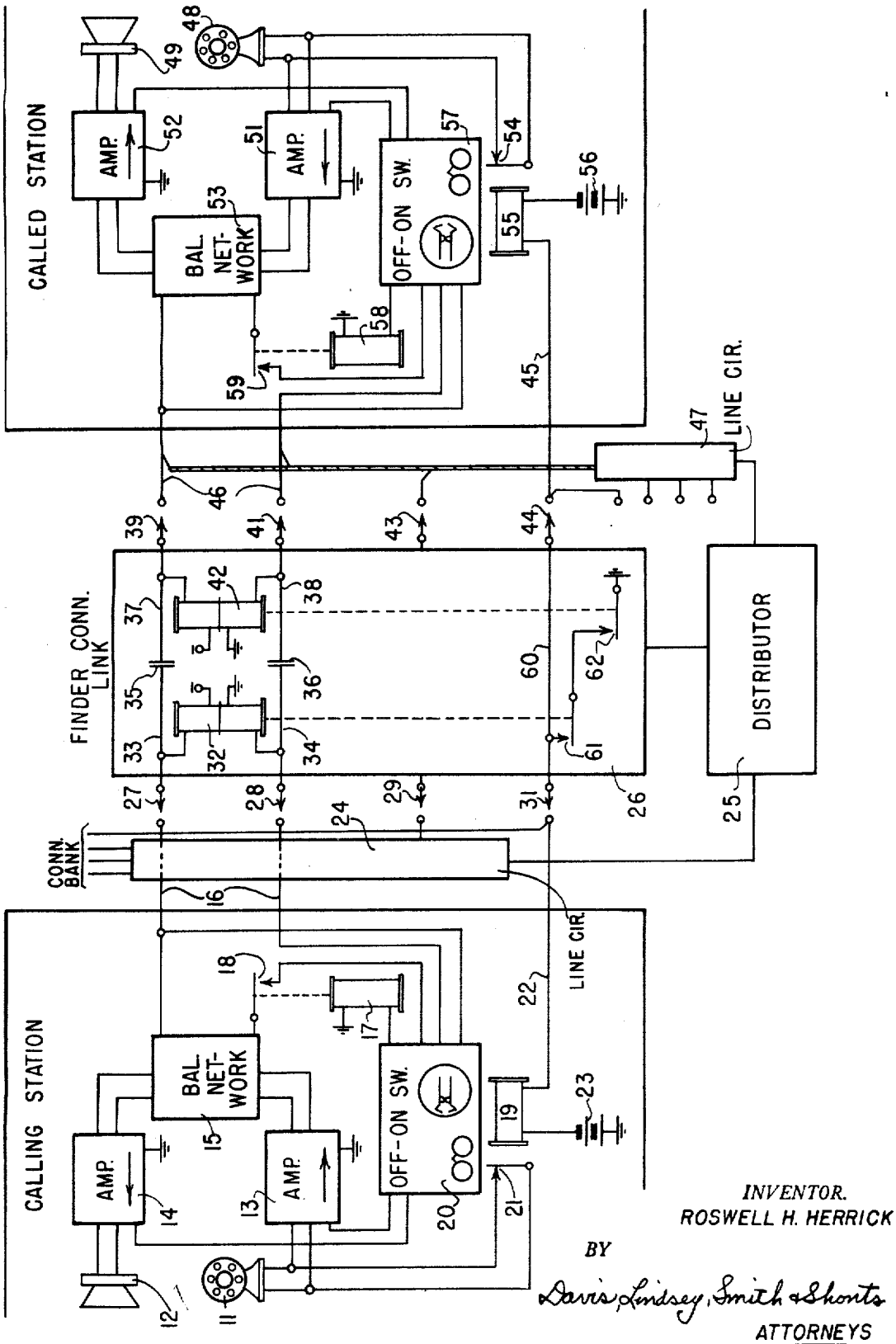
Feb. 13, 1945. R. H. HERRICK 2,369,352

TELEPHONE SYSTEM

Filed May 21, 1943



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Patented Feb. 13, 1945

2,369,352

UNITED STATES PATENT OFFICE

2,369,352

TELEPHONE SYSTEM

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Application May 21, 1943, Serial No. 487,869

13 Claims. (Cl. 179—1)

The present invention relates generally to improvements in telephone systems having telephone substation circuits incorporated therein coupled to signal current channels for the transmission of incoming and outgoing signal currents, and, more particularly, to improvements in such telephone systems for preventing interaction between the signal channels at a substation during the interval in which a substation is calling another substation.

In numerous installations the telephone substation circuit is provided with incoming and outgoing channel amplifiers to provide loudspeaking telephone communication. In the usual telephone substation circuit a balancing network is provided for preventing signal currents developed during the operation of the transmitter from being transmitted to the receiver and for similarly preventing signal currents incoming over the line extending to the substation from being transmitted to the transmitter. In such an arrangement one of the factors which determines the efficiency of sidetone suppression is the impedance of the talking circuit established by way of two connected subscriber lines. Since this impedance is not the same for any two different established connections, the balancing network of each substation is usually adjusted to provide maximum sidetone suppression efficiency for average line conditions. In those substation circuits which are provided with amplifiers for incoming and outgoing signal currents, the conditions of unbalance introduced in the substation circuit by the impedances of the lines over which the established connection extends may become intolerable. This is particularly true in an exchange area where the subscriber lines are of widely different lengths.

In order to obviate or minimize the interaction between the incoming and outgoing channel amplifiers which may result due to unbalance of the substation circuit occasioned by unfavorable line conditions, signal control switching means may be provided in the substation circuit for use during normal communication periods for selectively blocking the channel not in use. Such signal control switching means, however, are not effective during the interval in which a substation subscriber is calling another substation. Furthermore, the balancing network is not effective until connection has been completed at a called subscriber station. The substation circuit during the calling interval therefore is unbalanced to such an extent as to permit interaction between the incoming and outgoing channel amplifiers which produces a sound generally referred to as "howling." While "howling" occurs only during the calling interval and ceases as soon as a called substation answers, this condition may be particularly annoying to a subscriber even though it does not persist for any great length of time and it does not impair communication between substations after the called substation has responded to the call. Accordingly, it would be desirable to provide some means for obviating the possibility of interaction between the incoming and outgoing channel amplifiers at a subscriber station during the calling period.

It is an object of the present invention to provide an improved telephone system of the character described, wherein at least one of the communication channels at the subscriber station is disabled sufficiently to prevent interaction between the incoming and outgoing channel amplifiers.

It is another object of this invention to provide an improved telephone system of the character described with means for initially disabling at least one of the channel amplifiers at a substation together with means responsive to the completion of a connection at a called substation for rendering ineffective the disabling action.

It is a further object of this invention to provide an improved automatic telephone system having substations provided with loudspeaking communication channels with circuit means controlled at the telephone exchange which disable one of the communication channels at a subscriber station during the calling interval and which, in response to a response received from a called substation, restore the disabled channel to normal operating condition.

A still further object of the present invention is to provide an improved telephone system of the character having substations provided with loudspeaking communication equipment with circuit means interconnecting said substation with a telephone exchange which during the calling interval prevent interaction between the incoming and outgoing and loudspeaking equipment at a substation and in response to the completion of a connection at a called substation restore the substation equipment to normal operating condition.

The present invention is readily applicable to telephone substation circuits of various types having incoming and outgoing channel amplifiers to provide loudspeaking telephone communica-

tion. Some substation circuits provide only loudspeaking communication service and others provide a selection between the loudspeaking telephone and the conventional telephone. The invention is also applicable to those substation circuits wherein the amplifiers are completely disabled or blocked, or disabled to a certain degree when not in use during normal communication periods. The present invention operates to prevent interaction between the incoming and outgoing signal channels which may result in a condition commonly known as howling during a calling interval.

In accordance with the present invention means are provided for normally disabling at least one of the communication channels at a substation so that during a calling interval there is no possibility of interaction between the incoming and outgoing channel amplifiers which might result in a condiiton of howling. Although both channel amplifiers may be disabled, it generally is sufficient to apply a disabling action to one of the channel amplifiers which may be accomplished by applying a bias sufficient to reduce the gain level thereof or by a simple expedient, such as short-circuiting the transmitter, the loudspeaker, or the input circuit of the outgoing channel amplifier. While certain advantages may be obtained by the application of one or the other of the alternatives referred to, it is believed that these are not necessary for a complete understanding of the present invention and, hence, one method of disabling, as by short-circuiting the transmitter, is intended to indicate any one of these alternatives. Accordingly, the transmitter or microphone is normally short-circuited by a pair of contacts which may be opened by a relay. This relay is arranged to be controlled by apparatus normally found at an automatic telephone exchange. Such apparatus may comprise the talking battery-feed circuit relays which may be provided with auxiliary contacts connected in series with a circuit interconnecting the exchange with the relay at a substation which, when energized, is effective to enable the disabled equipment. The relays referred to at the central station are preferably one or more relays which are operated so as to complete a circuit in response to the completion of a circuit at a called substation. The control circuit interconnecting the substation with the exchange has been shown as being a single wire grounded circuit but it is to be understood that this is merely indicative of the additional control circuit to be supplied and that this circuit may be provided in any one of a number of ways well known by those skilled in the art.

Further features of the invention pertain to the particular arrangement of the circuit elements whereby the above and additional operating features are obtained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be understood readily by reference to the following description taken in connection with the accompanying drawing in which the figure illustrates a telephone system having incorporated therein the principal features of the invention as briefly outlined above.

Referring more particularly to the drawing, there is shown a calling substation having a transmitter 11, a loudspeaker 12, and outgoing and incoming channel amplifiers 13 and 14 therefor arranged to be connected by a balancing network 15 to a telephone line 16. Suitable automatic telephone equipment is provided which includes an off-on switch unit for supplying the necessary energy to the outgoing and incoming channel amplifiers 13 and 14 to condition them for use and to complete a connection between the balancing network 15 and the telephone line 16. The connection between the balancing network and the line 16 is completed by operation of a relay 17 having a pair of make contacts 18 interposed between the network and the telephone line. The relay 17 may be arranged to be energized in response to the conditioning of the incoming and outgoing channel amplifiers or may be energized in response to other means such as the off-on switch. The off-on switch control unit 20 also includes a suitable bell or signal device by which another party may signal the substation, and a suitable dial mechanism for calling. The particular elements and circuit arrangements of the ringer and the dial calling device together with the off-on switch are well known in the art and may comprise any of the elements and circuit arrangements suitable for this purpose.

During the calling interval the amplifiers 13 and 14 may cause interaction between each other sufficient to produce a condition known as howling due to the fact that the balancing network 15 is generally designed to be most efficient at average line conditions when the line 16 is connected through a telephone exchange to the line of a called substation. Since the interaction or howling condition is deemed to be undesirable during the calling interval, some means may be provided for disabling at least one of the substation communication channels as, for example, by short circuiting the microphone 11 by the break contacts 21 of a relay 19 which is connected in a circuit including a conductor 22 which is grounded through a suitable source of potential 23. While the microphone 11 has been shown as short-circuited, it is to be understood that this merely represents one of a number of different ways of disabling at least one of the communication channels at a substation. Other means, such as supplying adequate negative bias to a portion of one of the amplifiers or both of the amplifiers, or still other arrangements might also be utilized.

The calling substation subscriber in order to initiate a call actuates the off-on switch to energize and condition the amplifiers 13 and 14 for use. The relay 17 is thereupon actuated to close the contacts 18, thus completing a circuit with the telephone line 16 so that the dial mechanism may be actuated to transmit impulses to an exchange. At the exchange the line 16 terminates in a line circuit 24 which is associated with a distributor 25 and other suitable automatic telephone equipment which, for the purposes of convenience, may be called a finder-connector link 26. The finder-connector link is provided with a plurality of wipers 27 and 28 which complete a connection with the telephone line 16, a wiper 29 which completes a connection with a control conductor associated with the connector bank, and a wiper 31 which completes a connection with the conductor 22 which, at the calling substation, is connected in circuit with the relay 19 and a source of potential 23. The automatic telephone exchange equipment which has been referred to as the finder-connector link, includes a plurality of relays, of which several have been shown. Associated

with the wipers 27 and 28 there is usually a relay 32 which often is referred to as the line relay or the relay in the talking battery-feed circuit, and which is energized as soon as the wipers 27 and 28 complete connection with the calling substation telephone line 16. The wipers 27 and 28 are connected to conductors 33 and 34, respectively, which by means of suitable coupling devices 35 and 36, shown as capacitors, are coupled to conductors 37 and 38 which, in turn, are connected to wipers 39 and 41. That portion of the equipment between the wipers 27, 28 and 39, 41 may conveniently be referred to as the talking battery feed circuit equipment which includes another relay 42, often referred to as the back-bridge relay which is responsive to the completion of a connection at a called substation. The finder-connector link is, furthermore, provided with wipers 43 and 44 which connect with the control conductor and with another conductor 45 which, in turn, extends to the called substation. The finder-connector link therefore causes the wipers 39 and 41 to complete connection to a telephone line 46 which, in turn, is associated with a line circuit equipment 47. The telephone line 46 extends to a called substation which includes a suitable microphone 48, a loudspeaker 49, an outgoing amplifier 51, an incoming amplifier 52, and a balancing network 53 which interconnects the telephone line 46 with the incoming and outgoing communication channels. Normally one of the communication channels is disabled by suitable apparatus which may comprise a short-circuit across the microphone 48 obtained by the break contacts 54 of a relay 55. The relay 55 is connected in circuit with the conductor 45 and a grounded source of potential 56. The incoming and outgoing channel amplifiers may be conditioned for use by suitable equipment including an off-on switch unit 57 which is provided with a ringer and a dial calling device. In response to the actuation of the off-on switch to energize the incoming and outgoing channel amplifiers, a relay 58 is energized to close make contacts 59 interposed between the balancing network 53 and one of the telephone line conductors of the telephone line 46. As soon as a called substation has responded to a calling signal which actuates the ringer in the apparatus 57, a loop circuit is completed through the balancing network 53 so that at the central station the battery-feed talking circuit or back-bridge relay 42 becomes energized.

From the previous description it will be noted that at each substation at least one of the communication channels has been disabled and that relay means are provided which apparently would render ineffective this disabling means. This is accomplished by an auxiliary circuit which includes the conductor 22 from the calling substation, the conductor 45 to the called substation, and the wipers 31 and 44 of the finder-connector link. The line relay 32 may be provided with make contacts 61 which are connected in series with make contacts 62 arranged to be controlled by the back-bridge relay 42. A circuit therefore extends from the conductor 60 between the wipers 31 and 44 through the series make contacts 61 and 62 to ground. During the calling interval at a calling substation the microphone initially is rendered ineffective by the short-circuit 21 and this short-circuit cannot be removed until a connection is completed at a called substation in response to a calling signal. Therefore in response to the call initiated by the calling substation the finder-connector link 26 seeks the line 16 connected with the calling substation and the relay 32 is actuated thus to close auxiliary contacts 61. The wipers 39 and 41 complete connection with the outgoing telephone line 46 but the back-bridge relay 42 is not actuated until the off-on switch at the called substation is closed so as to bring about energization of the relay 58 which, in turn, closes its contacts 59 to complete the loop circuit through the balancing network 53. In response to this operation the relay 42 is actuated thus closing the contacts 62, thereby grounding the circuit between the wipers 31 and 44 so as to complete circuits through each of the relays at the calling and called substation thereby to remove the short-circuits from each of the microphones at these substations, whereupon the normal communication channels are then available for use. No interaction between the incoming and outgoing channel amplifiers at either of the stations will occur because now the balancing networks 15 and 53 provide sufficient protection against such interaction. If desired, each of the incoming and outgoing channel amplifiers may further be controlled by suitable control circuits, as is common in the art, to partially or totally disable the particular channel amplifier which is not in use during a particular portion of the communication carried on between two substations.

From the above description it becomes apparent that in addition to conventional loudspeaking communication equipment at the calling and at the called substation, there is provided an auxiliary circuit arrangement including the conductors 22, 60 and 45 which, together with the relays 19 and 55 and the sources of potential 23 and 56, are effective in response to the operation of the battery-feed circuit relays 32 and 42 to render ineffective any disabling action which has been provided to prevent interaction or howling between the incoming and outgoing channel amplifiers during a calling interval. While the control circuit thus provided has been shown as utilizing an additional conductor between each substation and the central station, it is to be understood that this is intended to merely represent an additional circuit which may be provided in any one of a number of manners utilizing a greater or lesser number of conductors, as will be appreciated readily by those skilled in the art.

It furthermore will be appreciated that while the finder-connector battery-feed talking link has been shown as being capacitively coupled by the capacitors 35 and 36, that other coupling devices, such as inductive coupling coils, might be utilized. Furthermore, while each of the relays 32 and 42 have been provided with auxiliary contacts 61 and 62, it is understood that another circuit arrangement might be provided wherein the contact 62 only is utilized and it is connected directly to a conductor 60 extending between the wipers 31 and 44 so that in response to the completion of a connection at a called substation the back-bridge relay, or other relay corresponding thereto, completes a circuit for the auxiliary control circuit, so that each of the substations which have been connected together by the exchange equipment will operate to render ineffective the disabling means at the substations.

While one embodiment of the invention has been disclosed, it will be understood that various

modifications may be made therein which are within the true spirit and scope of the invention.

What is claimed is:

1. The combination of an automatic telephone substation having incoming and outgoing channel amplifiers interconnected by a balancing network with means for preventing feedback between said amplifiers during a calling interval, said means comprising means normally disabling at least one of said amplifiers when said amplifiers are conditioned for use, and means for eliminating the effect of said latter means upon a response at the called substation.

2. The combination of an automatic telephone substation having incoming and outgoing channel amplifiers interconnected by a balancing network with means for preventing feedback between said amplifiers during a calling interval, said means comprising means normally disabling at least one of said amplifiers when said amplifiers are conditioned for use, and means responsive to the completion of a connection at a called substation for terminating the disabling action of said aforementioned means.

3. In an automatic telephone system the combination comprising an exchange, a substation provided with incoming and outgoing channel amplifiers and means normally disabling at least one of said channel amplifiers, and means at said exchange responsive to the completion of a connection at a called substation for rendering ineffective said disabling means.

4. In an automatic telephone system the combination comprising an exchange, a station provided with incoming and outgoing loudspeaking communication channels and means normally disabling at least one of said channels, a control circuit interconnecting said disabling means with said exchange, and relay means located at said exchange responsive to the completion of a connection at a called station for energizing said control circuit to render ineffective said disabling means.

5. In an automatic telephone system the combination comprising an exchange, a plurality of substations each provided with incoming and outgoing channel amplifiers and means normally disabling at least one of said amplifiers, relay means located at said exchange responsive to the completion of a connection at a called substation, switch means actuated by said relay, means located at the calling substation for rendering ineffective said disabling means, and a circuit interconnecting said latter means with said relay switch means to control the operation of said latter means.

6. In an automatic telephone system the combination comprising an exchange, a substation having a microphone and loudspeaker, incoming and outgoing channel amplifiers, means normally disabling at least one of said amplifiers, a relay for controlling said disabling means to enable said amplifier, means interconnecting said relay with said exchange, said exchange having a relay responsive to a response from a called substation and being provided with a pair of auxiliary open circuit contacts connected in series with said means interconnecting said substation with said exchange whereby said disabled substation amplifier will be enabled responsive to a response from a called substation.

7. In an automatic telephone system the combination comprising an exchange, a plurality of substations, each substation having incoming and outgoing loudspeaking communication channels, means for disabling at least one of said channels, a relay for controlling said disabling means to enable said channels, circuit means interconnecting said relay with said exchange, said exchange having a relay responsive to a calling substation and a relay responsive to a response from a called substation, each of said relays being provided with a pair of auxiliary open circuit contacts connected in series with said circuit means interconnecting said substation with said exchange whereby said disabled substation channels will be enabled responsive to a response from a called substation.

8. In an automatic telephone system the combination comprising an exchange, a plurality of substations each having a microphone, a loudspeaker, incoming and outgoing channel amplifiers, means for disabling at least one of said channel amplifiers, a relay for controlling said disabling means to enable said channel amplifiers, means interconnecting said relay with said exchange, said exchange having a line relay and a back-bridge relay each provided with auxiliary contacts connected in series with said means inter-connecting said substation with said exchange whereby in response to a completion of a connection at a called substation said substation channel amplifiers will be enabled.

9. In an automatic telephone system the combination comprising an exchange, a substation having a microphone, a loudspeaker, incoming and outgoing channel amplifiers therefor, at least one of said channel amplifiers being normally disabled, a relay for enabling said normally disabled channel amplifier, means interconnecting said relay with said exchange, said exchange having a relay responsive to the completion of a connection at a called substation, said last mentioned relay being provided with a pair of auxiliary open circuit contacts connected in series with said means interconnecting said substation with said exchange thereby to control said first mentioned relay to enable said channel amplifiers upon completion of a connection at a called substation.

10. In an automatic telephone system the combination comprising an exchange, a plurality of substations interconnected therewith by telephone lines, each substation having incoming and outgoing loudspeaking communication channels interconnected with a substation telephone line, means for disabling at least one of said channels during a calling interval, a relay for rendering ineffective said disabling means, a circuit for said energizing relay interconnecting said substation with said exchange, said exchange having a talking battery feed circuit including a relay, said exchange relay being provided with a pair of contacts connected in series with said first circuit interconnecting said exchange with said substation, and means for rendering ineffective said disabling means whereby upon completion of a connection at a called substation said disabled channel will be enabled.

11. In a telephone system, a calling station, a called station, an exchange including a plurality of automatic switches, means at said calling station for extending a connection to said exchange and for controlling said switches to extend a connection to said called station, a normally disabled amplifier at said calling station, means for enabling said disabled amplifier, and means at said exchange operated in response to said called station answering said connection for

controlling said enabling means at said calling station.

12. In a telephone system, an exchange including a link circuit, a plurality of substations, each of said substations including incoming and outgoing amplifiers interconnected by a balancing network and means normally disabling one of said amplifiers, means in said link circuit operated in response to a call initiated at one of said substations for completing a connection between said calling substation and said link circuit, means at said calling substation for thereafter controlling said link circuit to extend a connection to a called one of said substations, and means in said link circuit operated under control of said called substation for disconnecting the disabling means at said calling and called substations.

13. In a telephone system, a calling station having incoming and outgoing channel amplifiers interconnected by a balancing network, one of said amplifiers being normally disabled, means for enabling said disabled one of said amplifiers, a finder switch, a line terminating in said balancing network accessible to said finder, a called station, a connector having access to said called station, means operated in response to the initiation of a call at said calling station for controlling said finder to find and connect with said calling line, means at said calling station for operating said connector to extend a connection to said called station, means at said called station for completing said connection, and means at said calling station operated in response to the completion of said connection for operating said enabling means thereby rendering said disabled amplifier effective.

ROSWELL H. HERRICK.

CERTIFICATE OF CORRECTION.

Patent No. 2,369,352. February 13, 1945.

ROSWELL H. HERRICK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 55, claim 10, for the words "said energizing" read --energizing said--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of June, A. D. 1945.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

controlling said enabling means at said calling station.

12. In a telephone system, an exchange including a link circuit, a plurality of substations, each of said substations including incoming and outgoing amplifiers interconnected by a balancing network and means normally disabling one of said amplifiers, means in said link circuit operated in response to a call initiated at one of said substations for completing a connection between said calling substation and said link circuit, means at said calling substation for thereafter controlling said link circuit to extend a connection to a called one of said substations, and means in said link circuit operated under control of said called substation for disconnecting the disabling means at said calling and called substations.

13. In a telephone system, a calling station having incoming and outgoing channel amplifiers interconnected by a balancing network, one of said amplifiers being normally disabled, means for enabling said disabled one of said amplifiers, a finder switch, a line terminating in said balancing network accessible to said finder, a called station, a connector having access to said called station, means operated in response to the initiation of a call at said calling station for controlling said finder to find and connect with said calling line, means at said calling station for operating said connector to extend a connection to said called station, means at said called station for completing said connection, and means at said calling station operated in response to the completion of said connection for operating said enabling means thereby rendering said disabled amplifier effective.

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