Dec. 27, 1938. C. E. LOMAX 2,141,476

TELEPHONE SYSTEM

Filed Nov. 18, 1935

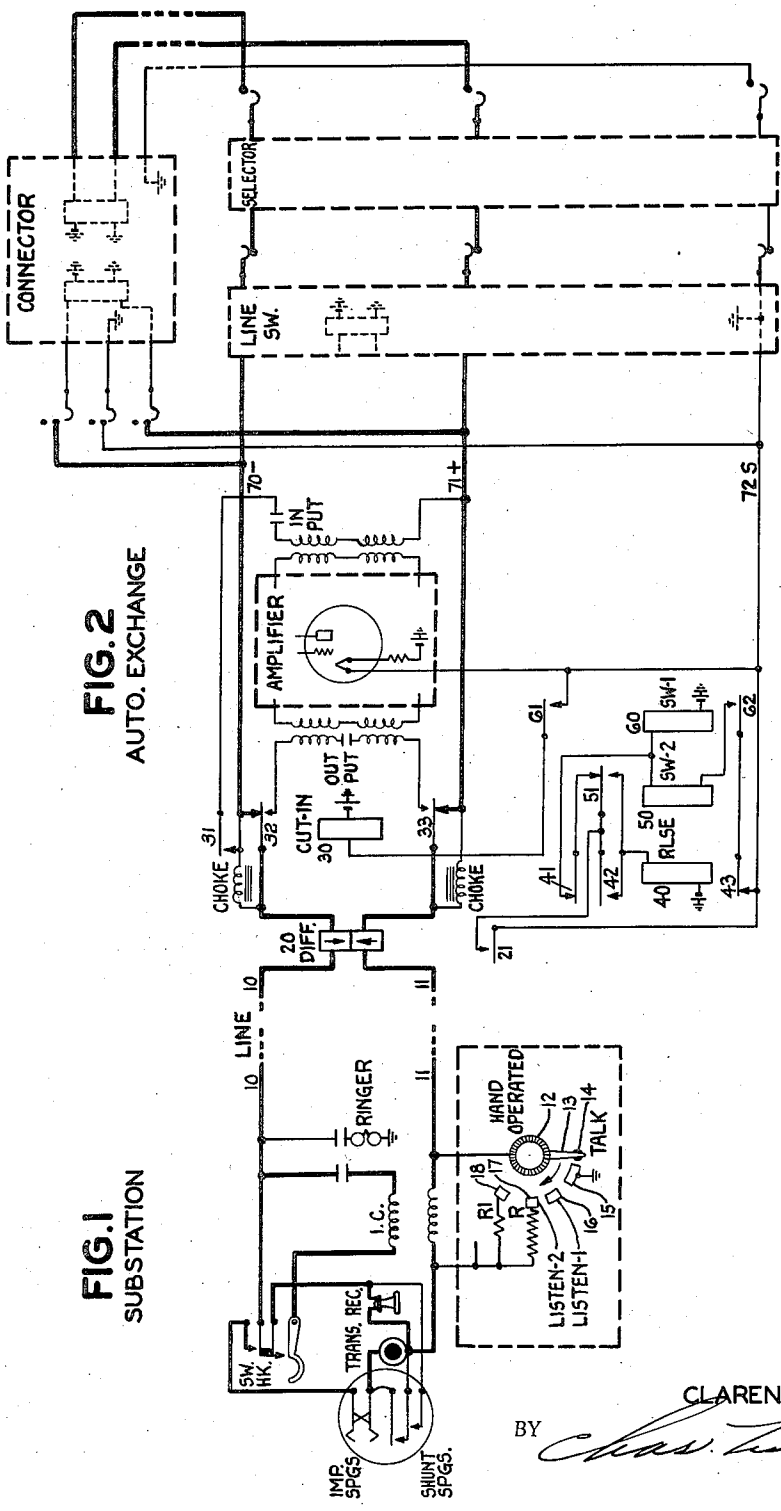


FIG. 2
AUTO. EXCHANGE

FIG. 1
SUBSTATION

INVENTOR.
CLARENCE E. LOMAX
BY Chas. Tu. Candy
ATTORNEY.

Patented Dec. 27, 1938 2,141,476

UNITED STATES PATENT OFFICE

2,141,476

TELEPHONE SYSTEM

Clarence E. Lomax, Oak Park, Ill., assignor to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application November 18, 1935, Serial No. 50,257

10 Claims. (Cl. 179—18)

This invention relates in general to telephone systems and more particularly to a switching arrangement under control of a subscriber for amplifying received speech currents.

In accordance with the present invention an amplifier is provided at the main exchange individual to the subscriber's line and the subscriber's substation is provided with a switch for controlling switching means at the exchange for cutting in and cutting out the amplifier.

Heretofore, in case a certain subscriber desired to have the received speech currents amplified, an amplifier and a switching arrangement was provided at the substation set and by means of a key the subscriber switched the amplifier in and out of the circuit at will. The installation of the amplifying arrangement at the substation has many disadvantages in that it requires a special wiring arrangement and apparatus which the average repair man cannot maintain and properly adjust.

It is more advantageous to install the amplifier at the main exchange because it is more economical, can be readily adjusted by a skilled person, and is less apt to be tampered with or stolen.

The object of the invention is to place an amplifier at the main exchange for amplifying speech currents transmitted to a subscriber's line and to provide means at the subscriber's substation for cutting in and cutting out the amplifier at will.

A feature of the invention relates to the circuit arrangement for enabling the subscriber to control the inclusion or exclusion of the amplifier in the circuit over only the two line conductors connecting the substation to the main exchange.

A further feature relates to the subscriber controlled means for reducing the current to the transmitter so the signals in the receiver can be amplified without causing howling between the transmitter and receiver.

Another feature relates to the means at the substation for grounding one of the line conductors to place the remote amplifier in or out of the circuit in combination with the circuit arrangements whereby the connection of this ground is ineffective until a loop circuit is closed over the two line conductors of the subscriber's line.

These and other features of the invention will be apparent from the following description of the drawing.

Fig. 1 shows the subscriber's substation provided with a hand operated switch and the two line conductors extending to the main exchange.

Fig. 2 shows the apparatus at the main office.

Referring now to Fig. 1, the substation circuit shown is substantially the same as that shown and described in Patent No. 1,657,635, issued January 31, 1928, to T. G. Martin. Associated with this substation circuit is a switch having a hand operated knurled knob 12 for rotating wiper 13 over the talk segment 14, grounded segment 15, first listening position segment 16, and other listening segments 17 and 18. The wiper 13 is electrically connected to the lower line conductor 11 and the listening segments 17 and 18 are connected by way of varying resistances R and R1 as shown. When wiper 13 is stopped on segment 17 the resistance R is connected in shunt of the lower winding of the induction coil IC. In a similar manner wiper 13 and segment 18 connect the resistance R1 in shunt of the lower winding of induction coil IC. Additional shunt circuits could be added for reducing the volume, if desired.

In Fig. 2 the subscriber's line conductors 10 and 11 terminate in an individual amplifying unit comprising a standard well-known amplifying arrangement, switching control relays 20, 30, 40, 50, and 60, and two choke coils. The line conductors 10 and 11 extend through both windings of the differential relay 20 and normally over back contacts of the cut-in relay 30 to the line switch indicated by the rectangle. The line switch has access to first selector switches which in turn have access to connector switches or second selectors dependent upon the capacity of the automatic system. The line switches, selector, and connectors are of the well-known type used in automatic telephone systems. Only the battery feed relays and the busying arrangement of the connector switches are diagrammatically shown.

In order to describe the invention it will be assumed that the subscriber removes the receiver to initiate a call. In response to the removal of the receiver the line relay in the line switch is operated over the subscriber's loop in the usual manner; the battery and ground connections being furnished from the line switch. The subscriber's loop in this case includes conductors 70 and 71, back contacts and armatures 32 and 33, and the upper and lower windings of differential relay 20. Relay 20 does not operate over this circuit because both windings oppose each other.

In response to the operation of the line switch line relay, ground is connected in the usual manner to lead 72 to busy the line and to light the filament of the amplifier tube, and the line switch

is operated in the well-known manner to select an idle first selector switch.

The subscriber now operates the calling device in accordance with the digits of the called subscriber to operate the selector and connector switches to complete the connection to the called line in the well-known manner. When the called party answers the talking circuit is completed over the heavy talking conductors through back contacts and armatures 32 and 33 and the windings of differential relay 20; talking battery being furnished through the windings of the line relay in the connector. The called party talking battery is furnished through the windings of the back bridge relay in the connector. The preceding operations are old and well-known and have been briefly described to illustrate the circuits when the amplifier is not in use.

Assuming now that the subscriber at the substation is hard of hearing and desires to cut in the amplifier. The subscriber turns the knurled knob 12 and wiper 13 in the direction of the arrow to segment 16 on the first listening position. When wiper 13 engages the elongated grounded segment 15, the differential relay 20 is energized because the lower winding is shunted from ground at the substation, segment 15, wiper 13, conductor 11, lower winding of relay 20, armature 33 and back contact, conductor 71, through the switches to ground through the lower winding of the battery feed relay. At armature 21 relay 20 completes the circuit for energizing relay 60 as follows: from grounded conductor 72, armature 21, armature 51 and back contact, armature 41, and through the winding of relay 60 to battery. Relay 60 energizes and at armature 61 connects grounded conductor 72 to cut-in relay 30 to cause the latter relay to energize. At armature 62 relay 60 prepares the circuit for relay 50 but this relay cannot energize because it is short-circuited. When wiper 13 passes off of grounded segment 15 differential relay 20 is again balanced and therefore deenergizes. At armature 21 relay 20 opens the short circuit around relay 50 whereupon relay 50 now energizes in series with relay 60. Relay 50 is energized and relay 60 is maintained energized over the following circuit: from grounded conductor 72, armatures 43 and 62 and through the windings of relays 50 and 60 in series to battery. At armature 51 relay 50 opens the original circuit of relay 60 at its back contacts and at its front contacts prepares the circuit for release relay 40.

Cut-in relay 30, upon energizing, cuts in the amplifier by connecting the conductors 70 and 71 to the input circuit at armature 31, by disconnecting conductors 70 and 71 from armatures 32 and 33, and by connecting the out-put circuit of the amplifier to the subscriber's line conductors 10 and 11 by way of the front contacts of armatures 32 and 33. Speech current transmitter over conductors 70 and 71 is now amplified and transmitted over conductors 10 and 11 to the substation receiver. The choke coils are provided to prevent the A. C. speech currents from being transmitted back over conductors 70 and 71 while at the same time provide circuits over which the differential relay 20 may be controlled.

In case the volume is too loud or the transmitter and receiver howl, the subscriber by further rotating wiper 13 can place a resistance R or R1 in shunt of the lower winding of the induction coil IC. Since these resistances vary, the volume can be reduced as desired by this shunting arrangement.

Since the amplifier provides only one way amplification, the subscriber at the substation, in order to talk, must return the hand operated switch 12 and wiper 13 to its normal or talk position 14. In response to restoring wiper 13 to talk position 14, wiper 13 again encounters grounded segment 15 for a sufficient time to allow the unbalancing and operation of differential relay 20. Ground at the substation through segment 15, wiper 13 and conductor 11, extends through the lower winding of relay 20, the lower choke coil and over conductor 70 to ground through the lower windings of the battery feed relay for shunting the lower winding of relay 20. The upper winding of relay 20 is energized from ground over the substation loop to conductor 10, upper winding of relay 20, upper choke coil, conductor 70, to battery through the upper winding of the battery feed relay. Relay 20, upon operating, at armature 21 completes the circuit for energizing release relay 40 as follows: from grounded conductor 72 armature 21, armature 51 and front contact, and winding of release relay 40 to battery. At armature 42 relay 40 completes a locking circuit for itself and at armature 43 opens the circuit of relays 50 and 60, which deenergize. At armature 61 relay 60 opens the circuit of cut-in relay 30 which deenergizes to disconnect the amplifier. At armature 51 relay 50 prepares the circuit to relay 60. When wiper 13 leaves segment 15 the differential relay releases armature 21 to release relay 40 thereby restoring the circuits to normal. The subscriber now talks over the heavy conductors in the usual manner. From the foregoing it will be seen that the amplifier may be cut-in and cut-out of the circuit whenever desired by the operation of the switching device at the substation.

In case the substation in Fig. 1 is called the amplifier may be operated in the same manner as previously described.

It should be noted that the switching device at the substation is connected to the lower talking conductor or the conductor which is normally connected to ground at the main exchange, so that the ground at the substation is only effective to control the amplifier circuits at a time when the receiver is removed and the subscriber's loop is closed over the line conductors 10 and 11.

What is claimed is:

1. In a telephone system, a main exchange, a calling subscriber's substation, a subscriber's line connecting the substation to said exchange, means at said exchange controlled from said calling subscriber's substation for extending said line to another subscriber's line, an amplifier at the main exchange, and means at the substation controlled at will by said calling subscriber for momentarily grounding one of the line conductors of said line to bring the amplifier into circuit at any time to amplify the incoming voice currents to said line.

2. In a telephone system, a main exchange, a subscriber's substation, a subscriber's line connecting the substation to said exchange, an amplifier at the main exchange, means at the substation controlled at will by a calling subscriber for momentarily grounding one of the line conductors of said line to bring the amplifier into circuit at any time to amplify the incoming voice currents to said line, and means including said last means operated responsive to a second momentary grounding of said line conductor for cutting said amplifier out of circuit with said line.

3. In a telephone system, a main exchange, a

subscriber's line connected to said exchange, means at the exchange controlled by the subscriber on said line for establishing a connection with a wanted subscriber including a talking circuit arranged for non-amplified transmission, a holding circuit including said talking circuit for maintaining said established telephone connection, an amplifier at the exchange, means for switching from said normal talking circuit to an amplified talking circuit including said amplifier for amplifying incoming voice currents to said line, choke coils included in said holding circuit to maintain the connection and for preventing the amplified voice currents from being transmitted back in the reverse direction in response to the operation of said means, and subscriber controlled means for at will operating said switching means over the subscriber's line to connect said amplified talking circuit or said normal talking circuit to said established connection.

4. In a telephone system, a main exchange, a subscriber's line connected to said exchange, an amplifier at the exchange normally disconnected from in circuit with said line, means controlled by the subscriber on said line for establishing a connection including a normal two-way talking circuit for transmitting incoming and outgoing voice currents over said line, means for switching from said normal talking circuit to an amplifier talking circuit including said amplifier to amplify incoming voice currents to said line, means for preventing the amplified incoming voice currents from being transmitted back over the incoming path, and subscriber controlled means for controlling said switching means over said subscriber's line at will to disconnect the normal talking circuit from said connection and to connect said amplifier to said connection while said connection is established.

5. In a telephone system, a main exchange, a calling subscriber's line connected in a talking connection through said exchange with a wanted subscriber, an amplifier at the main exchange, switching means at the exchange, a relay at the exchange, means at said calling subscriber's station actuated at will by the calling subscriber for operating said relay once for each actuation of said means to control the operation of said switching means, said switching means operatively connecting the amplifier in circuit with said connection to amplify the voice currents incoming to said line in response to the first actuation of said station means and relay and disconnecting the amplifier from in circuit with said connection in response to the second actuation of said station means and relay while the said connection is maintained.

6. In a telephone system, a main exchange, a calling subscriber's line connected in a talking connection through said exchange with a wanted subscriber, an amplifier at the main exchange, switching means at the exchange, a relay at the exchange, means at said calling subscriber's station actuated at will by the calling subscriber for operating said relay once for each actuation of said means to control the operation of said switching means, said switching means operatively connecting the amplifier in circuit with said connection to amplify the voice currents incoming to said line in response to the first actuation of said station means and relay and disconnecting the amplifier from in circuit with said connection in response to the second actuation of said station means and relay, and means whereby said station means is effective for operating said relay while said connection is maintained.

7. In a telephone system, a main exchange, a subscriber's line terminating in said exchange, an amplifier at the main exchange, a connecting relay for said amplifier, a normal non-amplified two-way talking circuit including back contacts on said connecting relay and said line; an amplified talking circuit including said line, said amplifier, and front contacts on said connecting relay for amplifying incoming voice currents to said line; and means individual to said line operated at the will of the subscriber thereon for operating said connecting relay to complete either talking circuit after a connection is established between said line and a called subscriber's line.

8. In a telephone system, a main exchange, a subscriber's line terminating in said exchange, an amplifier at the main exchange, a connecting relay for said amplifier, a normal non-amplified two-way talking circuit including back contacts on said connecting relay and said line; an amplified talking circuit including said line, said amplifier, and front contacts on said connecting relay for amplifying incoming voice currents to said line; means individual to said line operated at the will of the subscriber thereon for operating said connecting relay to complete either talking circuit after a connection is established between the subscriber on said line and a wanted subscriber, and choke coils connected in shunt of said back contacts on said connecting relay for preventing the amplified incoming voice currents from feeding back over the talking circuit.

9. In a telephone system, a main exchange, a calling subscriber's substation, a line connecting the substation to said exchange, an amplifier at the main exchange, means at the substation controlled at will by the calling subscriber for momentarily grounding one of the line conductors of said line, a differential relay normally connected in series with both line conductors of said line and operated in response to the grounding of one line conductor, and means controlled by the operation of said differential relay for bringing said amplifier into circuit to amplify the incoming voice currents to said line.

10. In an automatic telephone system, an exchange, a calling subscriber's line terminating in said exchange, means at said exchange controlled by said calling subscriber for completing a normal talking connection between said calling subscriber and a desired called subscriber, an amplifier included in said means normally disconnected from said normal talking connection; a switch operated at will by said calling subscriber for controlling the connecting of said amplifier in series with said normal talking connection to amplify the voice currents received by the calling subscriber, for varying the volume of the voice currents received by the calling subscriber, and for disconnecting the amplifier from the normal talking connection; said switch controlling operations only effective during the time said connection is established.

CLARENCE E. LOMAX.