control conductors the secondary control conductor is connected with.

8. In combination, a first control conductor, a second control conductor, and a third control conductor, a source of current, the first and second control conductors being connected to the two poles respectively of said current source, two secondary control conductors, means for connecting either of said secondary control conductors with any one of the first mentioned control conductors, and a sender variably operable in accordance with the connections between the first mentioned control conductors and said secondary control conductors.

9. In a telephone system, a plurality of directors, switching mechanism for selecting idle directors, each director including sending apparatus and a plurality of registering devices, an output control device for placing said sending apparatus under the control of said registering devices successively, and contacts on said output control device for initiating the release of the director and for guarding the same from seizure by said switching mechanism during its releasing operation.

10. In a telephone system, a director, switching devices for taking said director for use when the same is idle, a test conductor extending between said director and the test contacts of said devices, a holding relay in said director connected to said release trunk conductor, a restoring circuit in said director, contacts on said holding relay for maintaining said restoring circuit open, a sending device in said director operable to transmit a plurality of digits, a step by step sequence switch having a set of wipers and cooperating contacts, means for advancing said sequence switch one step after each digit transmitted by said sender, and means including one of the wipers and its contacts for disconnecting said holding relay from the test conductor upon the advance of the sequence switch after the last digit is transmitted.

11. In a register sender including registering devices for registering telephone numbers and a sending device responsive to settings of said registering devices to transmit digit impulses, hunting switches having access to said register sender, means for causing one of said hunting switches to seize said register sender and for subsequently operating the same, and means in said register sender responsive to the retransmission of the last stored digit for immediately rendering said register sender busy to the other hunting switches, for subsequently causing said hunting switch to free the said register sender, and for maintaining said register sender busy to the other hunting

switches regardless of its having been so freed until the same has been restored to its normal condition.

12. In a multi-office telephone system, two office registers set by the same portion of a telephone number, a train of switches, and means controlled by both of said registers to operate said train of switches.

13. In a register sender for use in a multi-office telephone system, two office registers, means for operating both of said office registers at the same time and in accordance with the same portion of a telephone number, a train of switches, and means controlled by both of said registers in accordance with their set position for setting up said train of switches.

14. In combination, two office registers each having wipers, said wipers being associated together in sets, means for operating said office registers in response to the same office-designating character in a telephone number, a switch controller, and means for operating said controller under the joint control of the wipers of one set and for then operating it under the joint control of the wipers of the other set.

15. In a director, a plurality of office registers operated simultaneously responsive to the office-designating portion of a number, a plurality of sets of wipers on each register, a sender adapted to be controlled jointly by the wipers of the first set, and a sequence switch for shifting the control to the other sets in turn.

16. In a director, a plurality of office registers operated simultaneously responsive to the office-designating portion of a number, a plurality of wipers on each register, a sender arranged to be controlled first by the wipers of one register, and means normally effective when all the wipers of the first register have exercised their control for causing said sender to be controlled by the wipers of the next office register.

17. In a register sender for use in a multi-office telephone system, a plurality of office registers each having a wiper, a sequence switch having a contact bank, and conductors extending between all said wipers and a like number contacts in said bank.

18. In a register sender for use in a multi-office telephone system, a plurality of office registers each having a plurality of wipers, a sequence switch having a contact bank, and conductors connecting all said wipers respectively to said contact bank, each wiper being thereby connected to a different contact in the bank.

19. In combination, a relay storage device including a pair of relays connected to a conductor and responsive to two potentials, respectively, means including a register for applying either one or both said potentials to said conductor to set said storage device, and

a control device operated to exercise a control in accordance with the setting of said device.

20. In combination, a relay storage device including a pair of relays connected to a conductor and responsive to two potentials, respectively, means including a register for connecting either one or both of said potentials to said conductor to set said storage device, switching apparatus, and a control device effective to position said switching apparatus in accordance with the setting of said storage device.

21. In combination, a relay storage device including a pair of relays connected to a conductor and responsive to two potentials re-

spectively, means including a register for connecting either one or both of said potentials to said conductor to set said storage device, an impulse sender, and means for operating said impulse sender to send a train of impulses in accordance with the setting of said storage device.

22. In a director, a set of four relays for storing a digit, a distributing frame, an office register having two wipers for connecting said relays with said frame, and connections on said frame for setting all said relays over said two wipers.

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