

Aug. 3, 1926.

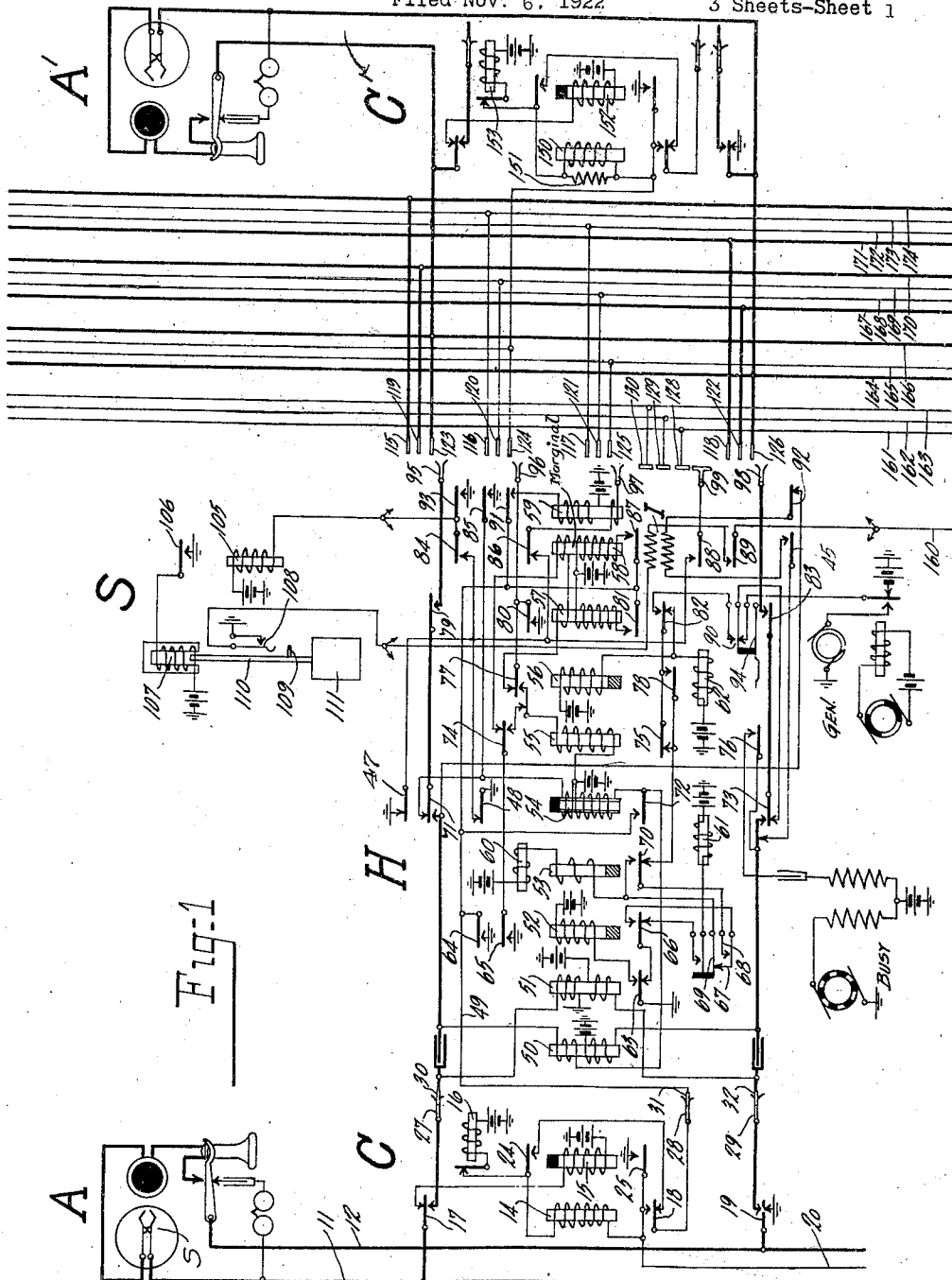
J. E. GARDNER

1,594,610

AUTOMATIC TELEPHONE SYSTEM

Filed Nov. 6, 1922

3 Sheets-Sheet 1



Inventor—
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3 Sheets-Sheet 2

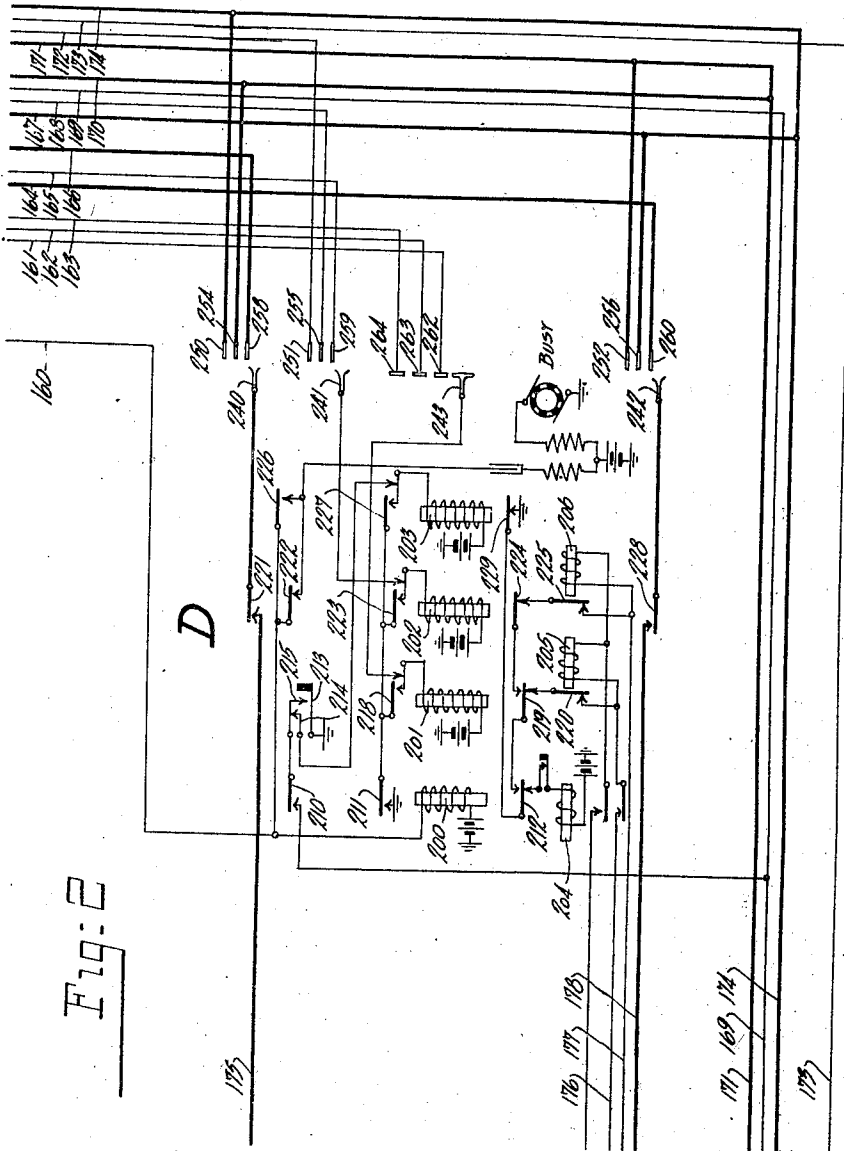


Fig. 2

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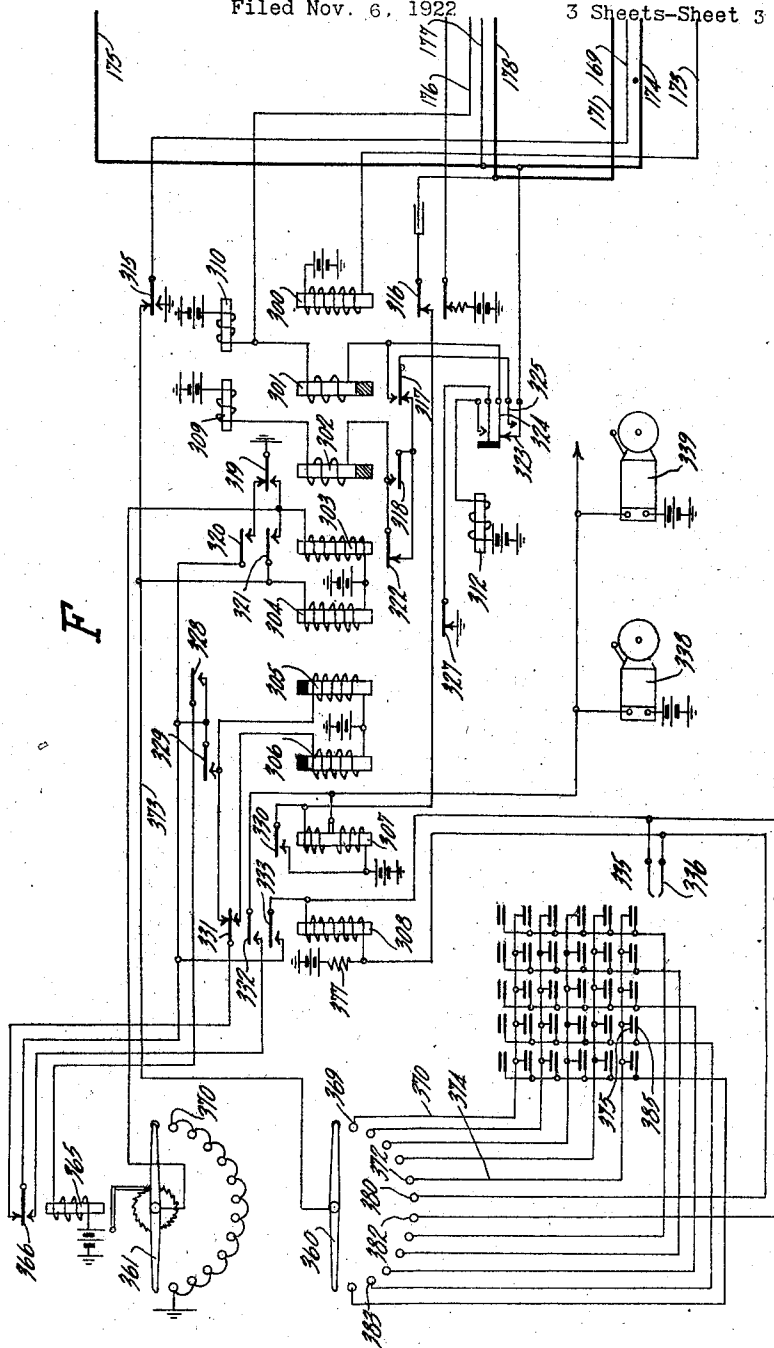
Filed Nov. 6, 1922

3 Sheets-Sheet 3

Fig. 3

I

F



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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SYSTEM.

Application filed November 6, 1922. Serial No. 599,185.

The present invention relates in general to automatic telephone systems, but is more particularly concerned with small automatic systems that are used in manufacturing plants, mercantile establishments and the like. Systems of this character have become widely known as private automatic exchange systems. In order to meet the more exacting requirements of the subscribers in these small systems it is the usual practice to provide special features which are not supplied in larger automatic systems.

One of these features is known as code calling. This is an arrangement whereby, if the party called is not at his telephone, a code call may be sent through the establishment having the private automatic exchange by calling a special number. The desired party's code is sent out to a number of bells or to signalling devices located at various points in the building. The called party responds to his call by dialing a special code answering number.

It is with this code calling arrangement that the present invention is concerned. The general object of the invention is to provide an improved type of code calling service arranged so that when a call is made to a party in the private automatic exchange that is entitled code call service, if the desired party does not respond within a certain length of time, his code call is automatically sent throughout the establishment, without the calling party having to perform any operation. The called party responds in the usual manner by dialing the code call answering number.

Another object of the invention is to provide means for utilizing the code calling equipment, above mentioned, for transmitting characteristic code signals in order to enable the calling subscribers to get in communication with certain parties not equipped with telephones.

Referring now to the drawings, comprising Figs. 1, 2 and 3, sufficient apparatus showing the invention applied to a private automatic exchange is illustrated, by means of the usual circuit diagrams, to enable the invention to be readily described and understood.

Referring now particularly to Fig. 1, in the upper left hand corner of the drawing there is shown an automatic substation A. The substation A is of the ordinary automatic type being provided with a calling device S in addition to the usual talking instrumentalities. The line conductors 11 and 12 of the substation A terminate at the exchange in the line or trunk selecting switch C.

The line switch C is of the usual rotary type whose wipers move in a forward direction only. The line switch C, together with a number of other line switches, has access to trunk lines extending to connector switches, one of these being the trunk line leading to the connector H from the bank contacts 30-32, inclusive.

The connector H is of the well known Strowger, vertical and rotary type of mechanical construction and has access to subscribers' telephone lines such as the line of the substation A'. Of course, as this is only a one hundred line or connector system the connector H also has access to the line of the substation A, though in order to avoid complicating the drawing this has not been shown.

The substation A' is similar to the substation A already described. The line of the substation A' terminates at the exchange in the line switch C' as well as in multiple bank contacts accessible to the connector switches such as H.

The line switch C' is similar to the line switch C except that it is provided with a resistance in shunt of the switching relay. This resistance is provided in order to give the subscriber at substation A the special service hereinbefore mentioned.

Relays, when shown with one end of their cores in solid black, are of the type which are both slow to operate and slow to release. Relays which are shown with one end of their cores cross-hatched are of the type which are relatively quick to pull up, but are slow to release.

Associated with the connector H and all the connectors of the exchange is a slow acting solenoid mechanism shown at S. This solenoid controls certain circuits which

will be described in detailed explanation which is to follow.

In Fig. 2 there is shown a finder switch D, which has access to all the subscribers' lines that are entitled to the special service hereinafter mentioned.

In Fig. 3 there is shown the code calling equipment proper. This equipment comprises a code selecting switch F, which is of the vertical and rotary type, and an interrupter switch I, which is of the same mechanical construction as the ordinary rotary line switch.

In order to completely describe the invention, the manner in which a call is made from one subscriber in the private automatic exchange to another subscriber therein will be described first.

For this purpose it will be assumed that the subscriber at substation A desires to communicate with the subscriber at substation A'. To call this subscriber the party at substation A will remove his receiver and operate his calling device for the two-digits of the desired party's number.

When the receiver is removed at substation A a circuit is completed for the line relay 15 of the line switch C over the line conductors 11 and 12 in series. The line relay 15, upon operating, initiates the trunk selecting operation of this switch in the usual manner. When an idle trunk is selected, which, it will be assumed, is the trunk line terminating in bank contacts 30-32, inclusive, the switching relay 14 is energized. Upon operating, relay 14, at its armature 18 places ground upon the test contact 31 of the seized trunk line in order to busy it. Additional results of the energization of relay 14 are that at armatures 17 and 19 the line conductors 11 and 12 are disconnected from the winding of the line relay 15 and from ground, respectively, and are extended by way of the front contacts of these armatures, wipers 27 and 29, bank contacts 30 and 32, through the upper and lower windings of the line relay 51 of the connector H to battery and ground, respectively.

The line relay 51 of the connector H is energized over the calling line loop. Upon operating, relay 51, at its armature 63 closes a circuit for the slow acting relay 52. The latter relay, upon energizing, prepares the switch circuits for operation at armatures 66 and 65, and at armature 64 places ground upon the release trunk conductor 49, thereby establishing a holding circuit for the switching relay 14 of the line switch C. This circuit may be traced as follows: from grounded release trunk conductor 49 by way of bank contact 31, wiper 28, armature 18 and its front contact, through the winding of the switching relay 14, and through the winding of the motor magnet 16 to battery. It will be understood that this holding cir-

cuit is established before the slow acting line relay 15 has had time to deenergize. A branch of this holding circuit may also be traced by way of the private normal conductor 20 to multiply connected bank contacts in the local connector switches such as H, whereby the said line is protected from intrusion during the connection.

The calling subscriber at substation A may now dial the first digit of the desired number. As a result of this operation, a series of interruptions is produced in the line circuit of the relay 51 and this relay deenergizes a plurality of times in response thereto. At each retraction of the armature 63 on the line relay, an impulse of current is sent to the vertical magnet 60. The circuit over which the first of these impulses is sent may be traced from ground by way of armature 63 and its back contact, armature 66 and its front contact, off normal springs 67 and 69, through the winding of the slow acting relay 53, and through the winding of the vertical magnet 60 to battery. As mentioned before, the above is the circuit over which the first vertical magnet impulse is sent. However, upon the first vertical step of the switch, the off normal springs are shifted and the remaining impulses to the vertical magnet traverse a new circuit, which is similar to the one above described, except that it includes the off normal springs 67 and 68 and armature 70 on the slow acting relay 53, which is now energized. Magnet 60 operates to raise the switch wipers 95-98, inclusive, step by step until the said wipers are raised to the proper level of bank contacts in accordance with the number of interruptions in the digit dialed. The vertical wiper 99 is also raised by the switch shaft to the proper level of bank contacts. This wiper is adapted to engage the vertical bank contacts such as 130 and to remain in engagement with them even when the switch shaft is rotated. This may be accomplished in any desired manner such as mounting wiper 99 on the switch shaft so that it is carried upward by the shaft but is free to permit the shaft to rotate. The slow acting relay 53 is energized in series with the vertical magnet 60 and maintains its armature attracted throughout the vertical movement of the switch thereby preserving the continuity of the vertical magnet circuit when the off normal springs are shifted. Shortly after the termination of the vertical movement the slow acting relay 53 deenergizes to prepare a circuit for the rotary magnet 62.

When the calling device at substation A is operated in accordance with the next and final digit of the called number, another series of interruptions is produced in the circuit of the line relay 51. This relay, in responding to these interruptions, causes the operation of the magnet 62 over the following

circuit: from ground by way of armature 63 and its back contact, armature 66 and its front contact, off normal springs 67 and 68, armature 70 and its back contact, back contact and armature 75, armature 82 and its back contact and through the winding of the rotary magnet 62 to battery. Magnet 62 operates to rotate the wipers 95-98, inclusive, of the switch into engagement with the bank contact set in connector H associated with the line of the substation A', which, we will assume, are the bank contacts 123-126, inclusive. The slow acting relay 56 is energized in multiple with the rotary magnet and operates at its armature 77 to connect the test wiper 96 to the winding of the test relay 55, and at armature 78 to short circuit the contact springs comprising armature 75 and its back contact on the test relay 55 so as to guard against premature opening of the rotary magnet circuit in case the test relay 55 should be energized by the switch wipers, during their rotation, engaging bank contact sets associated with busy telephone lines.

Assuming that the desired line is busy at the present time, there will be a ground potential connected to the test contact 124 and the test relay 55 will be energized. Upon operating, relay 55, at its armature 74 closes a point in its locking circuit, which is completed upon the deenergization of the slow acting relay 56, at its armature 75 opens the rotary magnet circuit and at its armature 76 connects a lead from the busy signalling machine to the lower heavy talking conductor. By the latter operation, the calling subscriber is given an audible signal to inform him that the desired line is inaccessible at the present time. The release of the connection follows the replacement of the receiver at the calling substation A. A detailed description of this release will be given hereinafter.

It will now be assumed that the line of the substation A' is idle when the switch wipers of the connector H are brought into engagement with the bank contacts 123-126, inclusive. Under these conditions, there will be no ground connected to the test contact 124 and the test relay 55 will not be energized. Then, upon the deenergization of the slow acting relay 56, a circuit is completed, which extends from ground by way of front contact and armature 65, armature 74 and its back contact, through the upper winding of the marginally adjusted relay 58, through the upper winding of the switching relay 57, back contact and armature 77, test wiper 96, bank contact 124, through the winding of the switching relay 150 in multiple with the resistance 151, and through the winding of the motor magnet 153 to battery. The relays 57, 58 and 150 are energized over this circuit. The relay

150, upon operating, only partially attracts its armatures due to the mechanical interlocking device controlled by the armature of the line relay 152 but the armature is attracted enough, however, to disconnect the line of the called substation from its normal battery and ground connections in the line switch C'.

In the connector H, the relay 57, upon operating, establishes a locking circuit for itself at its armature 81, at armature 82 opens the rotary magnet circuit and at armatures 79 and 83 completes the signalling circuit. Another result of the energization of relay 57, is that at the armature 80 direct ground is connected to the test contact 124 in order to busy the called line. Ringing current from the generator Gen is now intermittently projected out on the line of the substation A'. The marginally adjusted relay 58 is ordinarily not energized in series with the switching relay 57 and the switching relay in the called line switch. However, on all lines that are entitled to the special code calling service before mentioned, a resistance is connected in parallel with the switching relay in the called line switch. This may be seen in the line switch C', the resistance 151 being connected in parallel with the winding of the switching relay 150. Due to the resistance 151 being connected in multiple with the switching relay 150, which permits a greater current flow, the relay 58 in the connector H is energized. Upon operating relay 58 completes its own locking circuit at armature 87, at armature 86 prepares a circuit for relay 59, and at armature 84 closes a circuit for the relay 105. Other results of the energization of relay 58 are that at armature 88 ground is placed upon the vertical test contact 128 by way of the wiper 99, a circuit is prepared for relay 200 of the finder D at armature 89, and at armature 45 a signalling circuit is prepared. Relay 105, upon operating, at its armature 106 closes a circuit for the winding of the solenoid 107. The solenoid 107 operates the plunger 110. Due to the dashpot 111, the plunger 110 takes a considerable interval of time before it operates the spring 108 into engagement with its working contact.

It will first be assumed that the called subscriber at substation A' responds before the spring 108 engages its working contact. Under these conditions, the removal of the receiver at substation A' completes a circuit for the ring cut off relay 54. Upon operating, relay 54, establishes a locking circuit for itself at armature 72, at armatures 71 and 73 disconnects the ringing current and at the front contacts of these armatures finally completes the talking connection. Additional results of the energization is that at armatures 48 and 47 the circuit

of the relay 105 is opened and ground is removed from the vertical bank contact 128 and from the test contact 125. The back bridge relay 50 supplies talking current to the substation A', while relay 51 supplies talking current to the substation A.

When the conversation is terminated, the calling and called subscribers will replace their receivers upon their respective switch-hooks. When the receiver is replaced at substation A, the line relay 51 deenergizes and opens the circuit of the slow acting relay 52. The latter relay deenergizes to open the locking circuit of relays 54, 57 and 58 in the connector H and also to complete the circuit of the release magnet 61. An additional result of this deenergization is that the holding circuit of the switching relay 14 in the line switch C is opened. The release magnet 61 of the connector H operates to restore this switch to normal, its own circuit being opened at the off normal springs when the switch shaft reaches its released position. The switching relay 14, in the line switch C, deenergizes to restore the circuits of this switch to normal. In the above manner the connection is released.

It will now be assumed that the subscriber at substation A' is in some other part of the building and consequently does not answer. In this case, when the spring 108 on the solenoid engages its working contact, a circuit is completed, which extends from ground by way of working contact of spring 108 and the said spring, through the primary winding of the induction coil I, front contact and armature 89, conductor 160, through the winding of the start relay 200 in the finder D to battery. Relay 200, upon energizing, at its armature 210 prepares a circuit for relay 203 and at its armature 212 completes a circuit for the vertical magnet 205 of the finder D in multiple with the vertical magnet 310 of the code selecting switch F. Magnet 205, upon energizing, raises the switch wipers 240-243, inclusive, one step opposite the first level of bank contacts and at its armature 220 breaks its own circuit and the circuit of the vertical magnet 310 of the code selecting switch. Magnet 310 of the code selecting switch operates to raise the wipers 335 and 336 opposite the first level of bank contacts. Another result of the upward movement of the switch shaft is that the off normal springs are shifted, spring 213 placing ground on conductor 169 and disconnecting relay 203. The grounding of conductor 169 busies the code calling number and closes the circuit of relay 304 in the code selecting switch F. Relay 304 opens the release magnet current at armature 327. As the line of the substation A' is not located in the first level of bank contacts the vertical test contact of this level will not be grounded and the ver-

tical movements of the finder D and the code selecting switch F will continue until the wipers of the finder are brought opposite the level of bank contacts in which is located the line of the substation A'. When this occurs, as ground has been placed upon the vertical test contact 128 by the vertical test wiper 99, this ground potential is present upon the test contact 262 in the finder D, the test contact 262 being in multiple with the test contact 128 of the connector H. As soon as the vertical wiper 243 of the finder D engages this test contact a circuit is completed for the vertical test relay 201. Upon operating, relay 201 establishes a locking circuit for itself at armature 218, at armature 219 opens the circuit of the vertical magnets 205 and 310 thereby stopping the vertical operation of the switches D and F and at the front contact of this armature transfers the operating circuit to the rotary magnets 206 and 309 of the finder and code selecting switch, respectively. The rotary magnet 206 operates to rotate the wipers 240-242, inclusive, one step into engagement with the first set of bank contacts in the selected level and at its armature 225 opens its own circuit as well as the circuit of the rotary magnet 309 in the code selecting switch F. Magnet 309 operates to rotate the wipers 335 and 336 into engagement with the first set of bank contacts in the first level. The intermittent operation of magnets 206 and 309 continues until the wipers 240-242, inclusive, are brought into engagement with the set of bank contacts associated with the substation A' in the finder D, which, it will be assumed, are the bank contacts 258-260, inclusive. The slow acting relay 302 is energized in series with the rotary magnet 309 and maintains its armature attracted throughout the rotary operation. The continued energization of this relay retains the rotary magnet circuit intact after the energization of relay 303. When the finder wipers are brought into engagement with the above mentioned set of bank contacts, a circuit is completed which extends from ground by way of back contact and armature 47, front contact and armature 86 in the connector H, through the lower winding of the relay 59, wiper 97, bank contact 125, conductor 165, bank contact 259, wiper 241, and through the winding of the relay 202 to battery. Relays 59 and 202 are energized over this circuit. Relay 59, upon operating, establishes a locking circuit for itself at armature 91, completes the circuit of the upper winding of the ring cut off relay 54 at armature 85, closes another circuit for the relay 105 at armature 93, and at armature 92 opens the circuit of the secondary winding of the induction coil I. As the circuit of the relay 54 is completed by the energization of relay

59, the ring cut off relay energizes. Upon operating, relay 54 completes its own locking circuit, disconnects the signalling current from the substation A', and prepares the talking connection. The operation of armature 48 is without function at the present time due to the fact that the relay 59 has completed another circuit for relay 105.

In the finder D relay 202 operates to establish a locking circuit for itself at armature 223 and it opens the circuits of the magnets 206 and 309 in the finder switch D and the code selecting switch F, respectively, at armature 224. Other results of the energization of the relay 202 are that at armature 222 a lead from the busy signalling machine is connected to the starting conductor 160 and at armatures 221 and 228 the talking circuit is prepared.

The wipers 335 and 336 of the code selecting switch F are now in engagement with the set of bank contacts on the level which corresponds to the number of steps that the finder D has taken in finding the line of the substation A'. This is the same as the number of the line of the substation A' as the banks of the finder D are multiplied with those of the local connector switches. Thus the code call number of each called subscriber corresponds to his directory number. By this arrangement, as the code selecting switch F steps in synchronism with finder D, the number of steps the finder takes in locating the line of the called party, selects the code. The arrangement of having banks of the finder D multiplied with the corresponding contacts of the local connector switches is arbitrary. In fact, in larger private automatic exchange systems, in the majority of cases, it would be possible to bring all these special subscribers' lines into the banks of an ordinary one hundred line finder switch due to the fact that even in the larger private automatic exchange systems it is very seldom that there would be more than one hundred subscribers entitled to this special code calling service. Thus the selecting operation of the finder D could still be utilized even in the large systems to control the operation of the code selecting switch and selecting the code to be sent out.

It will be remembered that the slow acting relay 302 is energized in series with the rotary magnet 309. Upon operating, relay 302, at its armature 319 completes a circuit for the relay 303. The latter relay, upon operating, establishes a locking circuit for itself at armature 321 and at armature 320 prepares a circuit for the slow acting relay 305. At the termination of the rotary movement of the code selecting switch F, the slow acting relay 302 deenergizes and completes a circuit extending from ground by way of the armature 319 and its back con-

tact, front contact and armature 320, armature 366 and its back contact, armature 331 and its back contact, and through the winding of the slow acting relay 305 to battery. Relay 305 operates at its armature 328 to complete a circuit for the rotary magnet 365 of the interrupter switch I. Magnet 365 operates to open the circuit of the slow acting relay 305 at armature 366. After a short interval the slow acting relay 305 deenergizes to open the circuit of the magnet 365. Magnet 365 deenergizes and advances the wipers 360 and 361 of the code interrupter switch into engagement with the bank contacts 369 and 370. The operation of the wiper 361 completes another circuit for the relay 303 so as to prevent premature ending of the code in case the called subscriber should answer before a code is completed. This arrangement prevents a false signal being given. The operation of the wiper 360 places ground upon the conductor 370 extending to the next to uppermost level of bank contacts in the code selecting switch. However, as the wipers of the switch are on the bank contacts 375 and 385 this operation has no function at the present time. The magnet 365, upon deenergizing, also again closes the circuit of the slow acting relay 305. Relay 305 operates to again close the rotary magnet circuit. The operation of the relay 305 and the magnet 365 continues until the wiper 360 of the interrupter switch I is rotated into engagement with the bank contact 372. When this occurs a circuit is completed extending from grounded conductor 373 by way of wiper 360, bank contact 372, conductor 374, bank contact 375, wiper 335, through the winding of the relay 308 and the resistance 377 to battery. Relay 308 is energized over this circuit and, upon operating, establishes a locking circuit for itself at armature 333. Other results of the energization of relay 308 are that at armature 332 a circuit is prepared for the differential relay 307 and at armature 331 the circuit of the slow acting relay 305 is opened and a circuit closed at the front contact of this armature for the slow acting relay 306. Relay 306, upon energizing, at its armature 329 closes another circuit for the slow acting relay 305. The latter relay, upon energizing, at its armature 328 completes a circuit of the rotary magnet 365 of the code interrupter switch I. Magnet 365 energizes to open the circuit of the slow acting relay 306 at armature 366 and to close a circuit for the lower winding of the differential wound relay 307 in multiple with the bells 338 and 339. The bells such as 338 and 339 are located at various points in the establishment and serve to signal the called subscriber if he is any where in the building. The relay 307 operates at its armature 330 to close a circuit for its upper winding. As the relay

307 is differential, upon its energization the upper winding is energized and the armature 330 is retracted whereupon the relay again operates through its lower winding.

5 This buzzer like action of the armature 330 of the relay 307 serves to give a tone to the calling subscriber over a circuit which extend as follows: from battery by way of front contact and armature 330; back contact and armature 316, condenser, conductor 178, front contact and armature 228, wiper 242, bank contact 260, conductor 164, bank contact 126, front contact and armature 83, armature 73 and its front contact, condenser, over the line of the substation A and through the upper winding of the line relay 51 to ground. In this manner the calling subscriber is given a distinctive signal in order to inform him that the code is being sent out. As the circuit of the slow acting relay 306 is broken by the operation of armature 366, this relay deenergizes and opens the circuit of the slow acting relay 305. After a short interval, relay 305 deenergizes and opens the circuit of the rotary magnet 365, which deenergizes also. The deenergization of magnet 365 advances the wipers 360 and 361 in the engagement with the next set of bank contacts and also closes a circuit for the slow acting relay 306. Upon the wiper 360 engaging bank contact 380 the relay 308 is short circuited and consequently deenergizes. Relay 308, upon retracting its armature, opens the circuit of the bells 338 and 339 and also of the relay 307 at armature 332 and at armature 331 it opens the circuit of the slow acting relay 306 and closes a circuit for relay 305. Relay 305 again operates to energize the rotary magnet 365. The magnet 365 energizes and opens the circuit of the slow acting relay 305 and operation of the relay 305 and the magnet 365 cause the wipers 360 and 361 to be rotated into engagement with the next set of bank contacts. When the wiper 360 engages bank contact 382, a circuit is completed for the relay 308. The operation of relay 308 has the same functions as before, that is, its locking circuit is completed and also a circuit for the bells 338 and 339 and the interrupter relay 307 and also for the slow acting relay 306 is closed. The magnet 365 of the code interrupter switch I continues to advance the wipers 360 and 361 under the control of the slow acting relays 306 and 305. It will be seen that at each deenergization of the magnet 365 the circuit of the relay 307 as well as the bells such as 338 and 339 is opened, thus a series of short rings are sent out. When the wiper 360 engages bank contact 383, a circuit is completed which extends from grounded conductor 373 by way of wiper 360, bank contact 383, bank contact 385, wiper 336, and through the resistance 377 to battery. By

this operation the relay 308 is short circuited. The deenergization of relay 308 opens the bell circuit and also allows magnet 365 to be operated under control of the single interrupter relay 305. The rotation of the wipers 360 and 361 continues and when the wiper 360 engages bank contact 372 the code ring is again started. It will be seen that during the ringing periods the magnet 365 of the code interrupter switch I is controlled by two slow acting relays 306 and 305, consequently this operation is slower than when it is controlled by the single slow acting relay 305. This latter condition occurs during silent periods.

The called subscriber upon hearing this code ring will dial a special number, which is termed the code answering number, in order to converse with the calling subscriber. The operation when the called subscriber answers will be described with reference to the connector H, Fig. 1. It will be assumed that the connector H is operated into engagement with the bank contacts 115-118, inclusive, which are the bank contacts associated with the code answering number in the connector H. When the engagement is made with this set of bank contacts the switching relay 57 is energized over a circuit extending from ground by way of front contact and armature 65, armature 74 and its back contact, through the upper winding of relay 58, through the upper winding of the switching relay 57, back contact and armature 77, test wiper 96, test contact 116, conductor 173 and through the winding of relay 300 to battery. The relays 57 and 300 are energized over this circuit. The operation of the relay 57 has the same result as before described among which is the completion of the ringing circuit. However, immediately upon the energization of relay 57 a circuit is completed for the ring cut off relay 54, which extends from battery through the upper winding of relay 54, back contact and armature 71, armature 79 and its front contact, wiper 95, bank contact 115, conductor 174, conductor 175, front contact and armature 221, wiper 240, bank contact 258, conductor 166, wiper of the connector used to extend the connection to the line of the subscriber called via armature and front contacts of armatures such as, 79 and 71 of the connector H, winding of the back bridge relay, such as 50 of the connector H, armature and front contact, such as 64, to ground. The relay 54 is immediately energized and operates to disconnect the signalling current and to complete the talking circuit. The relay 300 in the code selecting switch F, upon operating, opens one point in the circuit of relay 304 at armature 315, at the front contact of this armature places ground on conductor 169 to busy the code

calling number and at armature 316 opens the ringing induction circuit. If the wipers of the code interrupter switch are now normal the relays 304 and 303 deenergizes and the switch F will be released and the code stopped. If the code interrupter switch I is off normal the relays 303 and 304 will be maintained energized until the wiper 361 comes to its normal position whereupon the code selecting switch will be released as before. This arrangement prevents mutilation of the code by its being stopped before being completed.

Conversation may now take place between the calling and called subscriber over the heavy talking conductors, battery being supplied to the calling subscriber from the windings of the line relay 51 of the first calling connector H and to the called subscriber from the windings of the line relay of the connector used in extending the connection to the code answering number.

When the conversation is terminated both subscribers will replace their receivers upon their respective switchhooks. The replacement of the receiver at the called station brings about the release of the line switch and connector used in extending the connection to the code answering number in the usual manner. The release of the connector H and line switch C occurs responsive to the replacement of the receiver at substation A. Immediately upon the release of the connector H the relay 200 in the finder D retracts its armatures and brings about the release of the finder. In the above manner the connection is released.

Should the subscriber called have not answered the release of the connections takes place in substantially the same manner as has already been described responsive to the replacement of the receiver at substation A, the difference in this case being that the code is stopped and the code equipment released by ground being removed from the conductor 169 by the deenergization of relay 200. In this case also the release does not occur until the interrupter switch I is in its normal position.

It will be remembered that, when the finder switch D found the line of the substation A', at the energization of the relay 202, a lead from the busy signalling machine is connected to the starting conductor 160. This provision is made so that if some other subscriber should connect with one of these special service subscribers' numbers he will receive a busy signal, inasmuch as the finder D cannot be operated to seize the line called. In order to explain this operation it will be assumed that the finder D was already in use when the subscriber at substation A extends a connection to the substation A'. In this case the energization of the relay 58

bridges the secondary of the induction coil across the talking conductors in the connector H as the relay 59 is not energized. In this manner the calling subscriber is given the busy signal in order to inform him that he cannot communicate with the called subscriber, the tone being induced from the primary of the induction coil in the starting circuit. The release of this connection occurs in the ordinary manner.

The above is the ordinary operation of the system in handling these special service calls. Sometime in systems of this character situations are encountered wherein a certain party may have no definite location and it is still desirable to be able to reach him at any time. In this case it will be seen that it is impracticable to give such party a telephone. However, in order to reach him or any other parties in like positions, what is known as a code calling number is provided. To call one of these parties it is only necessary to call this code calling number and then to dial the digits of the desired party's code. The code signal is then sent out in the usual manner.

The above operation will now be briefly described. For this purpose it will be assumed that the subscriber at substation A desires to call one of these special parties. To accomplish this result, the subscriber at the calling substation will remove his receiver and operate his calling device for the two digits of the code calling number. It will be assumed that these operations cause the calling line to be extended by way of the line switch C to the connector H and that this connector is in turn operated until its wipers are brought into engagement with the bank contacts 119-122, inclusive, which are the bank contacts associated with the code calling number in the connector H. When this occurs, assuming that the code calling number is idle, the switching relay 57 is energized in series with the relay 304 in the code selecting switch F. The operations of the relay 57 are the same as before stated with the exception that ringing current is not projected out over the wipers 95 and 98. The reason that ringing current is not projected out on these wipers is that, when the wipers of the connector are rotated into engagement with the code calling set of bank contacts, the cam spring 90 which is operated only on code numbers, is operated to disconnect the ringing current and to prepare a dialing circuit. The operation of this spring is controlled by a cam on a switch shaft in a well known manner.

The calling subscriber will now operate his calling device for the first digit in the code number of the desired party. By this operation of the line relay its armature 63 is caused to vibrate a plurality of times corre-

sponding in number to the number of interruptions in the digit dialed. At each retraction of the armature 63, an impulse of current is sent over a circuit extending from
 5 ground by way of armature 63 and its back contact, armature 66 and its front contact, off normal springs 67 and 68, armature 70 and its back contact, back contact and armature 75, armature 82 and its front contact,
 10 working contact of spring 90 and the said spring, back contact and armature 73, armature 83 and its front contact, wiper 98, bank contact 122, conductor 167, conductor 174, off normal springs 323 and 324, through
 15 the winding of the slow acting relay 301 and through the winding of the vertical magnet 310 to battery. The above is the circuit over which the first impulse is sent to the vertical magnet. However, upon the first
 20 operation of the vertical magnet, the off normal springs are shifted and the remaining vertical magnet impulses are sent over another circuit, which is similar to the one above traced, except that it goes through off
 25 normal springs 323 and 325 and armature 317 on the slow acting relay 301, which is now energized. Magnet 310 operates to raise the wipers 335 and 336 step by step until these wipers are placed opposite the desired
 30 level of bank contacts. Shortly after the end of the vertical motion of the switch, the slow acting relay 301 deenergizes and prepares a circuit for the rotary magnet 309.

When the calling device at the calling
 35 substation A is operated in accordance with the next and final digit in the desired number, the line relay 51 in the connector H again deenergizes a plurality of times. At each deenergization an impulse of current
 40 is sent to the rotary magnet 309 of the code selecting switch F over a circuit similar to the one previously traced. Magnet 309 operates to rotate the wipers 335 and 336 into engagement with the proper set of bank
 45 contacts to send out the desired code. The slow acting relay 302 is energized in series with the rotary magnet and operates at its armature 319 to close a circuit for the relay 303 and at armature 318 to short circuit the
 50 contact springs comprising armature 322 and its back contact on the relay 303. The relay 303 immediately energizes and at its armature 322 opens one point in the circuit of the rotary magnet, at armature 321 estab-
 55 lishes a locking circuit for itself and at armature 320 prepares a circuit for the slow acting relay 305. The subsequent operations of the code interrupter switch I, and the code ringing takes place as hereinbefore
 60 described. The called subscriber answers by going to the nearest telephone, removing the receiver thereat, and operating the calling device for the two digits of the code answering number. The results which occur
 65 responsive to this operation take place in the

same manner as has already been fully described.

It will be remembered as soon as the finder D steps off normal ground is placed upon the conductor 169. This operation
 70 serves two functions the first of which is to energize the relay 304 in the code selecting switch F and the other to place a ground potential upon the test contact associated with the code calling number in the banks
 75 of the local connector switches. In this manner it is impossible to use the code calling number while the code selecting switch is in use for an ordinary call.

Should the code selecting switch be in use
 80 for one of these special calls when ground is placed upon the starting conductor 160 in the ordinary operation of the system, the energization of the relay 200 completes a circuit for the relay 203. Relay 203, upon
 85 operating, at its armature 229 opens the circuit of the vertical magnet of the finder, at armature 227 establishes a locking circuit for itself and at armature 226 connects a lead from the busy signalling machine to
 90 the start conductor 160. By the latter operation the calling subscriber is given an audible signal in order to inform him that the called subscriber is inaccessible. The release of the connection in this case occurs in
 95 the usual manner responsive to the replacement of the receiver at substation A.

The features of the invention having been described and ascertained what is thought to be new and desired to have protected by
 100 Letters Patent will be pointed out in the appended claims.

What I claim is:

1. In a telephone system, an automatic switch, telephone lines accessible thereto,
 105 code signalling equipment, a signalling circuit, means for operating said automatic switch to connect with one of said lines, timing mechanism rendered operative responsive to connection with said line, and an automatic switch controlled by said timing mechanism for selecting a code and initiating the operation of said code signalling equipment to apply code signalling current to said circuit.
 115

2. In a telephone system, an automatic switch, telephone lines accessible thereto, a source of ringing current, code signalling equipment, a signalling circuit, means for operating said automatic switch to connect
 120 with one of said lines, means operative responsive to the establishment of said connection for connecting said source to said line, timing mechanism rendered operative responsive to connection with said line, and means controlled by said timing mechanism for selecting a code and for connecting said code signalling equipment to said circuit.
 125

3. In a telephone system, an automatic switch, telephone lines accessible thereto, a
 130

source of ringing current, code signalling equipment, a signalling circuit, means for operating said automatic switch to connect with one of said lines, means operative responsive to the establishment of said connection for connecting said source to said line, timing mechanism rendered operative responsive to connection with said line, means controlled by said timing mechanism for connecting said code signalling equipment to said circuit, a second automatic switch controlled from any other of said lines for connecting with said first calling line, and means operative responsive to the establishment of said last connection for disconnecting said code signalling equipment.

4. In a telephone system, an automatic switch, telephone lines, code signalling equipment, a signalling circuit, a finder switch, means for operating said automatic switch from a calling one of said lines to establish a connection with a called one of said lines, means operable a predetermined time interval after said connection is established for operating said finder switch to connect with said line, a code selecting switch and means for operating it in synchronism with said finder to select a code and for then applying said code to said circuit.

5. In a telephone system, an automatic switch, telephone lines, code signalling equipment, a signalling circuit, a finder switch, means for operating said automatic switch from a calling one of said lines to establish a connection with a called one of said lines, means operable a predetermined time interval after said connection is established for operating said finder switch to connect with said line, a code selecting switch and means for operating it in synchronism with said finder to select a code and for then applying said code to said circuit, and another automatic switch controlled from another calling one of said lines for connecting with said first calling line whereby a telephonic connection is established between said calling lines.

6. In a telephone system, an automatic switch, telephone lines, code signalling equipment, a signalling circuit, a finder switch, means for operating said automatic switch from a calling one of said lines to establish a connection with a called one of said lines, means operable after a predetermined time interval after said connection is established for operating said finder switch to connect with said line, a code selecting switch and means for operating it in synchronism with said finder to select a code and for then applying said code to said circuit, another automatic switch controlled from another calling one of said lines for connecting with said first calling line whereby a telephonic connection is established be-

tween said calling lines, and means operative when the last mentioned connection is established for disconnecting said code signalling equipment from said circuit.

7. In a telephone system, a group of connector switches, telephone lines, a finder switch common to said group, a code selecting switch associated with said finder, a signalling circuit, means for operating any one of said connectors to connect with one of said lines, means operative a predetermined time interval after said connection is established for operating said finder to find said called line, and means for operating said code selecting switch in synchronism with said finder to select a code ring.

8. In a telephone system, a group of connector switches, telephone lines, a finder switch common to said group, a code selecting switch associated with said finder, a signalling circuit, means for operating any one of said connectors to connect with one of said lines, means operative a predetermined time interval after said connection is established for operating said finder to find said called line, means for operating said code selecting switch in synchronism with said finder to select a code ring and apply it to said circuit, and means for operating another of said connectors to connect with said first calling line and to release said code selecting switch.

9. In a telephone system, a line, automatic switches for connecting with said line code ringing equipment, a code selecting switch common to said automatic switches, a finder switch associated with said code selector switch, means for operating said finder to connect said code selector switch with said line, and means for operating said code selecting switch in synchronism with said finder.

10. In a telephone system, a line, means for seizing said line, code ringing equipment, a signalling circuit, a code selecting switch, a finder switch associated therewith, means for operating said finder automatically in response to said seizure to connect with said line, means for operating said code selecting switch in synchronism with said finder, and means for thereafter applying the selected code to said circuit.

11. In a telephone system, a line, means for seizing said line, a finder switch, means for operating said finder in response to said seizure to connect with said line, and a code selecting switch controlled by said finder to select a code ring.

12. In a telephone system, a group of connector switches, a finder switch common thereto, telephone lines, means for operating any one of said connector switches to connect with one of said lines, a code selector switch, means controlled by such connection

for operating said finder switch to connect said code selector switch with said called line, and for causing said code selecting switch to select a code, a tone machine, means for operating another of said connectors to connect with another of said lines and means controlled by said finder for connecting a lead from said tone machine to said other connector.

13. In a telephone system, subscribers' lines, common signalling mechanisms, means controlled from any line for seizing said mechanisms via one path and transmitting code signals, means for extending a connection from a calling to a called one of said lines, and means operated if the called subscriber does not answer for automatically connecting said called line with said mechanisms via another path and transmitting a code signal thereafter.

14. In a telephone system, subscribers' lines, a set of signals common to said lines, mechanisms for operating said signals in accordance with different codes, means controlled from any line for seizing said mechanisms and operating them directly to select a code and for operating the signals in accordance therewith, and means for seizing the mechanisms through a switch associated with a called one of said lines and causing them to automatically operate to select a certain code and operate the signals in accordance therewith.

15. In a telephone system, subscribers' lines, a common signalling circuit, mechanisms associated with the circuit, means controlled from a line for seizing the mechanisms and directly operating them to select a code and transmit signals over the circuit in accordance therewith, means for extending a connection to one line from another, and means responsive thereto for seizing said mechanisms and causing them to automatically select a code corresponding to the called line and transmit signals over the circuit in accordance therewith.

16. In a telephone system, subscribers' lines, automatic switches any one of which may be used for interconnecting any two of said lines, a signal individual to each of said lines, a signal common to said lines, means in the switch used for causing the individual signal of the desired line to be actuated, means operative to disconnect said signal upon removal of the called subscriber's receiver, means for automatically disconnecting said signal after a definite period should the called subscriber fail to answer, means for causing the common signal to be then operated in the characteristic manner, and means under the control of a subscriber at the station of any of said lines for seizing and operating an idle one of said automatic switches to cause said com-

mon signal to be disconnected and a talking circuit completed.

17. In a telephone system, called lines of two classes, a code selecting and signalling switch, means for causing said switch to automatically operate to select a particular code when a line of one class is called, and means for directly operating said switch when a line of the other class is called.

18. In a telephone system, subscribers' lines, a plurality of connector switches available for use in extending talking connections to or from said lines, a signal common to said lines, means for operating one of said switches to extend a connection from a calling to a called one of said lines, means common to said connector switches causing said common signal to operate in a characteristic manner dependent on the line connected with, means for seizing and operating one of said connector switches to extend a connection to a calling line, and means responsive to the seizure of the calling line for disconnecting said common signal.

19. In a telephone system, a code called line, means for extending a connection to said line, a code selector switch, a signalling device, means for directly operating said switch to select a code and for causing said signalling device to be operated in accordance therewith, a subscriber's line, said first means operable to extend a connection to said subscriber's line and effective to operate a signal thereat, and means effective after a delay for causing said code selector switch to automatically operate to select a code and to cause said first signal to operate in accordance therewith.

20. In an automatic telephone system, a plurality of subscribers' lines, a plurality of automatic switches accessible to said lines, banks for said switches, said banks being multiplied so that any of said switches has access to any line in said system, a finder switch provided with a bank, said bank being multiplied to said other switch bank, a code switch and signals controlled thereby, means for operating one of said first switches to extend a connection from a calling to a called one of said lines, and means controlled through said engaged switch operative after a definite interval if the called party does not answer to cause said finder to automatically associate itself with said called line and to cause said code switch to operate said signals in a manner characteristic of said called line.

21. In a telephone system, lines, a connector switch for completing connections between said lines, signalling equipment in said switch for signalling called lines, code signalling equipment including line selecting and code selecting switches, means including wipers on the connector switch, ef-

fective each time a connection is set up to a called line, for placing a test potential upon contacts of the bank of said line selecting switch which are individual to the line called, means effective after an interval
5 providing the called subscriber fails to respond for causing the line selecting switch to hunt for and seize the called line, and means for causing the code selecting switch to select a code contingent on the line selected. 10

In witness whereof, I hereunto subscribe my name this 1st day of November, A. D. 1922.

JOHN E. GARDNER.