March 12, 1929. C. GILLINGS 1,705,462

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 1. 1922 7 Sheets-Sheet 1

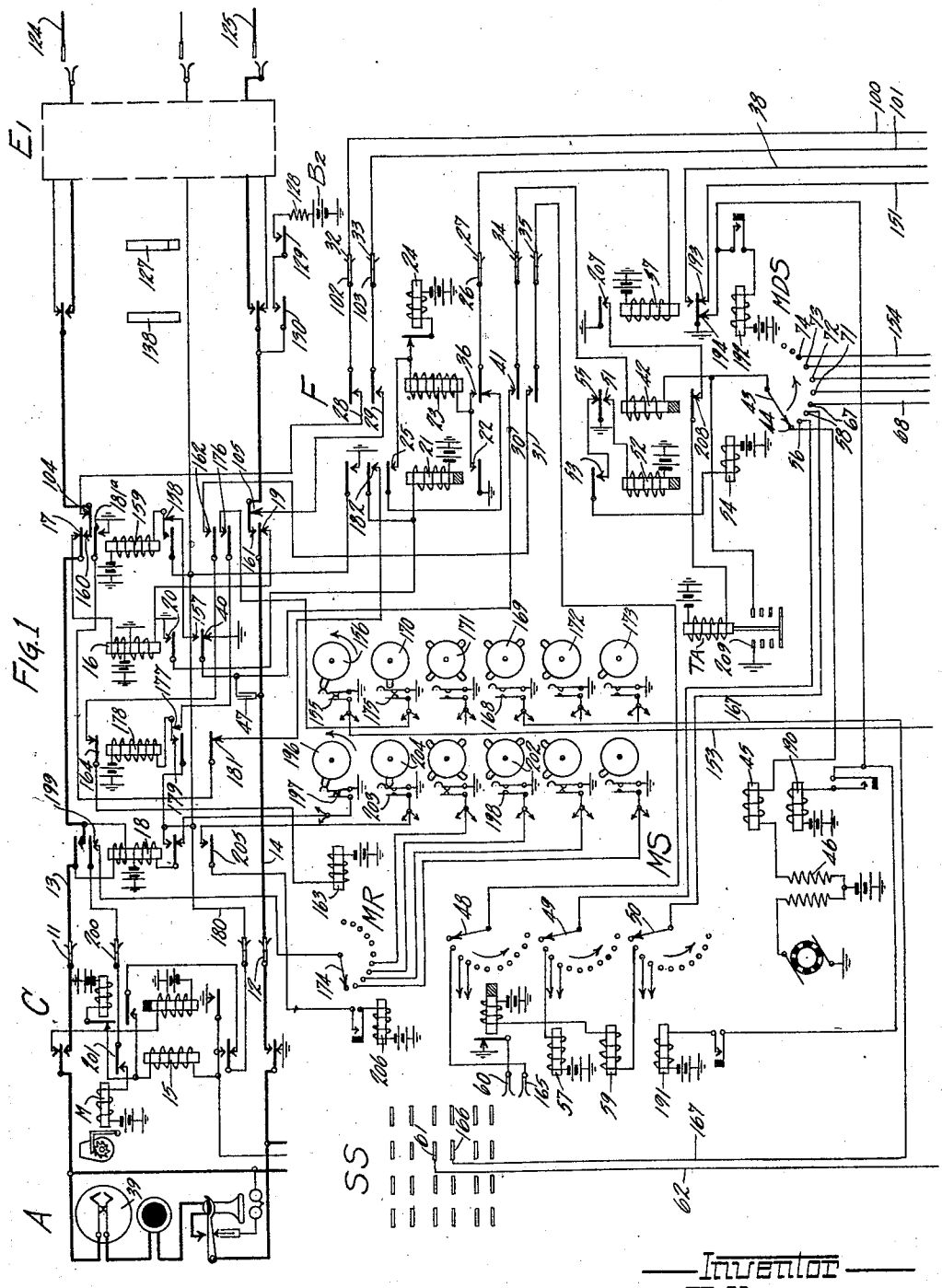


Fig. 1

Inventor

Charles Gillings

Chas. Tu. Cauby Atty.

March 12, 1929. C. GILLINGS 1,705,462

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 1. 1922 7 Sheets-Sheet 2

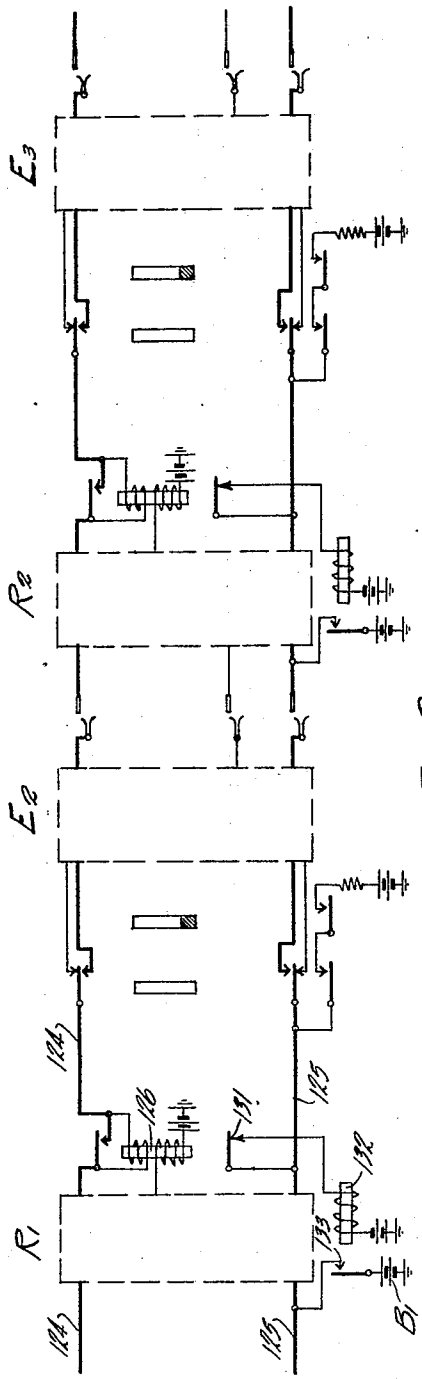


Fig. 2

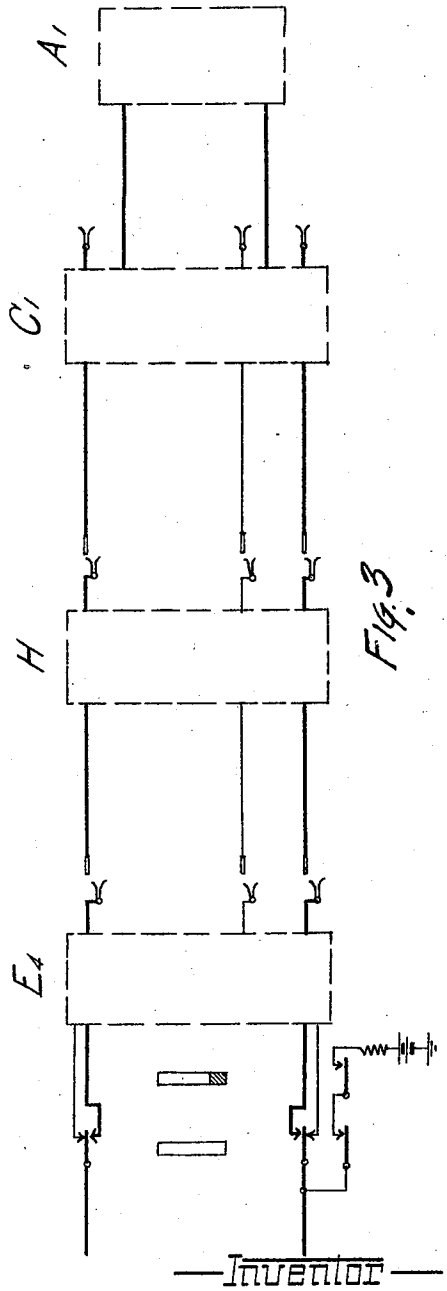


Fig. 3

Inventor

Charles Gillings

Chas. Tu. Candy Atty.

March 12, 1929. C. GILLINGS 1,705,462

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 1, 1922 7 Sheets-Sheet 3

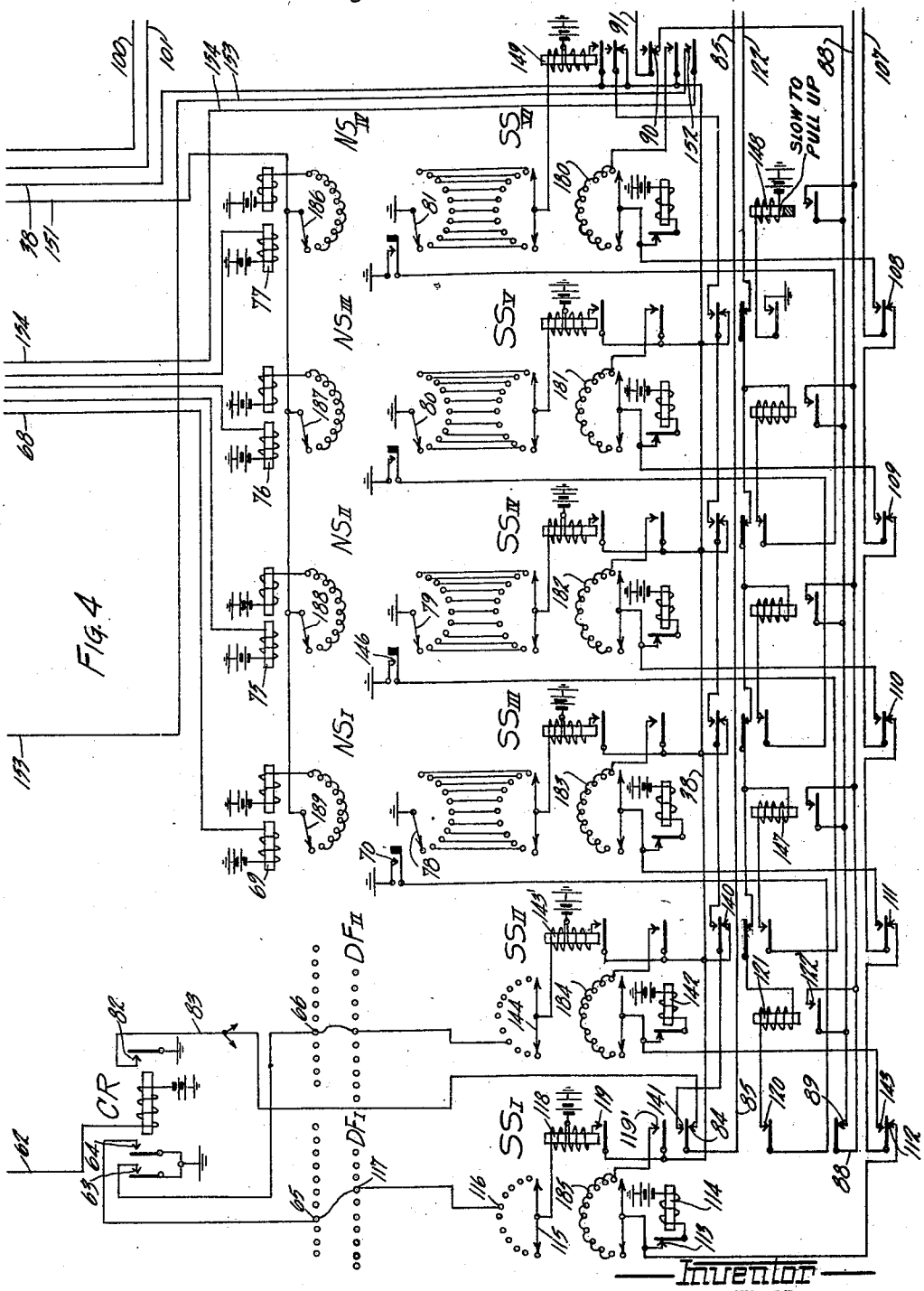


FIG. 4

Inventor
Charles Gillings
Chas. Lee Cady Atty.

March 12, 1929. C. GILLINGS 1,705,462

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 1. 1922 7 Sheets-Sheet 4

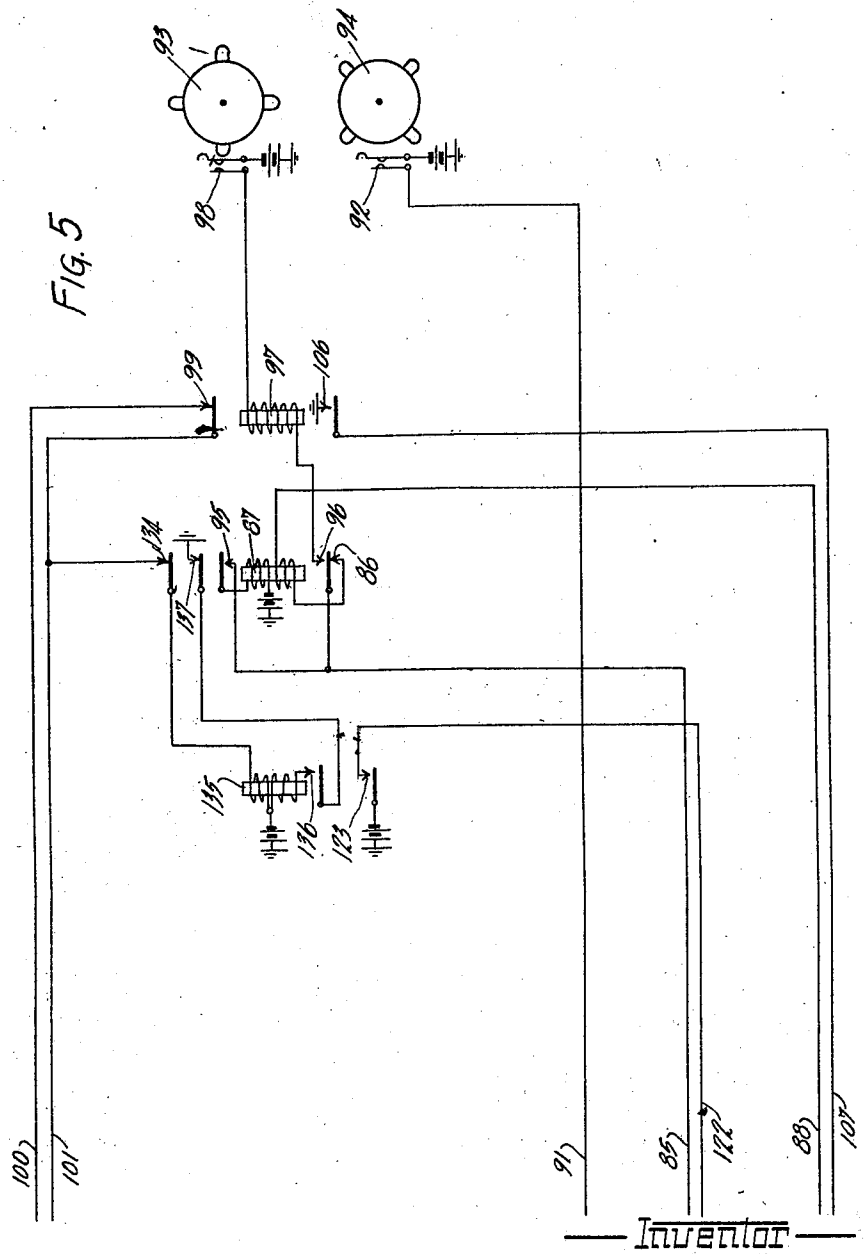


FIG. 5

Inventor
Charles Gillings
Chas. Tu. Candy Atty.

March 12, 1929. C. GILLINGS 1,705,462

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 1, 1922 7 Sheets-Sheet 5

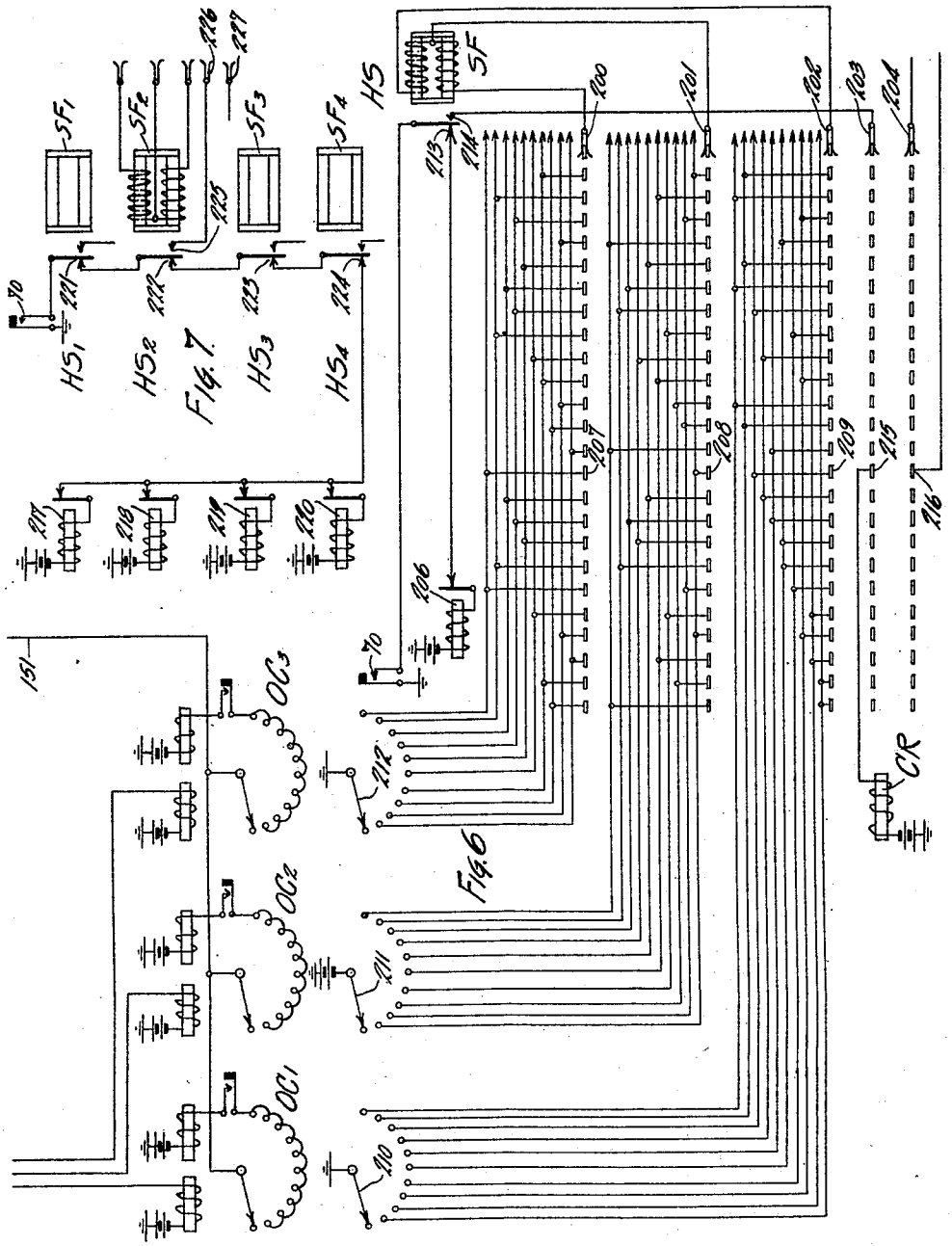


Fig. 7

Fig. 6

Inventor
Charles Gillings
Chas. H. Candy Atty.

March 12, 1929. C. GILLINGS 1,705,462

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 1. 1922 7 Sheets-Sheet 6

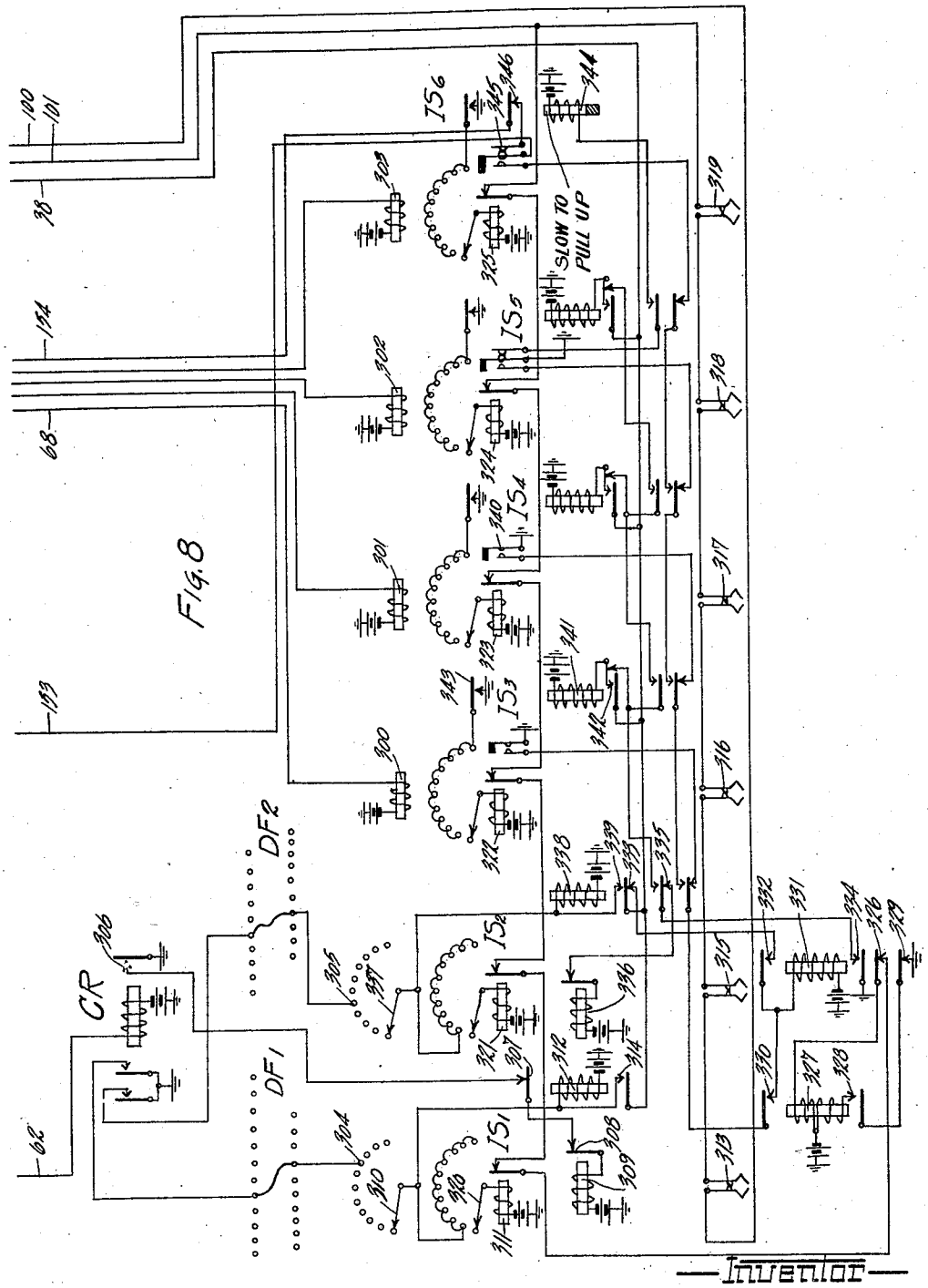


Fig. 8

Inventor
Charles Gillings
Chas. Tu. Candy Atty.

March 12, 1929. C. GILLINGS 1,705,462

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 1. 1922 7 Sheets-Sheet 7

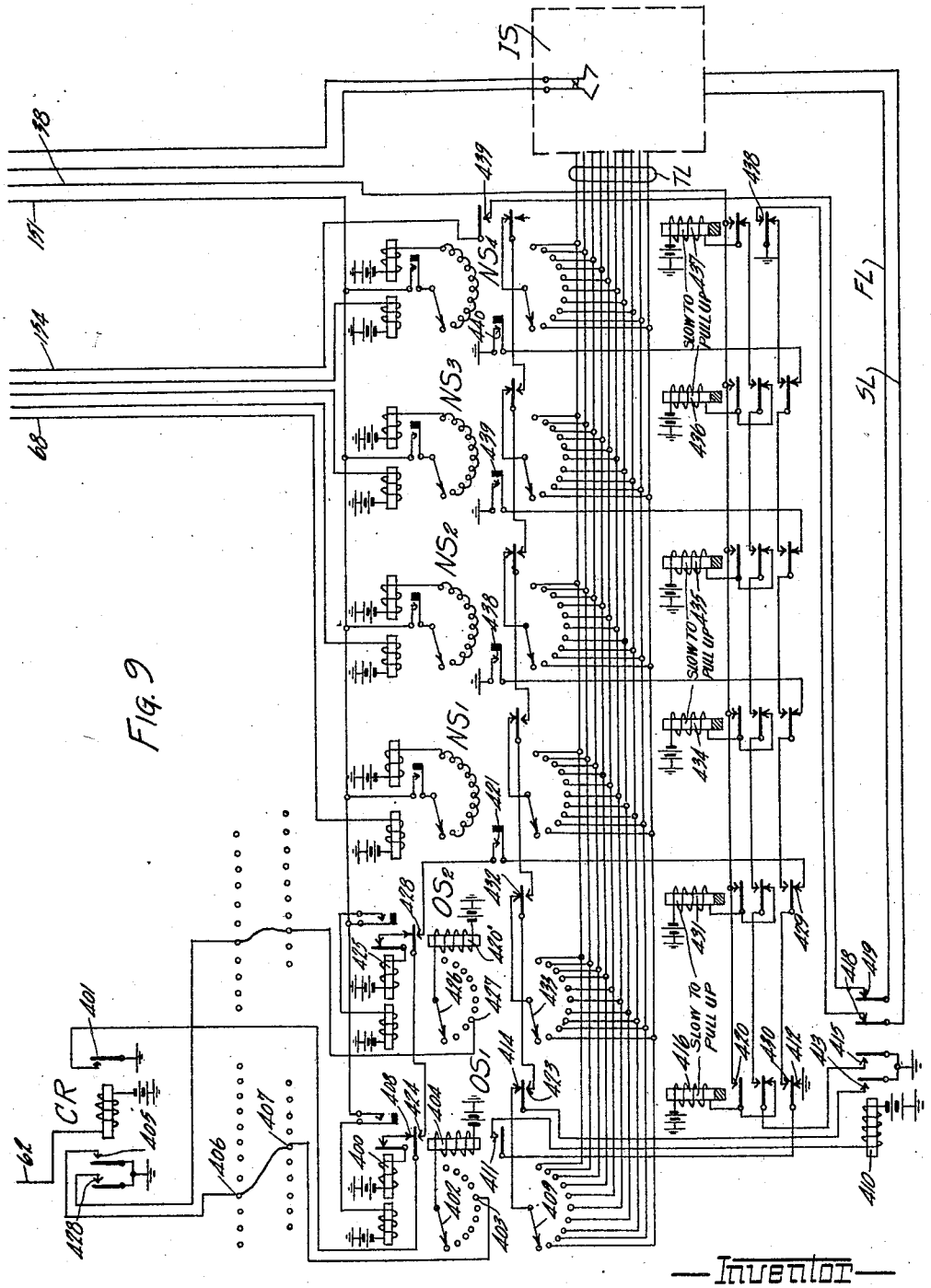


Fig. 9

Inventor
Charles Gillings
Chas. H. Candy Atty.

Patented Mar. 12, 1929. 1,705,462

UNITED STATES PATENT OFFICE.

CHARLES GILLINGS, OF LIVERPOOL, ENGLAND, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

AUTOMATIC TELEPHONE SYSTEM.

Application filed November 1, 1922, Serial No. 593,239, and in Great Britain December 17, 1921. Renewed January 7, 1929.

The present invention concerns improvements in or relating to telephone systems employing automatic switches, and more particularly to improvements in that type of system which employs a register device for storing up impulses and thereafter controlling the operation of automatic switches to complete the connection. Such registers have been largely used in connection with what are known as revertive control systems, that is to say, systems in which series of impulses corresponding to the setting of the registers are sent back from the selector switches successively as they operate to complete the connection.

One of the features of the present invention is the application of such registers to automatic telephone systems of the Strowger or like type, in which the impulses are emitted from the register to control the operation of the selector and connector switches. Such registers are particularly advantageous in large net-work where they facilitate the change of subscriber's numbers, and also facilitate trunking changes which may be necessary. Incidentally they simplify the zone or multi-metering schemes and arrange for a better utilization of the available apparatus.

Another feature of the present invention relates to an improved register and translator for use for instance in converting large networks from manual to automatic working, in which the names of the manual exchanges are retained, and for this reason the number holes of the dial are given alphabetical as well as numerical designations and the subscriber first dials a number of series of impulses corresponding to the first letters in the name of the exchange, usually the first three letters.

Accordingly, a registering device is provided adapted to respond to a plurality of series of impulses, usually 3, and to have a separate and distinct setting position for each exchange or group of lines in the network, so that by a suitable translating arrangement any desired series or combination of series of impulses may be generated to route the call to the desired exchange. The invention will be better understood by referring to the accompanying drawings, in which

Figures 1, 2, 3, 4, and 5 illustrate by way of example a complete arrangement for carrying the invention into effect.

Figures 6, 7, 8, and 9 show an alternative arrangement which may be substituted for certain parts shown in the other figures.

Referring to Figures 1 to 5, it will be assumed that it is desired to establish a connection between a subscriber at substation A to a subscriber at substation A1. The subscriber at substation A lifts his receiver, which in the usual manner initiates the operation of the line switch C to establish connection by means of its wipers 11, 12, and 200 with an outgoing primary trunk line 13, 14. On the switching relay 15 of the line switch operating, a circuit will be completed for the line relay 16 of a group of relays associated with the trunk line selected, as follows: battery, relay 16, contact 17, upper winding of relay 18, line 13, wiper 11, substation A, wiper 12, line 14, contact 19, relay 16 to earth. Relay 18 is so designed that it can only energize when both its windings assist each other, which only occurs when the current through the speaking leads is reversed, therefore, relay 16 only energizes and at its contact 20 completes a circuit for relay 21. Relay 21 energizes and at its contact 22 completes a circuit for the switching relay 23 in series with rotary magnet 24 of a rotary switch F, while at its contact 25 it connects the test wiper 26 of the switch F to a junction point of the magnet 24 and the switching relay 23. The operation is then identical with that of the well-known rotary line switch, and the magnet 24 is operated until wiper 26 engages an unearthed contact. It will be assumed this is the contact 27. When this occurs, relay 23 operates and switches through the leads 28, 29, 30, 31 to the bank contacts 32, 33, 34, 35, while at its contact 36 a circuit is completed for relay 37 as follows: battery, relay 37, contact 27, wiper 26, contact 36, contact 22, earth. Relay 37 energizes and connects earth to the lead 38, which lead 38 serves as a holding lead for maintaining various devices operated as long as the relay 37 is operated. The subscriber at A will now hear the dial tone from transformer 46 over magnet 45, contact 44, wiper 43, relay 42, contacts 34, 41, condenser 47, lead 14 and his instrument, and will operate his impulse sender 39 in accordance with

the first series of impulses, i. e., the first digit of the exchange code, the relay 16, thereby releases a number of times and at its contact 40 completes a circuit as follows:—earth, contact 40, contact 41, contact 34, series relay 42, wiper 43, contact 44, magnet 45, winding of dial tone transformer 46 to battery. The magnet 45 and series relay 42 respond to this first series of impulses, the magnet 45 to step the wipers 48 to 50 of minor switch MS a number of steps in accordance with the digit dialled while the series relay 42 at contact 51 completes a circuit for slow release relay 52 which energizes and at its contact 53 prepares a circuit for the magnet 54 of the master digit switch MDS: this circuit is completed at contact 55 after relay 42 has deenergized at the end of a first series of impulses, so that the wiper 43 is advanced to contact 56. The next series of impulses thereby passes over the same circuit to wiper 43 whence it passes over contact 56 and wiper 49 to the vertical magnet 57 of a Strowger switch SS having two directional movements. The Strowger switch SS represents one of a number, usually 8 or 9, connected with the different contacts accessible to the wipers 48 to 50, the vertical magnet responds to raise the wipers to the level corresponding to this series of impulses on the completion of which the magnet 54 has its circuit completed as before and steps the wiper 43 to the contact 58 so that the impulses next effect the operation of the rotary magnet 59 over the wiper 50. The wipers of the switch SS are thereby rotated to certain contacts in the row. When this occurs, a circuit is completed for a code relay CR corresponding to the exchange required connected to one of the contacts selected, this circuit may be traced from earth, wiper 60, contact 61, lead 62, relay CR to battery. Relay CR, therefore, energizes and connects earth at contacts 63 and 64 to contacts 65 and 66 of two distributing frames DF I and DF II. On the cessation of the third digit, the wiper 43 is advanced to the contact 67, so that the impulse circuit may be traced over lead 68 to magnet 69 of the first storing switch NS I. At the cessation of this digit and the remaining three digits, the wiper 43 is brought successively into engagement with contacts 71 to 74. The magnets 75 to 77 of the number storage switch NS II, NS III, NS IV are operated in accordance with these last three digits and serve to store the number of the wanted subscriber in the exchange determined by the first three digits. The distributing frames DF I, DF II consist of ten terminals on one side and a number of terminals corresponding to the number of code relays provided on the other side. The ten terminals of the distributing frames DF I, and DF II are connected to corresponding contacts on sender switches SS I and SS II respectively. Similarly, the ten contacts of the switches NS I to NS IV swept over by the wipers 78 to 81, are connected to the ten contacts of other sender switches SS III, SS IV, SS V, SS VI. When the code relay CR is operated, a circuit is prepared through its contact 82 which may be traced as follows: earth, contact 82, lead 83, common to all the code relays, contact 84, lead 85, contact 86 (Fig. 5), lower winding of relay 87, lead 88, contact 89 (Figure 4), contact 90, lead 91, contact 92, controlled by the impulse cam 94. The impulse cams 93 and 94 are mounted on a common shaft and while the cam 93 is adapted to generate impulses corresponding to the impulses generated by a dial switch or impulse sender of the usual type, the cam 94 is adapted to close a circuit only between impulses. This insures that only the correct impulses are generated and that no circuit is completed at an unsuitable time. As soon, therefore, as the cam 94 closes contact 92, relay 87 energizes and at its contact 95 completes a locking circuit for itself to the lead 85, and earth on contact 82 as previously described. At contact 96 a circuit is prepared for impulse relay 97, which energizes each time the cam 93 closes the contact 98. Relay 97 at contact 99 thereby periodically opens a circuit across the leads 100 and 101, which leads extend via contacts 32 and 33 (Figure 1) wipers 102, 103, leads 28, 29, contacts 104, 105 to line relay of selector E1, which relay is not shown, as it forms no part of the present invention. It will thus be appreciated that each time contact 99 is opened, the vertical magnet of the selector E1 responds and raises the wipers one step. Relay 97 at contact 106 also completes a circuit over lead 107, contacts 108 to 112 (Figure 4), magnet 114, to battery. Magnet 114 of sender switch SS I, therefore, responds with the vertical magnet of the selector switch E1 until the wiper 115 engages the contact 116 connected to that contact 117 on the frame DF I to which the contact 65 selected by the code relay CR has been connected. When this happens, a circuit may be traced as follows, earth, contacts 64, 65, 117, 116, wiper 115, relay 118 to battery. Relay 118 energizes and at contact 112 opens the circuit of magnet 114, which thereupon comes to rest, at contact 84 disconnects earth from lead 85, thereby releasing relay 87 and preventing the further energization of relay 97, so that exactly the same number of impulses operate the selector E1 as operate the switch SS I, the number being determined entirely by the connection made at the distributing frame DF I. At contact 119, relay 118 locks itself energized over a circuit which may be traced as follows: earth, battery, relay 118, contact 119, lead 38 which was earthed by relay 37, and at contact 119′ connects the grounded lead 38 to the restoring bank 185, whereupon the switch is automatically advanced to normal by magnet 114, which interrupts its own cir-

cuit at contact 113. If the number switch NS I has left its normal position, off normal contact 70 will be closed and a circuit prepared as follows: earth, contact 70, contact 120, relay 121 to lead 122. This circuit is not completed until contact 123 is closed which will only take place after the next switch to respond to the train of impulses has been taken into use. The selector E1 on being raised to the desired level, rotates automatically to find an idle line, assumed to be the line 124, 125 leading through repeater R1 of well-known construction, and of which only the polarized relay 126 is shown, to a selector E2 in another exchange. On the selector E2 being taken into use, the relay 138 of the selector E1 energizes to switch through and a momentary circuit is completed as follows: until the release relay 127 falls back, which it does shortly afterwards: earth, battery B2, resistance 128, contacts 129, 130, 105, leads 29, contacts 103, 33, lead 101, contact 134, to relay 135 and normal battery to earth. The battery B2 has its negative pole connected to earth instead of its positive pole, which is the usual convention, and, therefore, an increased current will flow through the relay 135, this relay is so adjusted that it will not respond to normal currents on the line, but will respond to the increased currents. Relay 135, therefore, responds to the energization of the release relay and at contact 136 completes a locking circuit for itself through contact 137 to earth. The closure of contact 123 completes the circuit previously described and relay 121 energizes, and at contact 122′, completes the circuit between the leads 88 and 91, opened at contact 89 on relay 118 energizing. As earth was connected to lead 85 from lead 38, through contacts 140, 141, it will be appreciated that conditions are now the same as they were when the operation of switch SS I was started. Relay 87 energizes, as also relay 97 to perform a similar function, relay 97 this time causing the operation of the vertical magnet of selector E2, and of the magnet 142 of sender switch SS II, the circuit of this latter magnet being completed through contact 143. This operation continues until wiper 144 engages the contact selected by the connection at the distributing frame DF II when relay 143′ is energized. This relay operates in a similar manner to relay 118 and for that reason no further description need be given of the operating circuits, the selector E2 is operated to the required level as determined by the switch SS II, and in that level hunts for an idle trunk line passing through the repeater R2 to a third selector E3. Repeater R2 and selector E2 are identical in construction with those previously described, and when E3 is taken into use, a booster impulse is transmitted and repeated at R1 by means of relay 132 and battery B1 and contact 133 to cause the reenergization of relay 135. Relay 132 is adjusted similarly to relay 135, then if the off normal contact 146 is closed, the relay 147 will energize and relays 87 and 97 will operate as before described, the number of impulses generated being now controlled by SS III. The third selector operates to the required level and selects an idle fourth selector E4. The booster impulse is then repeated over the lower talking conductor to cause the operation of relay 135 when the cycle is completed and the succeeding impulses are sent out in a similar manner under the control of SS IV—SS V, and SS VI, successively. The connector H responds to the last two impulses and as there is no trunk hunting operation between these impulses, it is sufficient to arrange that the relay 148 is somewhat slow to pull up, thereby ensuring that the necessary pause takes place between the transmission of these last two series of impulses without requiring the transmission of a special booster impulse. On the termination of the transmission of the last series of impulses, the relay 149 energizes and, besides performing the functions previously described with relation to relay 118, at contact 152 connects leads 153 and 154 together. By this operation, a circuit is prepared as follows: earth, contact 155, lead 153, contact 152, lead 154, contact 74, wiper 43, relay 42, contacts 34, 41, lead 30, contacts 157, 158, relay 159 to battery. This circuit includes contact 155 for a purpose to be later explained, and when it is completed, relay 159, being of high resistance, energizes alone in this circuit and at contacts 160, 161, switches through the leads 13 and 14 to the trunk lines 124, 125.

At contact 162 an impulse circuit is completed which may be traced as follows: earth, battery, magnet 163 of the meter switch MR, contact 164, contact 162, lead 31, contact 35, wiper 48, wiper 165, contact 166, lead 167, contact 168 controlled by the three point cam 169. It should be here explained that the cams 156, 170, 171, 169, 172, 173 are arranged on the same shaft, the pick-up cam 156 closing its spring 155 first followed by the cams 171, 169, 172, and 173, generating respectively 4, 3, 2, 1 impulses in a cycle and finally by stop cam 170, which serves to render further impulses ineffective. Further, as the register controller is located at the outgoing exchange and the contact 166 is representative of the wanted exchange, it is possible to accurately determine the charge to be made for a connection and for this reason it is assumed for the connection described the charge to be made is three units, consequently, the contact 166 is connected to the lead 167, which is controlled by the three point cam 169, obviously a different charge can be made by simply connecting contact 166 to any of the leads controlled by the 1, 2, or 4 point cams 173, 172, 171, respectively. The magnet 163, there-

fore, is connected up as above described under the control of pick-up cam 156, at contacts 155, and responds three times over the circuit described and steps the wiper 174 to third contact. The stop cam 170 then closes contact 175, completing a circuit as follows: earth, contacts 175, 176, 177, relay 178 to battery. Relay 178 energizes and at 164 opens the circuit of magnet 163, at contact 179 closes a locking circuit for itself to the release trunk conductor 180, and at contact 181 removes earth from the contact 182 which had maintained relay 21 energized after relay 16 had been disconnected at contacts 17 and 19. Relay 21 then deenergizes and at contact 22 opens the circuit of relay 23 which, accordingly, deenergizes and frees the impulse register. The opening of contact 22 also causes the release of relay 37, which falls back and at contact 194 closes a circuit for release magnets 192, 190, and 191 of switches MDS, MS, and SS, respectively, which thus restore to normal. Relay 37 at contact 193 connects earth to the lead 151 to release the switches NS I to NS IV.

At the connector H the ringing had been initiated in the usual manner and the called subscribed rung. On his response, the back bridge relay (not shown) of the connector H energizes and reverses current over the trunk conductors 124 and 125, thereby energizing the polarized relays 126 of the repeaters to disconnect the relays similar to 132, and further to energize the relay 18. Its two windings have now so energized as to assist each other. Relay 18 does not energize immediately, but only when the start cam 196 has closed the contact 197. When this occurs, a circuit is closed for the meter M which may be traced as follows: earth, contact 198, wiper 174, in third off normal position, contact 199, wiper 200, contact 201, meter M to battery. The meter, therefore, is energized three times by the three point cam 202 when a circuit is closed by step cam 204 as follows: earth, contact 203, contact 205, release magnet 206 to battery. The switch MR is, therefore, restored to normal and no further impulses can be generated. The meter has therefore been operated in accordance with the charge for the connection. It will thus be appreciated that the first of the digits of the subscriber's number have been stored on a register, the first three digits have been converted into two digits according to the impulses required, to reach the desired exchange, the remaining impulses have been generated in sequence and the call set up, and metering effected on the response of the called subscribed.

A time alarm relay TA is provided to prevent an impulse register being held up unduly, its circuit is completed through contacts 207, 208 when relay 37 is energized. Relay TA is slow to energize, but quick to restore and is so arranged that if a predetermined time has elapsed between the instant that relay 37 energizes and the subscriber commences to dial or a similar delay occurs between successive impulses, as determined by the energization of relay 42, a circuit will be completed from earth, through contact 209, relay 42, contacts 34, 41, lead 30, contacts 157, 158, relay 159 to battery. Relay 159, therefore, energizes and brings about the disconnection of the register switches so that these may be taken into use for another call. The subscriber will not then get his dial tone and can only get this by hanging up his receiver and initiating a fresh call. As the number of register sets are limited, it is important to insure that these are not taken into use except when required.

It will be noted that in the regular controller set shown in Figure 4, it is necessary to provide contact positions for every possible combination of the three digits. This approximates 1,000 positions and would necessitate the use of one minor switch and 10 Strowger switches. In practice, the whole 10 are not required, usually 8 or 9 being sufficient, but in any case a much larger number of contact positions must be provided than are required for the number of exchanges in a net-work, as in most cases, there would be less than 100 exchanges in a net-work and sometimes no more than 25 or 50.

The arrangements shown in Figures 6 and 7 have been developed with a view to reducing the size and number of switches required for the actual number of exchanges in an area. For this purpose, the digits of the office code are stored on three minor switches OC1, OC2, OC3 which are operated successively from the first three positions of the master digit switch MDS in Figure 1 for the first three series of impulses representing the office code, assumed to be 810 in this case. It will first be assumed that there are no more than 25 exchanges in the net-work. A hunting switch HS having a capacity of 25 lines is provided which has five wipers 200 to 204, the first three of which are connected to the windings of a shunt field relay SF, this relay has two cores with a winding on each core, the ends of each core being magnetically connected together and an armature supported adjacent to one end of the cores and is adapted to be attracted only when both windings are energized in a similar manner, due to the magnetic circuit being closed independently of the armature in every case except when the windings are excited, similarly wiper 201 is connected to the junction of these two windings, while the wipers 200 and 202 are connected to the other ends of these windings, respectively. The relay SF is, therefore, excited only when for instance the wiper 201 is connected to battery and the wipers 200 and 202 are connected to earth. On the first number switch NS1 (Figure 4) being operated,

its off normal spring 70 is closed; in this case to complete a circuit for the magnet 206 of the switch HS. The wipers 200 to 204, therefore, rotate until they reach the contacts 207, 208, 209, which contacts are connected respectively as follows: 209 to the 8th contact on which the wiper 210 of switch OC1 is resting, contact 208 to the first contact on which wiper 211 of switch OC2 is resting, and contact 207 connected to the 10th contact on which wiper 212 of switch OC3 is resting. It will thus be seen that when the wipers reach contacts 207 to 209, the necessary conditions are fulfilled for the operation of the relay SF, which opens the circuit of magnet 206 at 213 and at 214 closes a circuit to wiper 203, thereby operating the code relay CR, connected to the contact 215 on which wiper 203 is resting. Furthermore, the position on which the wipers are resting is distinctive of the wanted exchange as in the case of the contacts selected by the wipers of the Strowger switch SS in Figure 1. The relay CR can be, therefore, considered as identical with the relay CR mentioned therein and further operation of the impulse sender may correspond exactly. Similarly, the wiper 204 corresponds with wiper 165 of Figure 1 and may be connected directly to contact 35 of F, while contact 216, with which it engages, corresponds and is connected up similarly to contact 166.

It will thus be appreciated that the arrangement shown in Figure 6 can replace the arrangement shown in Figure 1 of the minor switch MS and the Strowger switches SS. As the number of exchanges is limited in the example shown in Figure 6 to the capacity of the hunting switch HS, an arrangement for increasing this capacity is shown in Figure 7, where it is assumed that there are 100 exchanges in the area and, consequently, four hunting switches HS1 to HS4 are required, assuming that each switch has a capacity of 25 lines. These switches are identical with the switch HS shown in Fig. 6, and for that reason the magnets 217—220 only and the shunt field relays SF1 to 4 are shown. When the off normal contact 70 is closed, a circuit is completed for the four magnets 217 to 220 in parallel through back contacts 221 to 224 of the shunt field relays SF1 to SF4. As soon as any of the test wipers to which the different shunt field relays have their windings connected come into contact with the contacts selected by the wipers 210, 211, 212, one of the shunt field relays will be energized and at its back contact immediately open the circuit of the operating magnets so as to bring all the switches HS1 to HS4 to rest. Assuming that the relay SF2 is the one operated, it will close at its front contact 225 a circuit for the code relay connected to the contact with which its wiper 226 is in engagement, the wiper 227 being similarly connected in every respect to the wiper 204.

In Figure 8 an alternative arrangement for transmitting impulses to that shown in Figure 4 is illustrated. In this case, the operation up to the energization of the code relay is identical with that described in relation to Figures 1 to 5. The number switches are constructed in a somewhat different manner to switches NS 1 to NS IV, (Figure 4), in that on release they are adapted to generate impulses; the mechanical construction is very simple as it may be substantially identical with the operation of the ordinary dial switch impulse sender, except that instead of being set by the fingers, it is set by a step by step ratchet device, the release being continuous but under the control of a governor and impulses being generated in an exactly similar manner by the revolution of the cam wheel. Similar switches are also provided for generating the impulses according to the exchange required. These switches are represented by the references IS1 to IS6, the operation of the switches IS3 to 6 is effected by means of the magnets 300, 301, and 302, and 303 operated for each successive step of the master digit switch MDS in the same manner as the switches NS1 to NSIV, (Figure 4).

The code relay CR, on operating, besides connecting earth through the distributing frames DF1 and DF2 as before to contacts 304, 305, at contact 306 completes a circuit through contacts 307, 308 to magnet 309. This magnet, therefore, operates step by step until the wiper 310 engages contact 304; when a circuit is closed both for release magnet 311 and for relay 312, the release magnet thereupon energizes and the wipers 320 and 310 return to normal under the control of a governor, generating impulses through the contact 313. The relay 312 at its contact 307 opens the circuit of the magnet 309 so that its operation is stopped and at contact 314 connects earth from lead 38 to maintain the release magnet 311 energized and also to lock itself energized. It will be noted that the impulse contacts 313 are connected in series with contacts 315 to 319 with leads 100 and 101, thereby causing the operation of a selector as previously described. On the wiper 320 reaching its normal position, the release magnet 311 deenergizes and at its armature completes a circuit connected to lead 101 through the contacts of the various release magnets 321 to 325. This circuit extends through contact 326 to the upper winding of relay 327, which relay does not energize normally but energizes as soon as booster impulse is received back due to the taking into use of a numerical switch to signify that conditions are such that the next series of impulses can be safely transmitted. Relay 327, therefore, energizes and at armature 328 locks itself energized in a circuit through contact 329, while at contact 330 it prepares a circuit for relay 331 which is completed as soon as the switch IS3 is

moved from normal position. Relay 331 then energizes and at armature 332 completes a locking circuit for itself to lead 38 through contact 333, and at contact 334 completes a circuit through contact 335 for the stepping magnet 336 of the impulse sender IS2. The magnet 336, therefore, operates step by step until the wiper 337 engages contact 305. When this occurs, a circuit is completed both for release magnet 321 and for relay 338, the release magnet energizes to cause impulses to be generated at impulse contact 315 in the circuit of the leads 100 and 101, while relay 338 at its contact 339 completes a locking circuit for itself and serves to maintain release magnet 321 energized until it returns to normal. At contact 333, the circuit for relay 331 is opened and as the circuits for both windings of the relay 327 were broken when relay 331 was energized, relay 327 is now restored to normal position. On the release magnet 321 deenergizing, a circuit is again completed at its contact to lead 101 in readiness for the next booster impulse to cause the re-operation of relay 327. Relay 327 operates as before and if the off normal contact 340 of the next impulse sending switch IS4 is closed, the relay 331 will also operate and at 334 complete a circuit for relay 341, which locks energized at contact 342 and at 343 energizes the release magnet 322 so that this returns to normal generating impulses through contacts 316, the successive release of switches IS4, IS5, and IS6 follows in a similar manner, as will be readily understood. The last relay 344 is made somewhat sluggish to operate so that the generation of impulses by IS6 will not follow too fast after the generation of impulses IS5. Relay 344 in conjunction with the off normal contact 345 and contact 346 completes the connection between leads 153 and 154 when the last impulse has been sent, the remaining operation is identical to that previously described in connection with Figures 1 to 7.

In the arrangement shown in Figure 9, it is proposed to use any well-known type of impulse sender and for that reason, it will be assumed that the impulse sender IS used is of similar construction to that shown in Figure 16 of British Patent No. 5249/13, the keys being replaced by the switches OS1, OS2, NS1, NS2, NS3, NS4. Consequently, only 10 leads are shown corresponding to the leads from the keys which are connected up in the order of the digits to be transmitted for setting the impulse sender and additional leads SL and FL known as the start lead for initiating the generation of the impulses, and the stop lead for indicating that the transmission of impulses is completed respectively. These leads are, of course, peculiar to the particular type of impulse sender employed and can be readily varied to conform to other types of impulse senders, as will be readily understood by those versed in the art. The switches NS1 to 4 are substantially identical with the switches having similar reference letters in Figure 4, except that in this case additional off normal springs are provided. The switches OS1 and OS2 for setting the impulse sender in accordance with the exchange required are of similar construction, but are operated somewhat differently as will be appreciated from the following description. As soon as the code relay CR has operated, a circuit is completed for magnet 400 through contacts 401 and 408, which operates intermittently until the wiper 402 engages contact 403 when a circuit is completed for relay 404 as follows: earth, contacts 405, 406, 407, 403, wiper 402, relay 404 to battery. Relay 404 energizes and at contacts 408 opens the circuit of magnet 400, thereby bringing the wipers 402 and 409 to rest. On relay 404 energizing, a circuit is completed for relay 410 through contacts 411 and 412, relay 410 energizes and at contact 413 completes a circuit through contact 414, wiper 409 to one of the solenoids of the impulse sender IS which is thereby set accordingly. At contact 415 a circuit is completed for relay 416 which is made rather slow to pull up so that contact 414 is opened after a short interval. At contact 420 relay 416, upon energizing, completes a locking circuit to itself to lead 38 which corresponds to the lead with the same reference in Figure 1. Relay 416 at contact 412 opens the circuit for relay 410, which immediately falls back, its circuit not being again completed until both the off normal contact 421 and the relay 420′ have been operated. Relay 404, on energizing, at contact 424 completes a circuit for magnet 425 of switch OS2, which operates automatically until the wiper 426 comes into contact with contact 427 when relay 420 energizes and brings the switch to rest. At contact 428, a circuit is now completed which may be traced as follows: earth, contacts 401, 424, 428, 421, 429, 430, 411, relay 410 to battery. Relay 410 again energizes and at contact 415 completes a circuit for relay 431 which like relay 416 is somewhat slow to pull up, thereby allowing a short interval of time for earth to be connected through contacts 413, 423, 432, wiper 433, to one of the leads TL, leading to the impulse sender to operate the solenoid in accordance with the second series of impulses required to be generated. As the switches NS1, NS2, NS3, and NS4 have generally already been set at this time, the relay 410 will operate successively to energize the relays 434—437, which are similar to relays 416 and 431 in succession, the circuits for relay 410 being successively controlled by the different off normal contacts 438 to 440, as will be at once apparent from the similarity of the circuits. The impulse sender is accordingly set to generate 6 series of impulses according to the operation of the switches

OS1 anl OS2 and NS1 to NS4. On relay 437 being energized, a circuit is completed through contact 418 to start lead SL from contact 438, so as to start the impulse sender to operating. The impulses are, therefore, generated in accordance with the setting, a sufficient pause being left between each series of impulses to allow the necessary switching operations to take place. When the impulse sender has finished generating impulses, earth is connected to the lead FL due to its restoring to normal and a circuit is completed to lead 154 through contacts 419 and 439, which causes the switching through to take place in a similar manner to that described in connection with Figures 1 and 4. The metering arrangements, of course, are not affected by this modification.

It should be noted that when the impulse sending equipment of the type disclosed in Fig. 9 is used, the special arrangement shown and described for transmitting booster impulses back over the trunk is not required, and, therefore, the usual standard Strowger switches may be used.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a telephone system, a train of serially related automatic trunk hunting switches interconnected by trunk lines each having two talking conductors, an impulse sender for transmitting series of impulses, one series for each of said switches, to operate such switches to select trunk groups, means controlled by each of said switches when an idle trunk leading to the next succeeding switch is found for transmitting an electrical impulse back to said sender over one talking conductor only, and means in said sender controlled by said electrical impulse for starting said sender to transmit the next series of impulses.

2. In a telephone system, a train of serially related automatic trunk hunting switches and a connector switch accessible to the last of said trunk hunting switches, a sender for transmitting a series of impulses for each of said trunk hunting switches and two series of impulses for said connector switch to operate said switches, means in said impulse sender revertively controlled from said switches for starting said sender to transmit each of the series of impulses after the first and including the next to the last series, whereby the various series of impulses named are sufficiently spaced apart, and locally controlled timing means in said sender operative only between the last two series of impulses and effective to space the last two series of impulses apart.

3. In a call director, an office register having a plurality of different settings each corresponding to a different office, a plurality of office code relays, each of said relays being assigned to a different setting of said office register, means for setting said office register in any desired position to energize the corresponding relay, and means controlled by the last named relay for generating the digit impulses necessary to be transmitted to extend the call to the desired office.

4. In a call director, an office register having a plurality of different settings each corresponding to a different office, a plurality of office code relays, each of said relays being assigned to a different setting of said office register, and means for setting said office register in any desired position to energize the corresponding relay.

5. In a call director, a plurality of digit registers, a common impulse transmitter, a counting switch individual to each of said digit registers, means for operating said transmitter to transmit impulses, means for operating a given counting switch in synchronism with the transmitted impulses, a stop relay individual to each of said counting switches, means for energizing the stop relay of said given counting switch under the control of the associated register when a number of impulses corresponding to the setting of such register have been transmitted, and contacts controlled by said stop relay for transferring the control of said sending means to the next counting switch.

6. In a call director, a plurality of relays, a register having a wiper, means responsive to impulses representing part of a telephone number for operating said register to select and operate one of said relays through said wiper, and an impulse sender controlled by any selected relay to transmit impulses in accordance with the relay selected.

7. In a call director, a plurality of relays, a register, means responsive to impulses representing a part of a telephone number for operating said register to select one of said relays, and impulse sending mechanism controlled in accordance with the relay selected for transmitting a plurality of series of impulses of values depending upon the relay selected.

8. In a call director, a register, an impulse sender, a sending-control relay, means for operating said register in accordance with impulses representing a portion of a telephone number to select said relay in case the register is set in a particular position, and circuit connections whereby said impulse sender is controlled by said relay when the same is selected to transmit a fixed combination of impulses.

9. In combination, a sender for transmitting a plurality of series of impulses, a separate counting switch individual to said sender for controlling each of said series of impulses and a separate step-by-step register controlling each counting switch.

10. In combination, a plurality of counting switches, a sender common to said counting

switches, means for operating said sender to transmit a series of impulses under the control of each of said counting switches in turn, and a pick-up device for insuring synchronism between the sending and the counting of the impulses.

11. In an impulse sender, a counting switch, means for transmitting a series of impulses of a value controlled by said counting switch, a second counting switch, and means for transferring the control of said sender to said second counting switch whereby the value of the following series of impulses is controlled by said second counting switch.

12. In a register sender, a plurality of counting switches, a sender common to all said counting switches, means for operating said sender to transmit a plurality of series of impulses and for stopping said sender at the end of each series of impulses, the first of said series of impulses being transmitted under the control of the first counting switch, and means for transferring the control of said sender to another of said counting switches each time a series of impulses is transmitted.

13. In a register sender, a plurality of registers, a like plurality of counting switches corresponding, respectively, to said counting switches, means controlled by impulses representing a portion of a telephone number for setting said registers, sending means for transmitting a plurality of series of impulses corresponding in number to the number of said plurality of register switches and counting switches, and means whereby each of said series of impulses is controlled by a different counting switch as predetermined by the setting of the corresponding register.

14. In combination, a plurality of register switches, each having a wiper and a bank of contacts, a translator switch having a bank of test contacts arranged in sets of three test contacts each, three wipers arranged to contact with the separate contacts, respectively, of any set, and connections from the bank of each of said register switches to each set of a plurality of said sets.

15. In combination, a plurality of register switches, each having a wiper and a bank of contacts, and a translator switch having three test wipers and a cooperating bank of contacts, and connections from the bank of each of said register switches to each set of a plurality of sets of contacts in the bank of said translator switch, the said connections in the case of each register being independent of said wipers and bank contacts of the other registers.

16. In combination, a plurality of register switches and means for setting each independent of the setting of any other one, a translator switch, and testing means for stopping said translator switch in a position individual to any composite setting of said registers.

17 In combination, a plurality of register switches, a translator switch, means for setting said register switches each independent of the others, and means for setting said translator switch under the control of said register switches and into a position determined by only one possible composite setting of said registers.

18. In combination, a plurality of registers and a translating switch, means for setting said registers independent of each other, means for setting said translator switch in accordance with the setting of said register switches and into any one of any desired number of different positions, the setting of said translator switch into any one position being brought about by only one possible composite setting of said registers.

19. In combination, three register switches and a translator switch, means for setting said register switches, circuit connections whereby the first register switch applies ground to a first plurality of contacts in the bank of the translator switch, the second register switch applies battery to a second plurality of bank contacts of the translator switch, and the third register switch applies ground to a third plurality of bank contacts in the translator switch, whereby the translator switch is caused to assume a position corresponding to the composite setting of said register switches.

20. In a telephone system, a translator switch having a bank of contacts and three test wipers cooperating with said contacts, means for driving said translator switch over said test contacts, and means for stopping said translator switch responsive to two of said test wipers encountering the same potential at the same time that the third wiper encounters a different potential.

21. In a telephone system, a translator switch having a bank of contacts and three test wipers cooperating with said contacts, means for driving said translator switch over said test contacts, means for stopping said translator switch responsive to two of said test wipers encountering the same potential at the same time that the third wiper encounters a different potential, and means including three independently-operated register switches for applying said potentials to the bank of said translator switch.

22. In combination, three register switches and a translator switch, and circuit arrangements for driving said translator switch into the position corresponding to the instant composite setting of said register switches such that the positions of said translator switch may be assigned at random to correspond to the composite settings of said register switches.

23. In combination, three register switches

and a translator switch, means for setting said register switches, and means for driving said translator switch continuously until a position is reached indicative of the composite setting of said registers and for stopping said translator switch when said position is reached.

24. In combination, register switches and a translator switch, means for setting said register switches, and means for starting said translator switch from any position in which it is standing and for giving it a single hunting movement to bring it into a position corresponding to the instant composite setting of said registers.

25. A translator switch having three test wipers and a contact bank, means for driving said wipers around said bank, and means for stopping said translator switch under the joint control of all three test wipers.

26. In combination, an impulse circuit, means for transmitting a plurality of series of impulses over said circuit, a counting control circuit, and means including a plurality of counting switches operated over said counting control circuit successively to control the value of the transmitted series of impulses respectively.

27. In combination, a plurality of registers and a translating switch, means for setting said registers, said translating switch being provided with a separate test wiper for each of said registers, a bank of test contacts for each of said test wipers, means for operating said translating switch to advance its test wipers over their contact banks, and testing apparatus controlled over said test wipers in accordance with the settings of the separate registering devices to stop the movement of the translator switch when all test wipers simultaneously encounter predetermined test potentials at a point predetermined by the setting of all of said registers.

28. In combination, a plurality of register switches and means for setting each independent of the setting of any other, a translator switch, means for starting the operation of said translator switch, and means including testing means operable to test all of said registers simultaneously for stopping said translator switch in a position individual to any composite setting of said registers.

29. In combination, register switches and a translator switch, means for setting said register switches, and means for starting said translator switch and for giving it a single hunting movement to bring it into a position corresponding to the instant composite setting of said registers.

30. A translator switch having a plurality of test wipers and a contact bank, means for driving said wipers over said bank, and means for stopping said translator switch under the joint control of all said test wipers.

31. In a telephone system, a train of serially related automatic trunk hunting switches, an impulse sender for transmitting series of impulses, one series for each of said switches, to operate such switches to select trunk groups, means controlled by each of said switches when an idle trunk leading to the next succeeding switch is found for transmitting a momentary electrical impulse back to said sender, and means in said sender controller by said electrical impulse for starting said sender to transmit the next series of impulses.

Signed by me at Liverpool, England this 10th day of October, 1922.

CHARLES GILLINGS.