W. W. LEACH.

MEASURED SERVICE AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED OCT. 15, 1906.

931,132.

Patented Aug. 17, 1909.

2 SHEETS—SHEET 1.

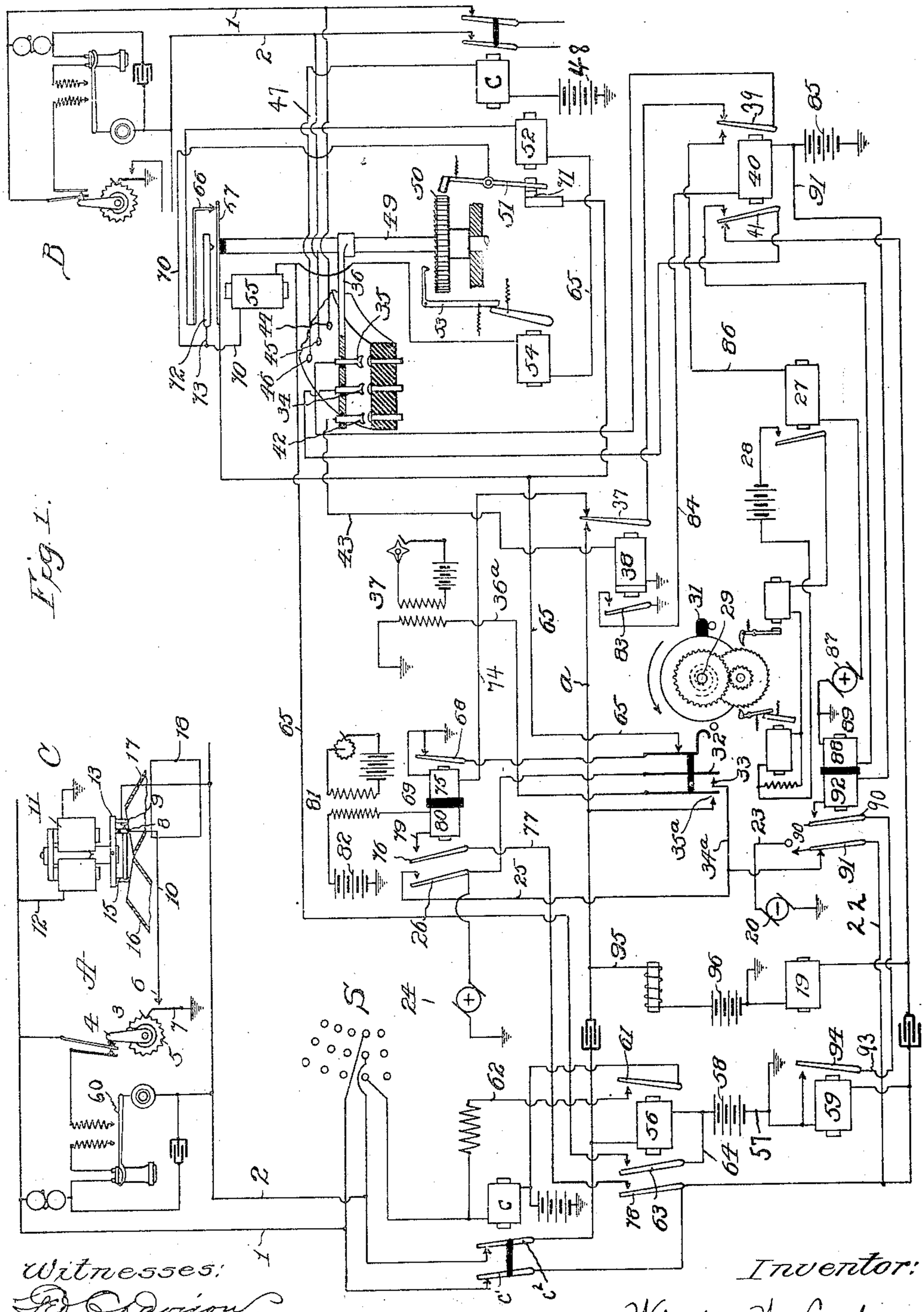

Fig. 1.

Witnesses:
Fred. C. Davison.
Alfred H. Moore.

Inventor:
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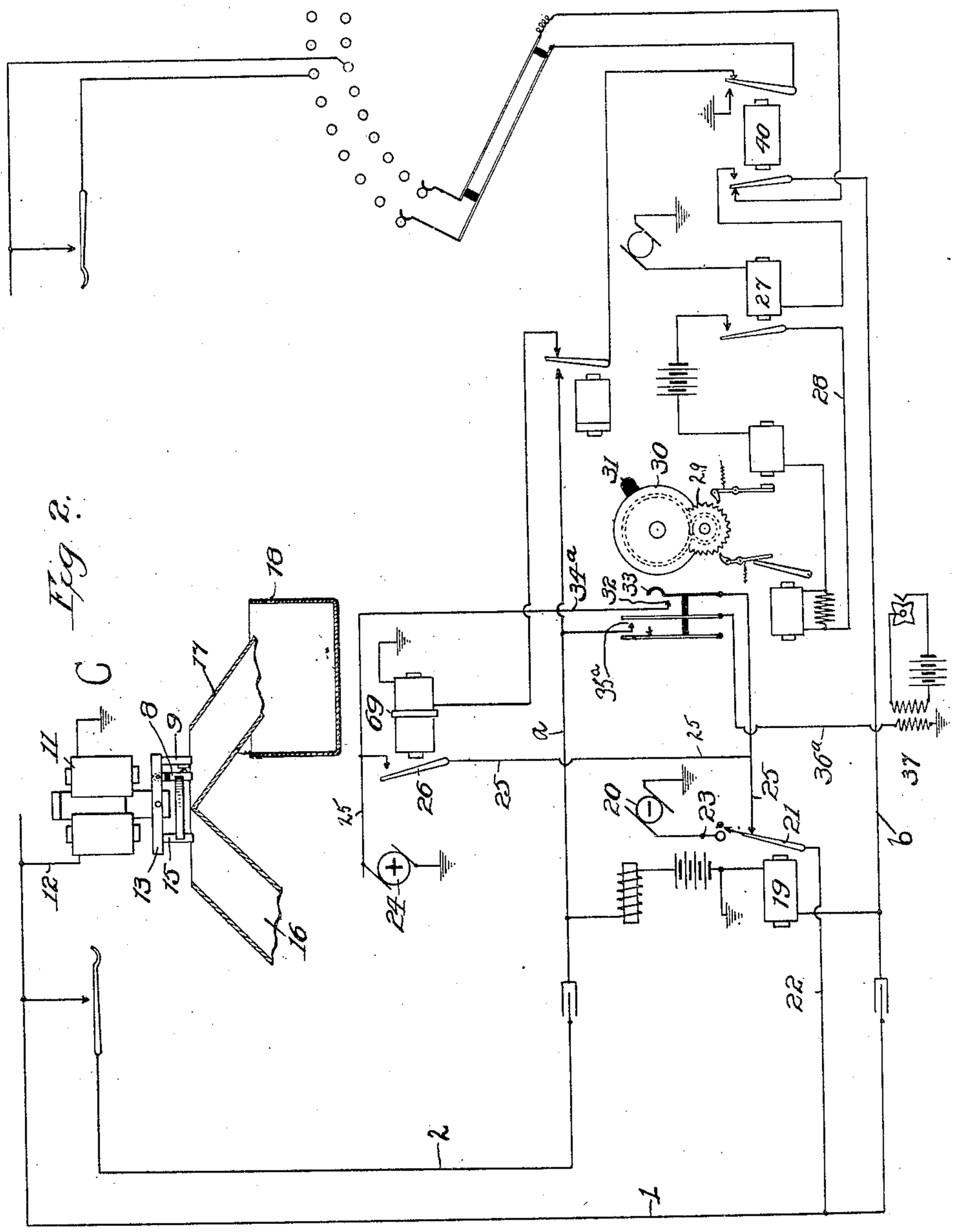

Fig. 2.

Witnesses:
Geo. C. Dawson
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Inventor:
Winfield W. Leach

UNITED STATES PATENT OFFICE.

WINFIELD W. LEACH, OF CHICAGO, ILLINOIS, ASSIGNOR TO RHODA A. LEACH, OF CHICAGO, ILLINOIS.

MEASURED-SERVICE AUTOMATIC TELEPHONE-EXCHANGE SYSTEM.

No. 931,132. Specification of Letters Patent. Patented Aug. 17, 1909.

Application filed October 15, 1906. Serial No. 338,939.

To all whom it may concern:

Be it known that I, WINFIELD W. LEACH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Measured-Service Automatic Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

My invention relates to an automatic telephone exchange system, and has for its object, in general, to provide an improved telephone system of this type with automatically operable toll mechanism arranged to place the subscriber of a calling line at a certain predetermined expense in every instance where a call is made and the called subscriber answers, and also to place the calling subscriber at no expense in the event that the called party fails to answer, or connection cannot be had with his line, owing to the busy condition thereof.

In general, my invention contemplates the provision of a toll device in association with a calling subscriber's line, which will be automatically operated to place the calling subscriber to a predetermined expense when the called party responds to the call by removing his telephone from its hook. The toll device may be located at the station of the calling line and require a tentative actuation by the calling subscriber before the automatic line switching mechanism at the central office may be operated by the calling subscriber to connect his line with the line of the subscriber with whom conversation is desired: and when the called subscriber answers, the toll device is finally operated to place the calling party to such expense. If the called line is busy, or for any reason the called party does not answer after being signaled a predetermined period, the toll device is operated and placed in normal condition without putting the calling subscriber to any expense.

My invention relates, more specifically, to an automatic telephone exchange system wherein the inter-connection of subscribers' lines is governed by the tentative payment or deposit of a coin in a collector at the calling station, and has for its object in this connection to provide an improved arrangement of circuits and apparatus whereby different final dispositions of such a coin are automatically effected upon the response of the called subscriber, the non-response of the called subscriber, and the busy condition of the called line, respectively.

In carrying out my invention, I may provide electromagnetic mechanism, operated upon the response of the called subscriber, for operating the coin collector at the calling station to finally deposit the coin therein in the cash box. In case the called line is busy, mechanism is automatically operated to cause the coin collector at the calling station to transfer the coin tentatively deposited into the refund chute leading to the refund tray on the outside of the box. This mechanism may be operated by the busy signal apparatus when the same is applied to the calling line, in the event that the called line is found busy. I also provide means, automatically operated in case the called subscriber fails to respond, adapted to effect the transfer of the said tentatively deposited coin, into the refund chute. The said means may be arranged to be operated after a ringing current has been applied to the called subscriber's line for a predetermined period. I may also cause a peculiar or distinctive "don't answer" signal to be impressed upon the line at the same time that the coin is refunded.

I will describe my invention more particularly by reference to the accompanying drawings, which represent diagrammatically an automatic telephone exchange system equipped with my invention, reserving, however, for the appended claims a statement of the parts, improvements and combinations which I deem novel with me.

In the drawings, Figure 1 is a diagram of an automatic telephone exchange system equipped with improvements embodying my invention; Fig. 2 is a simplified diagram to illustrate simply the operation of the improvements embodying my invention.

Similar letters of reference designate like parts throughout the several views.

Referring first to the simplified diagram, I will describe the embodiment of my invention, therein shown in skeleton. Two telephone lines are shown connected at the

central office by conductors *a b* and line switching mechanism of any desired type controlled from the calling station A. At the calling station is provided a coin collector C, of a well-known type, having a polarized magnet 11 in a branch 12 from the limb 1 of the line to earth, said magnet being unresponsive to the battery at the central office. The said magnet is provided with a tilting armature 13 carrying a pair of stops 15, 8, adapted to support a coin tentatively deposited in the collector; the stop 8 may form the member of a pair of contacts 8, 9 adapted to be closed by the coin, and which may control the operation of the line switching mechanism. The armature 13, when tilted in one direction, is adapted to withdraw the stop 15 from the path of the coin and allow the same to fall into a refund chute 16 leading to the outside of the coin collector; and when the armature is tilted in the opposite direction, it removes the stop 8 from the path of the coin and permits said coin to fall into chute 17 leading to a cash box 18. It will be understood that other forms of coin collectors than the one shown may be equally as well employed in connection with my invention.

At the central office is provided a relay 19 which receives current when the called subscriber removes his telephone from its hook in response to a call; said relay when energized applies current from a generator 20 of, for example, negative current, to the limb 1 of the calling line and operates the magnet 11 of the coin collector at the station of such line, to cause said magnet to tilt its armature 13 in a direction to remove the stop 8 from the path of the coin, and permit said coin to fall into the chute leading to the cash box. The armature 21 of relay 19 is connected with a conductor 22 leading to the limb 1 of the calling line, and said armature may carry a spring member adapted to make a momentary wiping contact with a movable contact connected with a conductor 23 leading to the free pole of a grounded generator 20. In case the called line were busy, a test relay 69 would operate before the continuity of the conductors *a b* was completed, and in addition to causing the restoration of the switching mechanism and the application of a busy test to the calling line, would serve to apply current from a grounded generator of, for example, positive current to the limb 1 of the calling line, operating magnet 11 of the coin collector, and causing said magnet to tilt its armature 13 in a direction to remove the stop 15 from the path of the coin and permit the coin to fall into the refund chute 16 leading to the outside of the box. The free pole of a grounded generator 24 is connected with a conductor 25 which leads through the armature 26 and normally-open front contacts of said test relay to the back contact of the armature 21 of relay 19. Thus when the test relay 69 is operated due to the busy condition of the called line, the armature 26 of said relay in its attractive movement permits current to flow from the generator 24 over conductor 25, armature 21 and back contact of relay 19, conductor 22 to the limb 1 of the line and to earth through the magnet of the coin collector at the calling station.

The magnet 27 is adapted to be included in the ringing circuit and to respond to the ringing current therein, to effect the connection of the generator 24 with the limb 1 of the line to operate the magnet 11 and refund the coin. The magnet 27 is adapted in response to the ringing current passing therethrough, to make and break a circuit 28 including a source of current and the stepping and retaining magnets of a gear 29 adapted through the agency of intermediate reduction gearing to advance a disk 30 carrying a cam 31 adapted when the disk has been advanced a predetermined distance, dependent upon the time it is desired to give the called subscriber in which to answer the call, to close a pair of contact springs 32, 33, and complete a branch 34^a around the armature 26 and its front contact of relay 69. Current may now flow from the generator 24 by way of conductors 34^a, 25 and 22 to limb 1 of the line, to operate the coin collector magnet and refund the coin. Said cam 31 may also a pair of contacts 35^a adapted to complete the continuity of a conductor 36^a leading from a special signal apparatus 37 to the limb 1 of the calling line, this signal indicating to the calling subscriber that the called party has failed to respond. The cam 31 may also when advanced the said predetermined distance, effect the restoration of the line switching mechanism; said cam may open a pair of contacts controlling the circuits of the retaining mechanism.

Turning now to Fig. 1, I will describe in detail a telephone exchange system equipped with improvements embodying my said invention. In said figure, two telephone lines are shown extending in limbs 1, 2 from substations A, B, respectively, to a central office, where each line is provided with line selecting and connecting mechanism. I will describe in detail the circuits and apparatus associated with the line of station A, it being understood that the line of station B is equipped in exactly the same manner; and for convenience of description I will consider station A as the calling station and station B as the called station.

At the substation is provided the usual telephone apparatus in a bridge of the limbs 1 2. A calling device 3 is provided at the substation, which may comprise a spring-

actuated arm 4 adapted to be set in a position representing the number of the line wanted, or a digit thereof, and to be returned under the influence of a spring to operate a gear 5 to cause the same to intermittently close a pair of contacts 6 7, a number of times dependent upon the adjustment of the arm 4. The arm 4 while away from normal position maintains open a pair of contact springs controlling the substation bridge of the line.

The contacts 6, 7 control the operation of the central office line selecting mechanism, these contacts being in turn controlled by a pair of normally-open contacts 8, 9, within the coin collector C, which are closed by a coin when tentatively deposited by a subscriber. The contact spring 7 is connected to earth, and the contact spring 6 is connected with a conductor 10 which leads through contacts 8, 9, within the collector, to the limb 2 of the line.

At the central office, the limbs 1 2 of the line may pass through the armatures c' c^2, respectively, of a cut-off relay c, to the contacts 34, 35, upon the rotatable selector arm 36, the limb 2 extending through a condenser, armature 37 and its normally-open front contact of relay 38, through the armature 39 and back contact of relay 40, to the selector contact 35, while the limb 1 extends through a condenser, armature 41 and back contact of relay 40, to the contact 34.

The third terminal 42 upon the selector arm is connected with a conductor 43 leading through the winding of relay 38 to ground, said relay 38 being preferably sluggish in its action. The contact arm 36 is arranged to sweep over terminals, which may be connected directly with telephone lines, or with trunk lines leading to other selecting mechanism. In the present case, for convenience of description and illustration, I have shown the terminals as representing telephone lines, that is, each line is provided with a set of three terminals, terminal 44 being connected with the limb 1 of the line, while the terminal 45 is connected with the limb 2 of the line. The local terminal 46 of the set is connected with the conductor 47, which leads through the cut-off relay c to the free pole of grounded battery 48. The limbs 1 2, are, of course, multiplied to contacts upon the different selectors S in the exchange.

The selector arm 36 may be mounted upon a vertical rotary shaft 49 provided with a ratchet 50 adapted to be engaged by a stepping pawl 51 operated by an electromagnet 52, said ratchet being provided with a retaining pawl 53 operated by a magnet 54. After the selector arm has been moved to the position opposite the desired set of line terminals, a magnet 55 is arranged to force the shaft 49 downwardly and bring the contacts upon the selector arm into engagement with the desired line terminals.

A relay 56, which controls the line selecting mechanism, is provided in a bridge 57 of the limbs 1 2 of the line, said bridge also including a battery 58, having its negative pole grounded, and a relay 59, said battery being interposed between the relays 56 59, with its positive or free pole connected with the limb 2 of the line. When the telephone is removed from its hook at the calling station A, a circuit is completed by way of the bridge 57 and limbs 12 for the relays 56 59, and current also flows from the free pole of battery 58 through bridge 57, limb 2 of the line, through the substation bridge closed by the telephone switch 60, to limb 1 of the line, and thence to earth through branch 12, which includes the electromagnet of the coin collector. The current from the said central office battery does not affect the magnet 11 of the coin collector.

The relay 56 is provided with a sluggish armature 61, which is adapted when attracted to close a shunt 62 about the cut-off relay C of the calling line, to prevent its improper actuation if such line should be selected and tested by another line during the conversation.

Line selecting operation.—The armature 63 of relay 56 controls the circuits of the line selecting mechanism, the armature being connected with the conductor 64, which extends to the free pole of battery 58, while the front contact of said armature is connected with a conductor 65, which leads through the retaining magnet 54 and stepping magnet 52 in series, through normally closed contacts 66 67 controlled by relay 55, through the armature 68 and back contact of busy test relay 69, to earth. A branch conductor 70 leads from conductor 65 through the winding of connecting magnet 55, through a pair of contacts 71, which are intermittently made and broken by the armature of the stepping magnet in its operation, back to the conductor 65. Said contacts 71 are arranged to prevent, while being rapidly made and broken, the energization of the connecting magnet 55, but when allowed to come to rest to permit sufficient current to flow to operate the magnet 55. The magnet 55 is provided with an armature 72 connected by a conductor 73 with the said conductor 70. Said armature, when attracted, forces the shaft 49 downwardly, and engages spring 67 to separate the same from its anvil 66, to thereby complete a circuit for magnet 55 independent of the contacts 71. The calling subscriber at station A, in initiating a call, deposits a coin in the collector C, which falls upon the stops 15 8, closing the contacts 8 9. He thereupon operates the calling device to make and break the contacts 6 7 a

predetermined number of times, dependent upon the number of the line desired, and a circuit is intermittently made and broken for the relay 56 at the central office, said circuit extending from the free pole of battery 58, through relay 56, bridge 7, limb 2 of the line, contacts 8 9 closed by the coin, through the contacts 6 7 of the calling device. Relay 56, in vibrating its armature 63, intermittently makes and breaks a circuit extending from the free pole of battery 58, conductors 64 and 65, through retaining magnet 54, and stepping magnet 52, through the springs 66 67, armature 68 and back contact of busy test relay 69 to earth. The retaining magnet 54 is operated to throw the pawl 53 into engagement with the ratchet 50, and also the stepping magnet 52 operates to rotate the shaft 49 and bring the selector arm into position opposite or over the set of terminals representing the line desired.

When the contact arm 4 of the calling device returns to normal position, after operating contacts 6 7, it closes again the metallic circuit of the limbs 1 2, maintaining the relays 56 59 energized, and current flows from the free pole of grounded battery 58 through conductors 64 65 70, through connecting magnet 55, contacts 71, which are now at rest, back to conductor 65 and thence to earth through the armature 68 and back contact of relay 69. Sufficient current now flows in this circuit to operate the connecting magnet 55, which attracts its armature 72, forcing the shaft 49 downwardly, and bringing the terminals 34 35 42 into engagement with the terminals 45 44 46 representing the called line. The armature 72 also engages contact spring 67, to separate the same from its anvil 66, and completes a circuit from conductor 65 through the connecting magnet 55, conductor 70, conductor 73, armature 72 of relay 55, and contact spring 67, back to conductor 65, and to earth independent of the contacts 71.

Test of called line.—The limb 2 of the line is normally open at the armature 37 and front contact of sluggish relay 38, which is included in the circuit above traced, and a testing conductor extends from the terminal 35 upon the selector arm, through the limb 2 of the line, to the armature 37 of relay 38, whose back contact is connected with a conductor 74 leading through a winding 75 of the busy test relay to earth. In case the called line is busy there will be potential upon the terminal 44 from the central office battery 58 by way of the substation of the line, and current will flow through the testing conductor and winding 75 of the test relay 69 to earth and energize said relay before the sluggish relay 38 has had time to respond to the current in the local circuit 47 43. The relay 68 when thus energized attracts its armature 68, opening the circuit 64—65—70—73—65 of the connecting magnet 55, and allowing the selector mechanism to be restored to normal condition by means of a suitable spring. Said relay 69 is also provided with an armature 76, which is connected with a conductor 77 leading to the front contact of an armature 78 of relay 56, said armature 78 being connected with the limb 1 of the line. The front contact of armature 76 of relay 69 is connected with a conductor 79 which leads through the winding 80 of relay 69, through the secondary winding of a busy tone apparatus 81, to the free pole of grounded battery 82. And when said relay 69 is energized, due to said testing current, and the armatures are given their initial attractive movement, current flows from the free pole of grounded battery 82 through the winding 80 of said relay, armature 78 and front contact of said relay 56 to limb 1 of the line, and thence by way of bridge 57 to earth, locking up the relay 69, whereupon busy test current is applied to the line, said current flowing from the secondary winding in conductor 79, through conductor 77, limb 1 of the line, through the substation apparatus, limb 2 of the line, bridge 57, to earth. The subscriber, upon hearing the busy tone in his telephone, hangs up his receiver 56, which retracts its armatures, the armature 78 opening the locking circuit of the busy tone relay 69 and restoring the same to normal position.

Refund of coin where called party's line is busy.—The relay 69, which operates when the called line is busy, is provided with an armature 26, adapted when attracted to complete the connection of positive generator 24 with the limb 1 of the line, by way of conductors 25, 22. Current from the positive generator 24 now flows to earth through the winding of the electromagnet 11 of the coin collector, operating the said magnet and causing the same to tilt its armature 13 in a direction to throw the coin into the refund chute 16.

Calling a free line where subscriber answers.—In the present condition, when the contacts upon the selector rest in engagement with the terminals of the called line, there is no potential present upon the contact terminal 44, and the testing conductor receives no current; the sluggish relay 38, however, which is included in the local circuit 43—47, completed by contacts 42, 46, is operated, and cuts off the conductor 74, which includes the winding 75 of the test relay, from the limb 2 of the line, at the same time completing the continuity of said limb. The relay 38 is provided with an armature 83 which is connected to ground, the front contact of said armature being connected with a conductor 84 which leads through the relay 40 to the free pole of a grounded battery 85, and said relay 38, when attracted, in case the

called line is free, completes a circuit to operate relay 40, which thereupon attracts its armatures 39, 41, whose front contacts form the terminals of a conductor 86, including a ringing generator 87 and the winding 88 of a relay 89. Thus, when the relay 40 is energized, ringing current flows from the upper pole, for example, of the generator 87 through the armature 41 and front contact of relay 40, line conductor 1, contacts 34, 45 upon the selector, limb 2 of the called line, thence through the bell at the substation of the called line, back over limb 1 of the called line, through the contacts 44, 35 of the selector, limb 1 of the calling line, armature 39 and front contact of relay 40, through the winding 88 of the relay 89, to the lower pole of the generator 87. The relay 89 is arranged to be unresponsive to the current flowing in the circuit just traced, owing to the high resistance in the line at the substation, but when the called subscriber responds by removing his telephone from its hook, a shunt is established about the bridge containing the bell and condenser at the substation, and the winding 88 is enabled to energize the magnet 89 sufficiently to attract its armatures 90, 91. The front contact of armature 90 of relay 89 is included in a conductor 91, which leads from the free pole of grounded battery 85, through a low resistance winding 92 of relay 89, while the armature 90 is connected with a conductor 93, which leads through the armature 94 and front contact of relay 59 to the bridge 57 and earth. The conductors 91, 93 and 57 act as a shunt about relay 40, to cause the same to retract its armatures 39, 41, and break the ringing circuit above traced, the relay 89 being locked up by means of its winding 92 included in said shunting circuit. A bridge 95 of the limbs 1, 2 of the line is provided between the condensers and the contacts upon the selector, said bridge containing a battery 96 between impedance coils to furnish the talking current required by the called station for transmission purposes. The armature 91 of relay 89 is connected by conductor 22 with limb 1 of the calling line, and is adapted in attracting to complete momentary contact between a pair of wiping contacts to connect the conductor 23 including grounded negative generator 20 with conductor 22 and limb 1. A momentary impulse of current from said generator now flows to earth through the magnet 11 of the coin collector, operating said magnet to cause the same to tilt its armature in a direction to throw the coin into the chute 17 leading to the cash box.

Refund of coin where called subscriber fails to answer.—The magnet 27 in the ringing circuit in response to the ringing current, operates the magnets of the stepping mechanism, and if the called subscriber does not answer before the advancing disk operates its springs, the coin will be refunded, the switching mechanism restored to normal position, and a "don't answer" signal given to the calling subscriber. The cam 31 is adapted, when the called subscriber has been signaled a predetermined length of time, to close contacts 32, 33, which connect the positive generator 24 by way of conductors 25, 34^a, 22 with limb 1, whereupon the coin collector is operated as already described.

While, for convenience of illustration, a number of batteries are shown in the drawing, it will be understood that in practice these may be and usually are, one and the same.

It will be understood, that while for convenience of illustration and description, I have shown an embodiment of my invention applied to a small system, the invention may be equally applicable to many other systems, both large and small; and I do not desire to be understood as limiting the application of my invention to any particular automatic telephone exchange system.

I claim:—

1. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line having a coin controlled magnet connected with said line, automatic line switching mechanism operable upon the tentative deposit of a coin in said collector, for uniting said lines, a generator at the central office for operating said magnet, a source of ringing current, means automatically operated upon the connection of said lines for applying said ringing current to the called line, a relay in said ringing circuit unresponsive to said current while the normal high resistance is included in the called line at the station thereof, said relay responding when said resistance is shunted by the removal of the called subscriber's telephone, and means controlled by said relay for connecting said generator with the called line.

2. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line having a coin controlled magnet connected with said line, automatic line switching mechanism operable upon the tentative deposit of a coin in said collector, for uniting said lines, a generator at the central office for operating said magnet, a source of ringing current, means automatically operated upon the connection of said lines for applying said ringing current to the called line, a relay in said ringing circuit unresponsive to said current while the normal high resistance is included in the called line at the station thereof, said relay responding when said resistance is shunted out by the removal of the called

subscriber's telephone, means controlled by said relay for connecting said generator with the called line, and means controlled by said relay for cutting off said ringing current from the called line.

3. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line having a coin controlled magnet connected with said line, automatic line switching mechanism operable upon the tentative deposit of a coin in said collector, for uniting said lines, a generator at the central office for operating said magnet, a source of ringing current, means automatically operated upon the connection of said lines for applying said ringing current to the called line, a relay in said ringing circuit unresponsive to said ringing current while the normal high resistance is included in the called line at the station thereof, said relay responding when said resistance is shunted out by the removal of the called subscriber's telephone, and a pair of wiping contacts operated by said relay in responding to connect said generator momentarily with the calling line.

4. The combination with a calling and a called telephone line, of a coin collector associated with the calling line at the station thereof, automatic line switching mechanism, operable upon the tentative deposit of a coin in said collector, for completing the connection of said lines, and means automatically operated in case said line is busy, for operating said coin collector to refund said coin.

5. The combination with a calling and a called telephone line, of a coin collector associated with the calling line at the station thereof, automatic line switching mechanism, operable from the calling station, upon the tentative deposit of a coin in said collector, for connecting said lines, a test relay operated in case the called line is busy, and means controlled by said relay for operating said coin collector to refund said coin.

6. The combination with a calling and a called telephone line, of a coin collector at the calling station having a coin-distributing magnet connected with the line, automatic line switching mechanism, operable from the calling station upon the tentative deposit of a coin in said collector, for connecting said lines, a test relay, a circuit therefor completed in case the called line is busy, a source of current adapted to operate said magnet to refund said coin, and means controlled by said test relay for connecting said source of current with said calling line.

7. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station, automatic line switching mechanism at the central office, operable from the calling station upon the tentative deposit of a coin in said collector, for uniting said lines, a busy signal apparatus automatically applied to the calling line in case the called line is busy, and means controlled by said busy signal apparatus in operating, adapted to actuate said coin collector and refund said coin.

8. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station, automatic line switching mechanism at the central office, operable from the calling station upon the tentative deposit of a coin in said collector, for uniting said lines, a busy signal apparatus automatically applied to the calling line in case the called line is busy, and means controlled by said busy signal apparatus in operating, adapted to actuate said coin collector and refund said coin, and means controlled by said busy signal apparatus, for restoring said line switching mechanism to normal condition.

9. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station having a polarized coin-distributing magnet connected with the line, automatic line switching mechanism, operable from the calling station upon the tentative deposit of a coin in said collector, for connecting said lines, sources of current of opposite polarity at the central office, means, automatically operated in case the called subscriber answers, for connecting one of said sources with the calling line to operate said magnet and finally deposit said coin, and means, automatically operated in case the called subscriber's line is busy, for connecting said other source of current with the calling line to operate said magnet and refund said coin.

10. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station having a polarized coin-distributing magnet connected with the line, automatic line switching mechanism, operable from the calling station upon the tentative deposit of a coin in said collector, for connecting said lines, sources of current of opposite polarity at the central office, a relay adapted to connect one of said sources with the calling line to operate said magnet and deposit said coin, a circuit for said relay completed upon the response of the called subscriber, a test relay adapted to connect said other source of current with the calling line to operate said magnet and refund said coin, and a circuit for said test relay completed in case the called line is busy.

11. The combination with a calling and a

called telephone line, of a toll device associated with the calling line at the substation thereof, automatic line switching mechanism, operable upon the tentative actuation of said toll device, for completing the connection of said lines, and means, automatically operated, in case the called subscriber fails to respond to the call, for restoring said toll device to normal condition without placing said calling party to expense.

12. The combination with a calling and a called telephone line extending from substations to a central office, of a toll device associated with the calling line at the substation thereof, automatic line switching mechanism, operable upon the tentative actuation of said toll device, for completing the connection of said lines, means, automatically operated, in case the called subscriber fails to respond to the call, for restoring said toll device to normal condition without placing said calling party to expense, and means automatically operated upon the response of the called subscriber for operating said toll device to place the calling subscriber at expense.

13. The combination with a calling and a called telephone line extending from substations to a central office, of a toll device associated with the calling line at the substation thereof, automatic line switching mechanism, operable upon the tentative actuation of said toll device, for completing the connection of said lines, means, automatically operated, in case the called subscriber fails to respond to the call, for restoring said toll device to normal condition without placing the said calling party to expense, and means, automatically-operated upon the response of the called subscriber, for operating said toll device to place the calling subscriber at expense, and means, automatically-actuated in case the called line is busy, for operating said toll device without placing said calling subscriber to expense.

14. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line, automatic line switching mechanism, operable upon the tentative deposit of a coin in said collector, for completing the connection of said lines, and means, automatically operated in case the called subscriber fails to respond after a predetermined period, for operating said coin collector to refund said coin.

15. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line, automatic line switching mechanism, operable upon the tentative deposit of a coin in said collector, for completing the connection of said lines, means for automatically applying ringing current to the called line upon the completion of connection therewith, and means, automatically operated, in case the called subscriber fails to respond after said ringing current is applied a predetermined period, for operating said coin collector to refund said coin.

16. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the called line, automatic line switching mechanism, operable upon the tentative deposit of a coin in said collector, for completing the connection of said lines, means for applying ringing current to the called line, stepping mechanism operated by said ringing current, and means operated by said stepping mechanism after a predetermined period, for operating said coin collector to refund said coin.

17. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station having a coin-distributing magnet connected with the line, automatic line switching mechanism, operable from the calling station, upon the tentative deposit of a coin in said collector, for connecting said lines, a source of current at the central office adapted to operate said magnet to refund said coin, and means, automatically operated in case the called subscriber fails to respond, for connecting said source of current with the calling line.

18. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station having a coin-distributing magnet connected with the line, automatic line switching mechanism, operable from the calling station, upon the tentative deposit of a coin in said collector for connecting said lines, a source of current at the central office adapted to operate said magnet to refund said coin, means for applying ringing current to the called line, a relay in said ringing circuit, and means operated by said relay after the called subscriber has been rung a predetermined period and fails to answer, adapted to connect said source of current with the calling line.

19. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station having a coin-distributing magnet connected with the line, automatic line switching mechanism, operable from the calling station, upon the tentative deposit of a coin in said collector, for connecting said lines, a source of current at the central office adapted to operate said magnet to refund said coin, means for applying ringing current to the called line, a relay in said ringing circuit responsive to said ringing current, and electromagnetic stepping mechanism op-

erated by said relay, said mechanism being adapted when ringing current has been applied to the called line a predetermined period, to connect said source of current with the calling line.

20. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the calling station having a coin-distributing magnet connected with the line, automatic line switching mechanism, operable from the calling station, upon the tentative deposit of a coin in said collector, for connecting said lines, a source of current at the central office adapted to operate said magnet to refund said coin, means for automatically applying ringing current to the called line upon the completion of connection therewith, a relay in said ringing circuit, a circuit closing device, stepping mechanism therefor, operating magnets for said mechanism, a circuit for said magnets intermittently made and broken by said relay, and a connection of the said source with the calling line completed by said circuit closing device when advanced a predetermined distance.

21. The combination with a calling and a called telephone line, of a toll device associated with the calling line at the substation thereof, automatic line switching mechanism, operable upon the tentative actuation of said toll device, for completing the connection of said lines, and means, automatically operated, in case the called subscriber fails to respond to the call, for restoring said toll device to normal condition without placing said calling party to expense, and a characteristic signal applied to the calling line in case said called party fails to respond.

22. The combination with a calling and a called telephone line, of a toll device associated with the calling line at the substation thereof, automatic line switching mechanism, operable upon the tentative actuation of said toll device, for completing the connection of said lines, and means automatically operated, in case the called subscriber fails to respond to the call for restoring said toll device to normal condition without placing said calling party to expense, and means actuated upon the failure of said called party to respond, for restoring said switching mechanism to normal condition.

23. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line, a coin-distributing magnet for said coin collector connected with the calling line, automatic line switching mechanism at the central office for completing connection between said lines, means at the central office for actuating said coin collector magnet to deposit a coin tentatively deposited therein, and means at said central office for actuating said magnet to refund said coin.

24. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line, a polarized coin-distributing electromagnet for said coin-collector connected with the calling line, automatic line switching mechanism at the central office for completing the connection of said lines, sources of current at the central office of opposite polarity, means at the central office for applying current from one of said sources to the calling line to actuate said magnet and deposit a coin tentatively deposited in said collector, and means at said central office for applying current from said other source to the calling line to actuate said magnet and refund said coin.

25. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line, a coin-distributing electromagnet for said collector connected with the calling line, automatic line switching mechanism at the central office, operable upon the tentative deposit of a coin in said collector, for completing connection between said lines, means at the central office for actuating said magnet, in case the called party responds, to deposit said coin, and means at said central office for actuating said magnet, in case connection cannot be had with the called party, to refund said coin.

26. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line, a coin-distributing electromagnet for said collector connected with the calling line, automatic line switching mechanism at the central office, operable upon the tentative deposit of a coin in said collector, for completing connection between said lines, means at the central office for actuating said magnet, in case the called party responds, to deposit said coin, and mechanism at said central office, automatically operated in case the called party fails to answer, or his line is busy, for actuating said magnet to refund said coin.

27. The combination with a calling and a called telephone line extending from substations to a central office, of a coin collector at the substation of the calling line, a polarized coin distributing electromagnet for said coin collector connected with the calling line, automatic line switching mechanism at the central office for completing connections between said line after the tentative deposit of a coin in said collector, sources of current of opposite polarity at the central office, automatic mechanism at the central office, operated upon the response of the called sub-

scriber, for applying current from one of said sources to the calling line to actuate said magnet and deposit said coin, and means for applying current from said other source to the calling line to actuate said magnet and refund said coin.

In witness whereof, I hereunto subscribe my name this 13th day of October A. D., 1906.

WINFIELD W. LEACH.

Witnesses:
A. H. Moore,
G. Filippi.