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J. E. GARDNER

AUTOMATIC TELEPHONE SYSTEM

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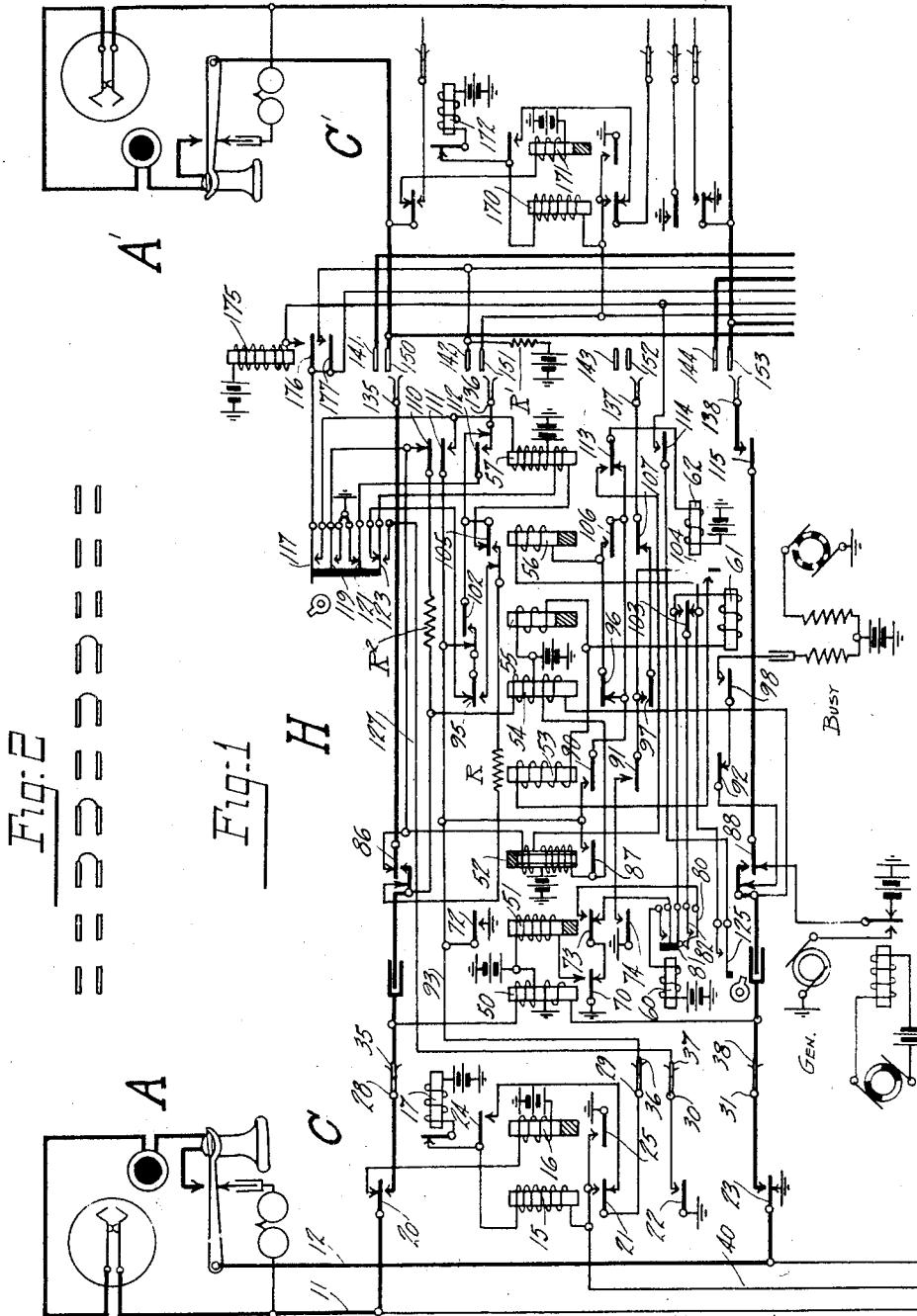


Fig. 2

Fig. 1

—Inventor—
John E. Gardner
Charles C. Candy, Att'y.

UNITED STATES PATENT OFFICE.

JOHN E. GARDNER, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

AUTOMATIC TELEPHONE SYSTEM.

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The present invention relates in general to automatic telephone systems but is more particularly adapted to be used in small automatic exchanges which are known commercially as private automatic exchanges. In exchanges of this character certain special features are usually provided for the convenience of the subscribers among which probably the most important is known as conference calling. This is an arrangement to enable three or more parties to be telephonically connected together at the same time. There are several ways for accomplishing this result the most common of which is to have each party desired in the conference notified either by means of a code call or by communicating with each one separately and telling him to call the conference number. If the conference code call is rung, it will, of course, be apparent that all the subscribers who are usually included in the conference will then call the conference number. However if the party setting up the conference desired to include only certain subscribers therein he would call each one separately and instruct him to call the conference number at any predetermined time.

Hitherto, in arrangements of this nature it has been more or less impossible to protect the conference number from intrusion and any subscriber who desired, knowing that a conference was being held might listen to it. Also any party was able to set up a conference. These arrangements are more or less undesirable.

A feature of the present invention is therefore to provide a means for positively protecting the conference from intrusion when it is once established.

Another object is to restrict conference calling so as to prevent all the subscribers except important officials of a company having a private automatic exchange from using the conference feature.

The particular manner in which these and other results are accomplished will be described fully hereinafter reference being had to the accompanying drawings.

In the present case the invention has been shown applied to an isolated private automatic exchange but it will of course be readily apparent that it is not restricted to

this use and may be used wherever conference calling is installed.

Referring now to the drawings comprising a single sheet, in Fig. 1 is shown an automatic substation A, having a rotary line switch C of well known construction individual thereto. The line switch C in common with a plurality of other similar line switches have access to trunk lines leading to connector switches, one of these being shown at H. The connector switch H has access to local subscribers' lines and the conference number. It is of the Strowger type having 100 bank contacts arranged in ten rows or levels. Bank contacts 150-153, inclusive, are the terminals of a called subscriber's line the substation of which is shown at A'. Bank contacts 141-144, inclusive, accessible to the connector H are the terminals of the conference number which we will assume in the present case is the No. 60. The relay 175 is common to all the connector switches and is associated with the conference number.

Fig. 2 shows a certain manner of connecting the test banks of the local connectors such as H to secure rotary service.

Having described briefly the construction of the switches involved in the invention a detailed explanation of their operation will now be given. For this purpose it will be assumed that the subscriber at substation A desires to hold a conference with a number of other subscribers. He will therefore remove his receiver and operate his calling device in accordance with the digits of the first subscriber's number desired in the conference. When the subscriber answers the calling subscriber will tell him that a conference is to be held and will then hang up his receiver and in the same manner call the remaining subscribers. Each one of the called subscribers will then in turn call the conference number as will the calling subscriber at substation A after he has communicated with all the parties he desires in the conference. These operations will now be described.

When the receiver is removed at substation A the line relay 16 of the individual line switch C is energized over the line conductors 11 and 12 in series. Upon energizing, relay 16 at armature 25 completes a

circuit which includes the switching relay 15 and the stepping magnet 17 in series and at its armature 24 connects the test wiper 29 to the above circuit at a point midway between the switching relay and the stepping magnet 17. The operation of the rotary line switch C now depends upon whether the trunk line with which the switch wipers 28-31, inclusive, are in engagement is or is not busy. If busy, there will be a ground potential upon the test contact engaged by test wiper 29. The switching relay 15 will be short circuited and the stepping magnet 17 being supplied with direct ground by way of the said test wiper will operate as a buzzer to advance the switch wipers step by step in search of an idle trunk line. However, it will be assumed in the present case when the receiver was removed at the calling substation that the switch wipers of the line switch C were in engagement with the bank contacts shown in the drawings, and further that this trunk line was idle. Under these circumstances immediately after the operation of the line relay 16 the switching relay 15 is energized in series with the stepping magnet. It may be stated at this time that the switching relay 15 is of comparatively high resistance so as to prevent the operation of the stepping magnet 17 at this time. Upon energizing, relay 15 disconnects the incoming line conductors 11 and 12 of the substation A from the winding of the line relay 16 and from ground, respectively, and connects them by way of armatures 20 and 23 and their front contacts, wipers 28 and 31, to the upper and lower windings of the line relay 50 of the connector H.

The line relay 50 will be energized over the calling subscriber's line loop and upon operating, completes a circuit of the slow acting release relay 51. Relay 51 upon attracting its armatures, prepares the circuits of the connector H for operation at armature 73 and at armature 72 places ground on release trunk conductor 93 thereby establishing a holding circuit which extends by way of test contact 36, test wiper 29, armature 21 and its front contact, through the winding of the switching relay 15, and through the winding of the stepping magnet 17 to battery. It will be understood that the above traced holding circuit is completed before the slow acting line relay 16 has had time to deenergize. A branch of the holding circuit also extends by way of the private normal conductor 40 to multiply connected test contacts in the banks of local connector switches, such as the switch H, which have access to the line of the substation A, whereby said line is protected from intrusion in the usual manner.

The calling subscriber may now operate his calling device in accordance with the first

digit of the desired subscriber's number thereby producing a series of interruptions in the line circuit of the line relay 50. The line relay 50 retracts its armature a plurality of times in response to these interruptions each time sending an impulse of current over the following path: ground by way of armature 70 and its back contact, armature 73 and its front contact, off normal springs 80 and 81, winding of the vertical magnet 61, and the winding of the slow acting series relay 55 to battery. The above is the circuit over which the first impulse to the vertical magnet is sent but upon the first vertical step of the shaft the off normal springs are shifted and the remaining vertical impulses travel over a different circuit which includes the off normal springs 80 and 82 and armature 103 and its front contact, (relay 55 being now in an operated position). The vertical magnet 61 operates to raise the switch wipers 135-138, inclusive, step by step until they are placed opposite the level of bank contacts in which is terminated the line of the substation A'. The slow acting relay 55 is energized in series with the vertical magnet, maintains its armature attracted throughout the vertical operation of the switch, and shortly after its termination deenergizes transferring the operating circuit to the rotary magnet 62.

The calling subscriber may now call the final digit of his desired subscriber's number. As before, a series of interruptions are produced in the line circuit of relay 50 which retracts its armature a plurality of times in response thereto. A series of impulses are thereby sent to the rotary magnet 62 over a circuit extending from ground by way of armature 70 and its back contact, armature 73 and its front contact, off normal springs 80 and 82, armature 103 and its back contact, winding of the slow acting series relay 56, armature 96 and its back contact, back contact and armature 113, and through the winding of the rotary magnet 62 to battery. Magnet 62 operates to rotate the switch wipers step by step until they are placed in engagement with the bank contact set associated with the line of substation A' which we will assume are the bank contacts 150-153, inclusive. The slow acting relay 56 which is energized in series with the rotary magnet operates to connect the test wiper 136 to the upper winding of the test relay 54.

The further operation of the connector H depends upon whether or not the line of the substation A is or is not busy. If busy, there will be a ground potential present on the test contact 151 engaged by test wiper 136. Assuming this to be the case a circuit is completed from ground on test contact 151, by way of said test wiper, normally closed springs controlled by relay 57, amature 105

and its front contact, resistance R, normally closed springs controlled by relay 52, and through the upper winding of the test relay 54 to battery. Upon energizing, this latter relay at armature 95 establishes a holding circuit for itself and at armature 98 places the busy tone from the busy machine on the lower heavy talking conductor whereby the calling subscriber is notified that the line of the substation A' is busy. Upon hearing this tone the calling subscriber will replace his receiver upon the switchhook thereby initiating the release of the connector H and the line switch C in the well known manner.

It will now be assumed that the line of the subscriber at substation A' was idle when the wipers of the connector H are rotated into engagement therewith. Then, following the deenergization of the slow acting relay 56, a circuit is completed extending from ground on release trunk conductor 93, normally closed springs controlled by relay 55, armature 95 and its back contact, resting contact of spring 123 and the said spring, through the lower winding of the switching relay 57, back contact and armature 105, normally closed springs controlled by relay 57, test wiper 136, test contact 151, winding of the switching relay 170 of the line switch C', and thence through the winding of the stepping magnet 172 to battery. Relays 57 and 170 energize over this circuit. However, due to a mechanical interlocking controlled by the armature of the line relay, the switching relay 170 is only energized sufficiently to disconnect the line of the substation A' from its normal battery and ground connections in the line switch C'. Relay 57 upon energizing, establishes a locking circuit for itself at armature 111, places direct ground on test contact 151 at armature 112, and at armature 115 completes the ringing circuit. Ringing current is then intermittently projected over the line of the substation A' until the subscriber thereat removes his receiver. When this occurs a path for direct current is provided over the called subscriber's line loop for the upper winding of the ring cut off relay 52. The latter relay upon energizing, locks itself at armature 87 and at armatures 86 and 88 breaks the ringing circuit of the called subscriber and at the front contacts of these armatures finally completes the talking connection. Talking battery is furnished to the calling subscriber from the windings of the line relay 50 and to the called subscriber from the windings of the back bridge relay 54. The subscriber at substation A will now inform the called subscriber at substation A' that a conference is to be held and give him any other information necessary after which he will replace his receiver upon the switchhook. By this last operation the con-

connector H and the line switch C are released.

When, as in the case about to be described, there are a number of trunk lines going to an operator the connector H must be able to select and connect with an idle one of these trunks or should all be busy notify the calling subscriber of this fact. In order to accomplish this result the test contacts of each trunk line except the last are tied together and those of the last trunk line left open. Thus, as may be seen from Fig. 2, if the upper test contact of any one except the last trunk in the group be grounded, as is the case when one is busy, this ground will also be present on the lower test contact while, if the last trunk line be busy, ground will only be present on the upper test contact. From the above explanation it will be seen that ordinary individual lines have their test contact left untied.

The operation of the connector H when used in this case will now be briefly described. For this purpose it will be assumed that the calling subscriber at substation A has operated his calling device in accordance with the digits of the number associated with the group of trunks mentioned with regard to Fig. 2. Should this first line be busy a circuit will be completed by way of test wiper 136 for the test relay 54. A new circuit will also be completed extending from test contact engaged by test wiper 137, there being a ground present on the test contact engaged by this wiper as it is tied to the test contact engaged by test wiper 136, armature 107 and its back contact, armature 97 and its front contact, armature 104 and its back contact, winding of the stepping relay 53, and thence through the winding of the slow acting relay 55 to battery. Relays 53 and 55 energize over this circuit. Relay 53 upon operating, establishing a locking circuit for itself at armature 91 and at armature 90 completing the rotary magnet circuit. Relay 55 upon energizing, serves to maintain the test wiper 136 in connection with the test relay 54. Magnet 62 operates to rotate the wipers into engagement with the next trunk line and to break the locking circuit of the stepping relay 53 at armature 104, which relay deenergizes opening the circuit of the rotary magnet which deenergizes also. If this next trunk line is busy the stepping relay 53 will be again energized to complete the rotary magnet circuit. This alternate operation of the stepping relay 53 and the magnet 62 will continue to take place until an idle trunk is found or the switch wipers are rotated into engagement with the bank contact set associated with the last trunk line in the group. In the latter case relay 53 will not be energized for the reason that the test banks are not tied together in this case. The relay 54, however, will remain energized

and serves to transmit the busy signal to the calling subscriber.

The calling subscriber at substation A may in the manner just described call all the other subscribers desired in the conference after which he will himself connect with the conference number. The latter operation will now be briefly described. When the receiver is removed at substation A the individual line switch C operates in the usual manner to select an idle trunk line terminating in a connector switch which we will assume is the connector shown at H. The line and release relays 50 and 51 energize as before described and with the same results.

When the calling device is operated for the first digit of the conference number, namely, 6, six interruptions are produced in the circuit of the line relay 50 which operates in response thereto. At each retraction of its armature an impulse of current is sent to the vertical magnet 61 in series with the slow acting relay 55. The vertical magnet 61 operates to raise the switch wipers step by step until they are placed opposite the sixth level of bank contacts. The slow acting relay 55 is energized in series with the vertical magnet and remains so throughout the vertical operation of the switch and at the termination thereof deenergizes and transfers the operating circuit to the rotary magnet 62.

The calling subscriber may now call the second digit of the conference number namely the digit 0. Ten interruptions are thereby produced in the line circuit of relay 50 which deenergizes a corresponding number of times. At each deenergization, an impulse of current is sent to the rotary magnet 62 in series with the slow acting relay 56. Magnet 62 operates to rotate the switch wipers 135-138, inclusive, into engagement with the tenth set of contacts in the sixth level which we will assume are bank contacts 141-144, inclusive. The springs 117, 119, 121, 123 and 125 are cam springs which are adapted to be shifted by the cam on the switch shaft when the switch wipers are rotated into engagement with the conference number 60. The slow acting relay 56 is energized in series with the rotary magnet and operates to connect the test wiper 136 to the test relay 54. The conference number will not however be busy at this time for the reason that even though the test contacts are multiplied in the usual manner the switching relay of each connector when operating on the conference number does not place ground on the test wipers similar to the wiper 136 as ground is removed by the operation of cam springs similar to spring 121. Then following the deenergization of the slow acting relay 56 a circuit is completed extending from ground on discriminating trunk conductor

127, working contact of cam spring 123 and the said spring, lower winding of the switching relay 57, back contact and armature 105, normally closed springs controlled by relay 57, test contact 142, and through resistance R' to battery. Relay 57 energizes over this circuit and upon operating establishes a locking circuit for itself at armature 111, at armature 114 prepares a point in the operating circuit for the associated conference relay 175, and at armature 115 prepares a point in the talking connection to the subscriber at substation A. Upon the cam spring 119 being shifted into engagement with its working contact by the operation of the switch shaft a circuit is completed from ground by way of working contact and spring 119, upper winding of the ring cut off relay 52, front contact and armature 113, through the winding of the rotary magnet 62 to battery. Relay 52 energizes over this circuit, locks itself at armature 87, and at armatures 86 and 88 completes the talking connection to the line of the subscriber at substation A. It will be seen that relay 57 upon operating, does not place ground on test wiper 136 for the reason that the cam spring 121 is out of engagement with its resting contact.

It may be noted also that unless the parties have ground on the discriminating trunk of their associated line switch the switching relay 57 or a similar relay in the associated connector switch will not be energized on the conference number. Therefore conference service is restricted to those subscribers whose line switches are connected in the manner shown in the line switch C having the armature 22 or similar armatures connected to ground. Should a subscriber not entitled to conference service attempt to connect with the conference number he will be unable to do so. A restricted service subscriber will not have any ground present on the discriminating trunk so upon operating a connector which, for the purposes of description is assumed to be the connector H, into engagement with the conference number no circuit will be completed for the switching relay 57 or a similar relay. A circuit is then effective extending from ground by way of working contact of spring 119 and the said spring, back contact and armature 110, through resistance R^2 , and upper winding of the test relay 54 to battery. Relay 54, upon energizing, at armature 98 places the busy tone on the calling subscriber's line thereby informing him that he is not allowed conference service. In the same manner as above described all the subscribers called by the subscriber at substation A will call the conference number and be connected thereto provided of course they are entitled to conference service. When the last subscriber that the

party at substation A called, comes in on the conference the subscriber at substation A after assuring himself of this fact will operate his calling device for another digit. A circuit is therefore completed extending from ground by way of armature 70 and its back contact, armature 73 and its front contact, off normal springs 80 and 82, armature 103 and its back contact, working contact of cam spring 125 and the said spring, armature 114 and its front contact, and through the winding of the common conference relay 175 to battery. Upon energizing, relay 175 at armature 176 establishes a locking circuit for itself which extends to the release trunk of all the connector switches brought into engagement with the conference number and at armature 177 places ground on the multiply connected test contacts of the conference number in the banks of all local connector switches. In this manner any subscriber now calling the conference number even though he should have ground connected to his discriminating conductor will not be able to obtain connection with the conference for the reason that there will be ground present on the test contacts of the conference number and the associated connector switch used by this subscriber will operate to transmit the busy tone to him thereby notifying him that a conference is being held and the conference number is inaccessible to him at this time.

Conversation may now take place between all the parties connected in on the conference and when this is terminated each party will replace his receiver upon the switchhook and by this operation will release his associated connector switch in the usual manner. The last party to hang up will cause the relay 175 associated with the conference number to deenergize and ground will be removed from the multiply connected test contacts of the conference number and all the apparatus will be returned to its normal condition.

Having fully described and ascertained the features of the invention what is considered to be new and desired to have protected by Letters Patent will be pointed out in the appended claims.

What I claim as my invention is:

1. In a telephone system, a calling subscriber's line, an automatic switch associated therewith, called lines accessible thereto, a calling device under the control of said calling subscriber for operating said switch into engagement with one of said called lines without making the same busy, and means individual to said automatic switch and responsive to the reoperation of said calling device for preventing another connection being established with the connected line.

2. In a telephone system, a calling sub-

scriber's line, an automatic switch associated therewith, called lines accessible thereto, a calling device under the control of said calling subscriber for operating said switch into engagement with one of said called lines without making the same busy, and a relay individual to said switch and energized in response to the reoperation of said calling device for applying a busy potential to said called line.

3. In a telephone system, an automatic connector switch operable for completing connections to called lines, means in said connector automatically responsive to the completion of a connection for making the connected called line busy, and means in said connector automatically responsive to the completion of a connection with a particular called line for maintaining the connected called line in idle condition.

4. In a telephone system, an automatic connector switch operable for completing connections to called lines, means in said connector automatically responsive to the completion of a connection for making the connected called line busy, means in said connector automatically responsive to the completion of a connection with a particular called line for maintaining the connected called line in idle condition, and means controlled at the option of the calling subscriber in case said last mentioned line is connected with for making the same busy.

5. In a telephone system, two lines, an automatic connector switch operable to complete a connection to either of said lines, and means in said connector automatically responsive to the completion of a connection for making the line busy only in case the line called is a particular one of said lines.

6. In a telephone system, two lines, an automatic connector switch operable to complete a connection to either of said lines, means in said connector automatically responsive to the completion of a connection for making the line busy only in case the line called is a particular one of said lines, and means operable thereafter by the calling party in case the other line has been connected with for making such line busy.

7. In a telephone system, a conference line, automatic switches operable each by a different calling party to connect with said line, said switches being arranged to connect with said line without making the same busy in order to permit each connection to be made before the previous connections are released, and means in each switch controlled at the option of the party using the same for making the conference line busy in order to prevent the establishment of any more connections therewith.

8. In a telephone system, a conference line, automatic switches operable each by a different calling party to connect with said line,

said switches being arranged to connect with said line without making the same busy in order to permit each connection to be made before the previous connections are released, and means in each switch controlled at the option of the party using the same for making the conference line busy in order to prevent the establishment of any more connections therewith, said means comprising a busying relay for the said conference line, and a plurality of conductors connected to said relay in multiple and extending each to a different one of said switches.

9. In a telephone system, subscribers' lines of two classes, a conference line, automatic switches common to said subscribers' lines and operable each by a different calling subscriber to connect with said conference line, said switches being arranged to connect with said lines without making the same busy in order to permit each connection to be made before the previous connections are released, and service restricting means whereby the subscribers whose lines are in a particular

class are prevented from operating one of said switches to connect with the conference line.

10. In a telephone system, subscribers' lines of two classes, a conference line, automatic switches common to said subscribers' lines and operable each by a different calling subscriber to connect with said conference line, said switches being arranged to connect with said lines without making the same busy in order to permit each connection to be made before the previous connections are released, and service restricting means whereby the subscribers whose lines are in one class are always prevented from connecting with the conference line, whereas the subscribers whose lines are in the other class may only be prevented from connecting with the conference line by a subscriber who has previously established such a connection.

Signed by me at Chicago, Illinois, this 21st day of January, 1921.

JOHN E. GARDNER.