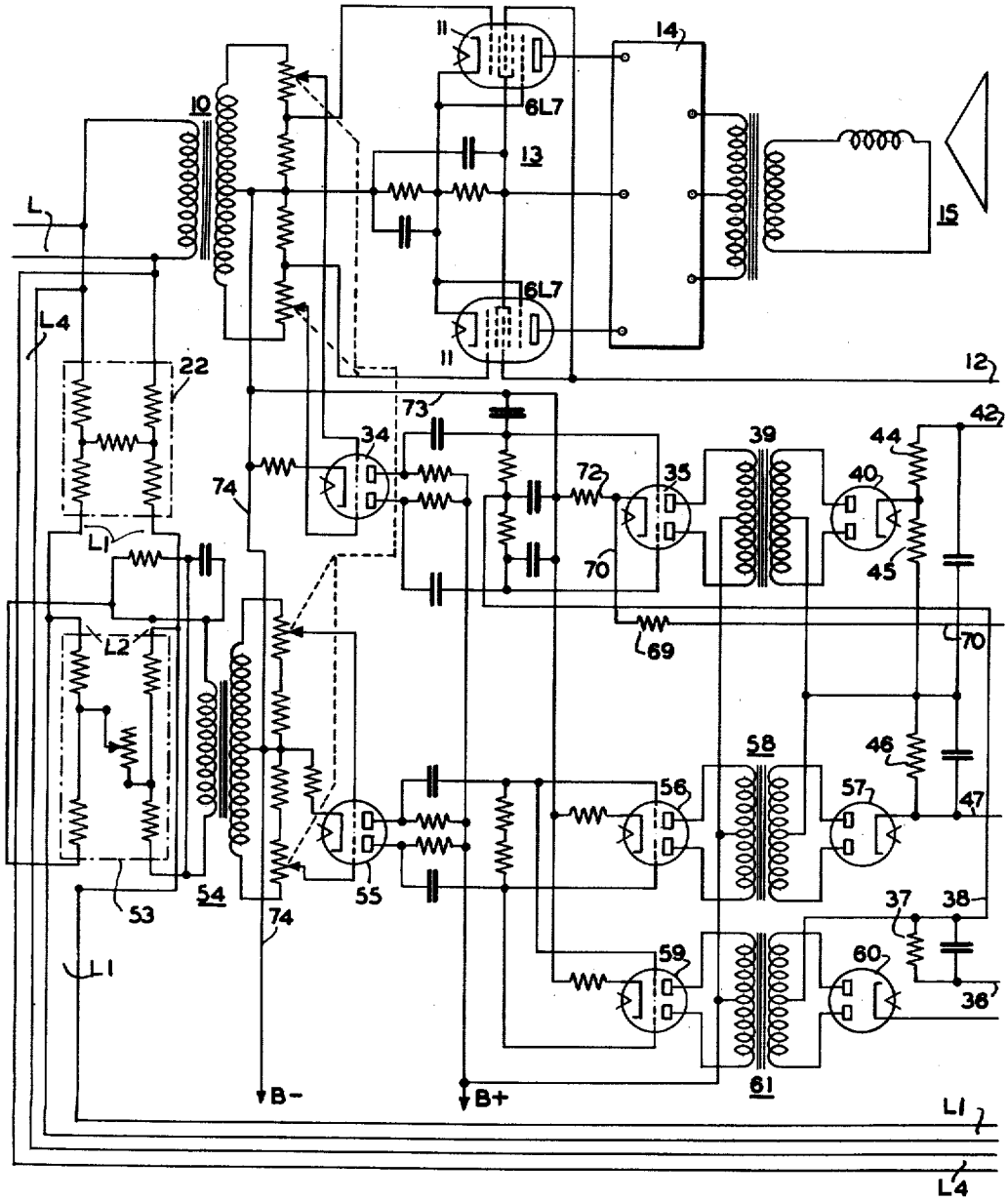
Feb. 27, 1945. C. W. BAIRD 2,370,388

COMMUNICATION SYSTEM

Filed April 1, 1943 2 Sheets-Sheet 1



Inventor

CLYDE W. BAIRD

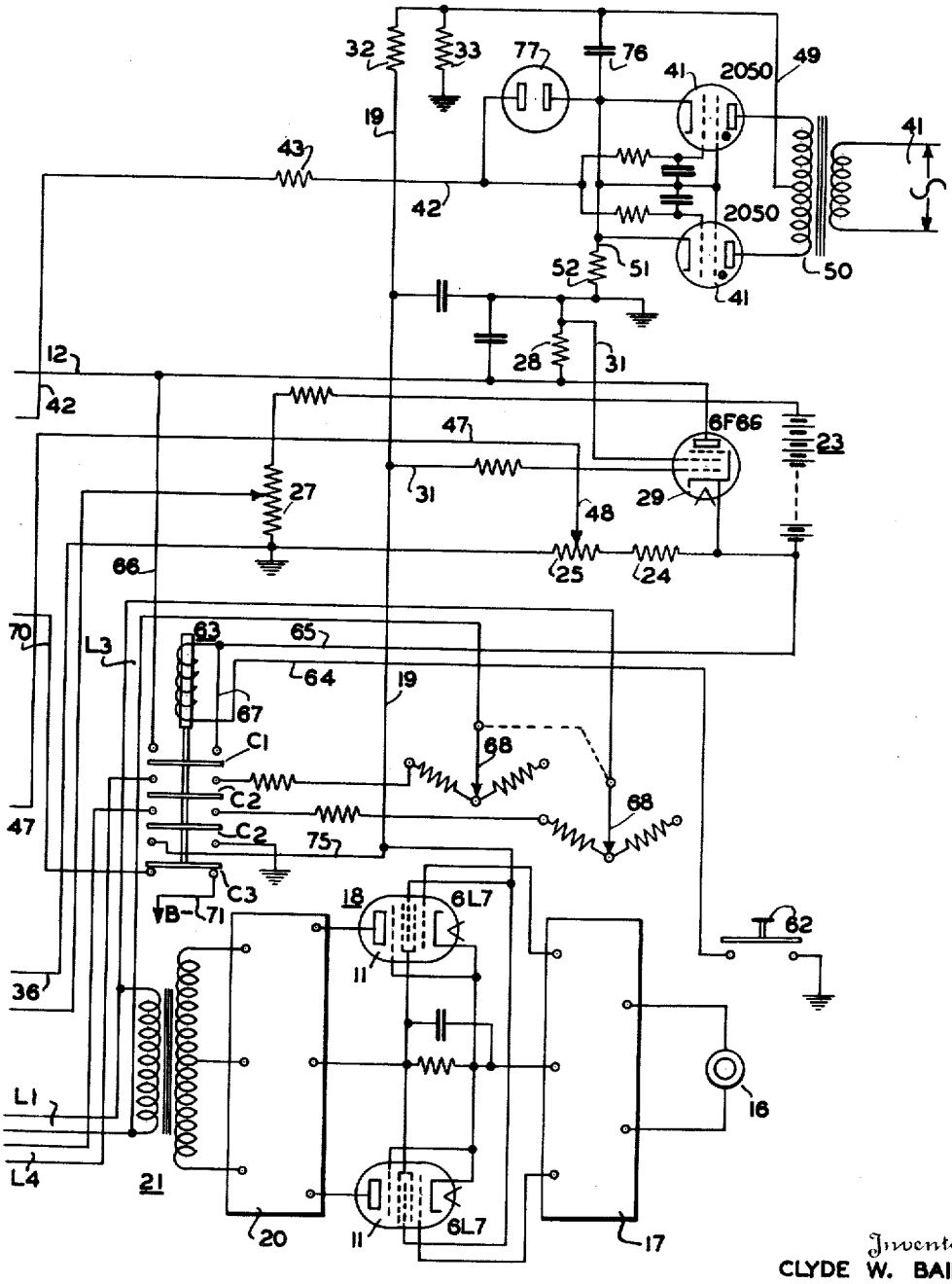
By Francis J. Klempay

Attorney

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COMMUNICATION SYSTEM

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Inventor
CLYDE W. BAIRD

By Frances J. Kingsley

Attorney

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COMMUNICATION SYSTEM

Clyde W. Baird, Columbus, Ohio

Application April 1, 1943, Serial No. 481,420

19 Claims. (Cl. 179—81)

This invention relates generally to communication systems, and more particularly to improvements in telephone terminal amplifiers and controls wherein the terminal station is of the loud-speaking type, i. e., consisting of a microphone and a loud-speaking unit.

While heretofore many communication systems involving a pair of interconnected loud-speaking telephone stations have been devised and operated each terminal or station assembly by itself has been inoperative or unsatisfactory for general use in telephone communication systems. Principally among the difficulties involved is the attainment of a desired amplification level without excessive feed back or singing while restraining speech clipping within unobjectionable bounds. The invention is concerned principally with terminal stations of the automatic type wherein outgoing signals are sent and incoming signals received without the necessity of the user or subscriber actuating any switching or other gear and has as its principal object the provision of an improved two-way loud-speaking terminal system whereby such assemblies may be of general applicability. To this end a terminal unit constructed in accordance with the principles of the invention may be readily connected into any commercial telephone line for use in conjunction with other similar units, with one or more conventional hand sets, or with such sets and units in conference combinations.

A more specific object of the invention is the provision of an improved telephone terminal amplifying and control circuit for loud-speaking operation which, while capable of automatic two-way operation without objectionable feed back or speech clipping, eliminates the necessity of employing the conventional hybrid line coupling coil. One of the disadvantages attendant the use of such coupling is the matching of the impedance of the coil with the impedance of the lines and since, as is well understood, line impedance may vary sporadically as a result, in part, of connections with various other lines it will be at once apparent that high efficiency cannot be generally maintained with hybrid systems. By eliminating the necessity of employing hybrid coupling arrangements the efficiency of the unit is maintained regardless of its particular application or use.

Another object of the invention is the provision of improved circuit arrangements for electronically blocking either the incoming signal channel or the outgoing signal channel when the opposite channel is in use whereby the blocking is positive thereby allowing unlimited volume output and unlimited level into the line, as desired.

A further object of the invention is the provision of an automatic loud-speaking telephone terminal station having the characteristics outlined above which is sensitive and quick in operation and which does not require the use of conventional relays with their attendant disadvantages. Moreover, the apparatus of the invention may be and is normally maintained in condition for instant use with the outgoing channel normally conditioned for reception, amplification, and transmission of audible signals while the incoming channel is normally blocked.

Usually it is undesirable that the incoming channel be conditioned by line level signals or by background noises originated adjacent another connected unit and the present invention provides a simple but effective device for determining the strength of incoming signals required to condition or unblock the incoming signals. Since the circuit or channel conditioning method provided by the present invention operates with extreme rapidity variations in the setting of this level control has a minimum effect on the quality of the signals reproduced.

A still further object of the invention is the provision, in apparatus of the kind involved herein, of a manually engageable and operable element which is operative at any time to disturb the balance in the unit to instantly condition the outgoing channel and block the incoming channel regardless of the strength of incoming signals.

The above and other objects and advantages of the invention will become apparent upon a consideration of the following detailed specification and the accompanying drawings wherein there is specifically disclosed a preferred embodiment of the invention.

The drawings, consisting of a single figure, on two sheets, are a schematic showing of an automatic two-way loud-speaking telephone terminal or subscriber station circuit constructed in accordance with the principles of the invention. The embodiment illustrated, while generally preferred, should be taken as exemplary only since the broader features of the invention may be expressed in many varied arrangements.

In the drawings, a two-conductor line L which is adapted to be connected to any private or commercial telephone line is coupled to a combined repeater and amplifying channel through the transformer 10. It will be understood that, if desired, the line L may be maintained either in continuous connection with the aforemen-

tioned telephone line or arranged to be readily connected therewith. Moreover, the terminal system of the present invention may be readily arranged for use in conjunction with manually operated indexing devices used in automatic switching systems. Thus, one application of the present invention is the substitution of a two-way loud-speaker unit for the handset of a conventional subscriber station.

The output of coupling transformer 10 is impressed on the primary control grids of a pair of space discharge devices 11 arranged in push-pull relation as shown. Devices 11 are preferably of the multiple control grid type, having secondary control grids both connected to a conductor 12. The function of the secondary control grids is to drive the devices 11 to cut-off upon the impression on conductor 12 of sufficiently negative potential. The stage represented by the devices 11 constitutes, in effect, a controlled repeater station, designated by numeral 13, and the output of this station is further amplified at 14 and then utilized to drive a loud speaker 15.

A microphone 16 feeding through an amplifier 17 drives a controlled repeater and amplifying station 18 which is similar in construction and operation to the station 13 of the incoming channel, having a pair of multiple grid space discharge devices 11 connected in push-pull relation. The output of amplifier 17 is connected to the primary control grids of the discharge devices while the secondary control or blocking grids of the devices are connected to a conductor 19. The potential normally impressed on the conductor 19 is sufficiently positive with respect to the cathodes of the discharge devices of the repeater 18 to condition the repeater for instant operation.

Means to be hereinafter described is provided to drive this potential highly negative to positively block the repeater 18. The output of the repeater or control stage 18 is amplified at 20 and impressed through a coupling transformer 21 on a two-conductor line L1. Line L1 is coupled to the line L through a voltage transforming network 22 consisting entirely of resistances and in which the values of the resistances are chosen so that a greater voltage drop is attained in the direction L1 to L than in the reverse direction. The ratio with respect to direction may be of the order of 2:1.

In accordance with the preferred and illustrated embodiment of the invention the incoming signal channel consisting of the control or repeater stage 13 and the amplifier 14 is normally positively blocked by action of the negative biasing potential impressed on the secondary control grids of the discharge devices of the stage 13 while the outgoing signal channel consisting of amplifiers 17 and 20 and control or repeater stage 18 is normally conditioned for transmission. Means now to be described is operative to unblock the incoming signal channel upon receipt of incoming signal strength of predetermined proportions and to simultaneously block the outgoing signal channel. Moreover, the operation of the apparatus is such that upon use of the outgoing channel the level of operation of the incoming signal strength responsive element utilized to unblock the incoming channel and to block the outgoing channel is automatically raised thus further insuring against singing in the system.

A suitable source of direct current baising potential, as the battery 23 for example, is provided and the resistors 24, 25 and 26 as well as a potentiometer 27 are connected in series across the source with a ground connection made at the negative terminal of the potentiometer 27. Thus the ground potential is positive with respect to the negative terminal of the source 23 and with respect to any intermediate point on the resistor 25. Connected between ground and the negative terminal of the source 23 through a resistance 28 is a space discharge device 29 normally biased for conduction by means of the grid circuits 30 and 31, the former leading from ground while the latter is connected to the conductor 19 which leads to the blocking grids of the repeater 18. Conductor 12 leading from the blocking grids of the repeater 13 is connected directly to the anode of the tube 29 and since, during conduction in the tube, the anode potential is substantially below ground potential the discharge devices 11 in stage 13 will be held non-conducting. Conductor 19 is connected to ground through the series resistances 32 and 33 whereby normally the blocking grids of the stage 18 are biased in positive direction with respect to the cathodes thereof.

Deriving signal energy from the coupling 10 in parallel with the stage 13 is an amplifier 34 the output of which is impressed on a second amplifier 35. Amplifier 35 is provided with a modulated grid biasing control but is normally conditioned for maximum output, the positive grid potential being supplied from ground through conductor 36, resistance 37, and conductor 38. The output of amplifier 35 is impressed through a coupling transformer 39 on a full wave rectifier 40. The output of rectifier 40 is utilized, in the manner now to be described, to block the outgoing intermediate stage 18 and to simultaneously condition the incoming amplifying channel.

A suitable source 41 of alternating current is connected to a full wave rectifier consisting of the space discharge devices 41' which are preferably of the gas filled type. The control grids are connected through suitable grid resistors to a grid biasing circuit comprising in series a conductor 42, resistances 43, 44, 45 and 46, conductor 47, and an adjustable tap 48 on the resistor 25. Thus, in the quiet condition of the system the control grids of the devices 41' are biased negatively with respect to their cathodes and are therefore non-conducting. Upon the receipt of incoming signal strength rectifier 40 will be activated, impressing its output across resistance 45 in opposition to the direction of application of negative grid bias furnished the tubes 41 and the signal strength, if sufficient, will alter the bias on tubes 41 sufficient to start their conduction. Upon this happening the flow of current from ground through resistance 33, conductor 49, transformer secondary winding 50, tubes 41, conductor 51, and resistance 52 back to ground will drive the circuit connected end of resistance 33 highly negative with respect to ground, it being noted that the resistance 33 is of substantially greater value than resistance 52. Thus the potential in conductor 19 is made highly negative thereby driving the tubes 11 in stage 18 beyond cut-off whereby the outgoing channel is effectively blocked. By reason of the grid connection 31 the tube 29 will likewise be blocked thus extinguishing the flow of current through the resistance 28 thereby allowing the secondary control or blocking grids of the tubes 11 control stage

13 to assume ground potential whereby this stage is conditioned for signal transmission.

To eliminate the employment of a hybrid line coupling network while yet preventing the conditioning of the incoming channel from signal strength derived from the microphone amplifier I employ a second signal strength responsive network which derives its energy through a line L2 connected with the line L1. A voltage transforming network 53, commonly termed a "pad," and similar to the network 22 is interposed in the line L2. However, the common resistor is preferably made variable so as to provide for adjustment of the step down ratio. In order that the signals received in this second signal strength responsive network is in phase with the signals received at the amplifier 34 a coupling transformer 54 is employed. The secondary of transformer 54 drives an amplifier 55 the output of which in turn drives an amplifier 56. A full wave rectifier 57 is fed from the amplifier 56 through a coupling transformer 58 and its output is impressed across the resistance 46 in a direction which is additive to the normal negative grid bias furnished the rectifiers 41 through the conductors 47 and 42. Thus the effect of the circuit 53—58 when speech is imparted to the microphone 16 is to tend to increase those circuit parameters which function to block the control stage 13 and to condition control stage 18.

It will be apparent that outgoing signals impressed on the line L will likewise be impressed on the incoming signal strength responsive network 34—35, 39—40 tending to condition the incoming or speaker channel. To avoid the happening of the latter an amplifier 59 has its control grids connected to the output of the amplifier 55. Amplifier 59 feeds a rectifier 60 through a coupling transformer 61 and the output of rectifier 60 is impressed across the resistance 37 in opposition to the normal positive bias furnished the grids of amplifier 35 through conductor 36, resistance 37 and conductor 38. The effect of any material increase in the output of rectifier 60 is to diminish substantially the current conducted by tube 35 and therefore the network including tube 35 will have little if any effect on the operation of the system during use of the outgoing channel. It will be observed that the cathode of rectifier 60 is connected to the movable contact of the potentiometer 27 so that the sensitivity of the control provided by the network 59—61 on the operation of the rectifier 40 may be adjusted. Likewise it is desirable to control the signal strength required to effect predetermined operations of the signal strength responsive networks and for this purpose suitable potentiometers are interposed between the terminals of the secondaries of the transformers 10 and 54 and the grids of the amplifiers 34 and 55, respectively. As shown, these potentiometers are preferably ganged to provide a simplified control.

In order that a user or subscriber may take over control of the system and condition the outgoing channel for transmission regardless of conditions exisitent in the system as a whole a manually operative element is incorporated in the apparatus and, in practice, this element may take the form of a normally open switch built into the microphone stand. This switch, indicated by reference numeral 62, is operative when closed to energize the operating coil of a relay 63 through the circuit—ground, switch 62, conductor 64, the coil of relay 63, and conductor 65 to battery 23. Upon the closing of relay 63 the blocking grids of the repeater 13 are connected directly to the negative terminal of battery 23 through conductor 66, contactor C1 on relay 63, and conductors 67 and 65. This has the effect of holding or driving the tubes 11 of the stage 13 to cut-off regardless of the strength of the incoming signals. To increase the output level of the system when the take-over switch 62 is closed the pad 22 in the line L1 is shunted by a circuit including the line L3, the contactors C2 of relay 63 and the line L4 in series. The effect of the increased output level so effected is to take command over the incoming channel if a similar unit is connected to the other end terminal of the telephone line but in any case the audible output at the opposite terminal station will be appreciable. Means comprising the adjustable resistances 68 in the line L3 is provided to adjustably limit the increased output level upon actuation of the "take over" switch 62. In order that the increased level upon being reintroduced into the system through the transformer 10 will not trip the rectifier 41 the normal cathode connection of tube 35 to B— through the resistor 69, conductor 70, contact C3 of relay 63 and conductor 71 is opened forcing the cathode to B— current to flow through a resistor 72 of much greater value than the resistor 69, the circuit including in addition to the resistor 72 the conductors 73 and 74. Thus, the conduction in tube 35 is substantially cut off thereby rendering rectifier 40 ineffectual. To further insure the continuance of the conditioning of the repeater 18 its secondary control or blocking grids are connected directly to ground through the conductor 75 and contactor C3 of the relay 63.

In practice, the potential of the cathodes of the discharge devices 13 of the stages 11 and 18 as well as of the discharge device 35 is properly related to the ground potential through the B— and/or other connections so that proper control of all these devices by changes in grid potential relative to ground may be effected as well as readily understood. In operation, assuming the repeater 13 to be blocked while the repeater 18 is conditioned for operation in the manner aforesaid, incoming signals from the line L will be impressed through the transformer 10 onto the primary grids of the tubes 11 of the repeater 13 and also onto the grids of the amplifier 34. The same signals from line L will, in addition, be impressed on the grids of the amplifier 55 through the transformer 54 but the strength thereof will be reduced a predetermined amount by reason of the step-down action of the pads 22 and 53. Consequently rectifier 40 will receive substantially greater energy than the rectifier 57 and consequently the voltage developed across resistor 45 will be substantially greater than the voltage developed across the resistor 46. The former voltage predominates and the drop is in a direction tending to drive the potential on conductor 42 positive with respect to ground. Rectifiers 41' are thus rendered conductive during each half cycle of the alternating current source 41. Connected across the output of this rectifier is a capacitor 76 which delays for a predetermined number of half cycles the effect of conduction in the rectifier. Thus one or two impulses coming from the line is insufficient to trip the repeaters 13 and 18 but rather, the operation is accumulative so that a sustained signal, as a discernible portion of a vowel, for

example, is required to effect the reversal in the conditioning of the channels.

As explained above, sustained cyclic conduction in rectifiers 41' drives the blocking grids of the tubes 11 of the repeater 18 highly negative and through the connection 31 tube 29 is blocked and the secondary control grids of the repeater 13 assume the positive ground potential through the resistor 28 and the conductor 12. There is thus effected a positive locking action which the effect of the output of the rectifier 60 on the output of the rectifier 40 is insufficient to overcome. Moreover, the incoming channel remains conditioned for a predetermined interval, depending on the capacitance of capacitor 76, after the cessation of incoming signal strength to reduce speech clipping to a minimum. At the end of any appreciable pause the system reverts to its initial ready state with repeater 13 blocked and repeater 18 conditioned.

Upon transmission, the signal strength from amplifier 20 is impressed on the line L through the coupling transformer 21 and pad 22. This signal strength as impressed on the line L will be reintroduced through the transformer 10 onto amplifier 34 and the signal strength in line L1 is impressed on the amplifier 55 through the pad 53. At the outset the output of rectifier 40 is comparable to the output of rectifier 57. However, the rectifier 60 is comparable in energy output to the rectifier 57 and the effect of its operation is to diminish materially the efficacy of the amplifier 35. The output of rectifier 40 is accordingly diminished and the voltage developed across resistor 46 preponderates over the voltage developed across resistor 45 and is of such sign as to drive the grids of rectifiers 41' more negative. The rectifier 60 may therefore be considered as a means to lock the the system in condition for transmission. The small capacitor in parallel with the resistor 37 will delay slightly the reversal of the system upon cessation of use of the microphone 16.

The above specifically described embodiment of the invention should be considered as illustrative only as obviously many changes may be made therein without departing from the spirit or scope of the invention. For example, instead of effecting the blocking the repeaters 13 and 18 by grid control it is contemplated that the same may as well be accomplished by controlling the plate currents in these devices. It should also be apparent that the repeaters 13 and 18 may or may not have amplifying characteristics—their primary function being one of control. The rectifier 41' may be supplied with suitable direct current plate potential and time delayed means as a relay, for example, may be employed to interrupt conduction therein a predetermined interval after the cessation of incoming signal strength. Reference should therefore be had to the appended claims in determining the scope of the invention.

I claim:

1. Loud-speaking telephone substation apparatus adapted to be connected to a conventional two conductor telephone line of variable impedance comprising in combination a receiving amplifying channel, a transmitting amplifying channel, each of said channels including a space discharge device, means normally blocking the said device in said receiving channel, means comprising a rectifier having discontinuous output characteristics to provide a controlled potential source, and means responsive to the signal strength impressed on said receiving channel to control said rectifier, said rectifier when so controlled being operative to unblock the said device in said receiving channel and to block the said device in said transmitting channel.

2. Apparatus according to claim 1 further including a capacitor connected across the output of said rectifier whereby said unblocking and blocking is delayed sufficiently to avoid fake operation of the apparatus.

3. Apparatus according to claim 1 further including means to adjust the signal level required to effect said control of said rectifier.

4. Loud-speaking telephone substation apparatus adapted to be connected to a line of variable impedance comprising in combination a receiving amplifying channel arranged to be connected directly with said line, a transmitting amplifying channel, a voltage transforming network intermediate said last mentioned channel and said line, each of said channels including a space discharge device, a potential source means comprising said source to normally maintain the said device in said receiving channel in blocked condition and the said device in said transmitting channel in operative condition, means responsive to the signal strength impressed on said receiving channel, to effect a condition, means responsive to the signal strength existant in the output line of said transmitting channel to effect a condition in opposition to said first mentioned condition, and means responsive to the balance between said two conditions in control of the potential of said source whereby said channels are alternately conditioned for signal passage in accordance with directional signal conditions.

5. Apparatus according to claim 4 further including means to delay changes in said potential upon variation in the balance between said conditions whereby fake operation of the apparatus is prevented.

6. Two-way telephone terminal amplifying apparatus adapted to be connected to a commercial line comprising in combination a receiving amplifying channel arranged to be connected directly with said line, a transmitting amplifying channel, a voltage transforming network intermediate said last mentioned channel and said line, each of said channels including a space discharge device, an alternating current source, a controlled rectifier having discontinuous output characteristics connected to said source, a source of biasing potential operative to normally maintain the said device in said receiving channel in blocked condition and the said device in said transmitting channel in operative condition, means responsive to the signal strength impressed on said receiving channel in control of the operation of said rectifier, and means utilizing the output of said rectifier to alter the bias of said devices whereby said channels are alternately conditioned for signal passage in accordance with directional signal conditions.

7. Telephone substation apparatus comprising in combination receiving and transmitting amplifying channels each having a space discharge device operative to alternately block and condition its associated channel, means normally maintaining the said device in said receiving channel in channel blocking condition and the said device in said transmitting channel in channel readiness condition, a potential source, means responsive to the signal strength impressed on said receiving channel to effect a condition, means responsive to a predetermined proportion

of the signal strength impressed existant at the output of said transmitting channel to effect a condition in opposition to said first mentioned condition, and means responsive to the degree of balance attained between said two conditions to connect said source to said devices whereby said channels are alternately conditioned for signal passage in accordance with directional signal conditions.

8. Telephone substation apparatus comprising in combination a receiving amplifying channel and a transmitting amplifying channel each having a space discharge device operative to alternately block and condition its associated channel, means normally maintaining the said device in the receiving channel in channel blocking condition and the said device in the transmitting channel in channel readiness condition, an alternating current source, a gas-filled rectifier connected to said source and having a control grid, means normally biasing said grid to cut-off, means responsive to a preponderance of incoming signal strength to bias said grid for conduction in said rectifier, and means utilizing the output of said rectifier to reverse the normal condition of said devices whereby said channels are alternately conditioned for signal passage in accordance with directional signal conditions.

9. Apparatus according to claim 8 further including a capacitor connected across the output of said rectifier whereby the effect of conduction in said rectifier on said devices is sufficiently delayed to prevent false operation of the apparatus.

10. Apparatus according to claim 8 further characterized in that said rectifier is of the full-wave type whereby the appropriate channel is conditioned in minimum time.

11. Telephone substation apparatus comprising in combination a receiving amplifying channel and a transmitting amplifying channel each having a space discharge device operative to alternately block and condition its associated channel, a control network for said devices, a signal strength responsive device operative to effect a condition in proportion to the incoming signal strength impressed on said receiving channel, a second signal strength responsive device operative to effect a condition in proportion to the strength of output of said transmitting channel and in opposition to said first mentioned condition, means to control said network in accordance with the degree of balance between said two conditions, and means to diminish the efficacy of said first mentioned responsive device upon increase of signal strength impressed on said second mentioned responsive device.

12. Telephone substation apparatus comprising in combination a receiving amplifying channel and a transmitting amplifying channel each having a control device therein operative to alternately block and condition the channel, a control circuit for said devices operative to effect the blocking of one channel while the other is conditioned and vice versa, a signal strength responsive device operative to effect a condition in proportion to the incoming signal strength impressed on said receiving channel, a second signal strength responsive device operative to effect a condition in proportion to the strength of output of said transmitting channel and in opposition to said first mentioned condition, means to control said circuit in accordance with the degree of balance between said two conditions, and means to diminish the efficacy of said first mentioned responsive device upon increase of signal strength impressed on said second mentioned responsive device.

13. Telephone substation apparatus comprising in combination a pair of conductors adapted to be connected to a line, a receiving amplifying channel coupled to said conductors, a transmitting amplifying channel coupled to said conductors through a voltage transforming network, a device in each of said channels operative to alternately block and condition the channels, a control circuit for said devices operative to effect the blocking of one channel while the other channel is conditioned and vice versa, means to effect a condition in response to the signal strength impressed on said receiving channel, means to effect a condition responsive to the signal strength existant in the interconnection between said transmitting channel and said voltage transforming network and in opposition to said first mentioned condition, and means to control said circuit in accordance with the degree of balance between said two conditions whereby said channels are alternately conditioned for signal passage in accordance with directional signal conditions.

14. Apparatus according to claim 13 further including means to diminish the efficacy of said first mentioned responsive device upon increase of signal strength at said second mentioned responsive device.

15. Telephone substation apparatus comprising in combination a pair of conductors adapted to be connected to a line, a receiving amplifying channel coupled to said conductors, a transmitting amplifying channel coupled to said conductors, a device in each of said channels operative to alternately block and condition the channel, a control circuit for said devices operative to effect the blocking of one channel while the other is conditioned and vice versa, directional signal strength responsive means operative to control said circuit to condition said first mentioned channel while blocking said second mentioned channel upon the receipt of predetermined incoming signal strength, a microphone connected to the input of said second mentioned channel, and means comprising a manually operable element associated with said microphone to interrupt the control effect of said control circuit whereby said first mentioned channel may be blocked and said second mentioned channel may be conditioned irrespective of signal conditions existant in the apparatus.

16. Apparatus according to claim 15 further including means operable upon actuation of said element to increase the normal output level of said second mentioned channel.

17. Apparatus according to claim 15 further characterized in that said directional signal responsive means includes means responsive to the signal strength impressed on said said first mentioed channel together with means responsive to a predetermined proportion of the signal strength existant at the output of said second mentioned channel; and further including means operable upon actuation of said member to increase the normal level of output to said line from said second mentioned channel, and means operable simultaneously with said means to increase to render inoperative said means responsive to signal strength impressed on said first mentioned channel.

18. A two-way telephone terminal amplifier equipped with a microphone and a loud-speaker and adapted to be connected to a line, an am-

plifier for driving said speaker and means to couple said amplifier to said line, an amplifier driven by said microphone and means to conduct the output of the same into said line, means to alternately block and condition said amplifiers whereby the speaker amplifier is blocked while the microphone amplifier is conditioned and vice versa, means to control said means to block and condition comprising a circuit including a gas filled discharge device having a control grid, and means responsive to the relative strengths of the incoming signals impressed on said speaker amplifier and of the signals generated by said microphone amplifier to control the bias on said grid.

19. Apparatus according to claim 18 further including means to discontinue conduction in said device.

CLYDE W. BAIRD.

DISCLAIMER

2,370,388.—*Clyde W. Baird*, Columbus, Ohio. COMMUNICATION SYSTEM. Patent dated Feb. 27, 1945. Disclaimer filed Jan. 2, 1947, by the inventor.

Hereby enters the following disclaimer to certain of the claims in the specification, to wit:

The apparatus as set forth in claims 1 and 3, except wherein the discontinuous output characteristics of the rectifier which provides the controlled potential source results from powering said rectifier from a stable alternating current source.

The apparatus as set forth in claim 3, except wherein the means to adjust the signal level required to effect control of the rectifier is independent of the control over the signal strength transmitted by the receiving amplifying channel.

The apparatus as set forth in claims 4, 11, 12, and 13, except wherein the condition effected in response to the signal strength impressed on the receiving channel is a potential drop, wherein the condition effected in response to the signal strength existent in the transmitting channel is a potential drop, and wherein said potential drops are set up in opposition directly in serially connected circuit whereby the means responsive to the balance between the two conditions is the summation of the opposing potential drops.

[*Official Gazette February 18, 1947.*]

plifier for driving said speaker and means to couple said amplifier to said line, an amplifier driven by said microphone and means to conduct the output of the same into said line, means to alternately block and condition said amplifiers whereby the speaker amplifier is blocked while the microphone amplifier is conditioned and vice versa, means to control said means to block and condition comprising a circuit including a gas filled discharge device having a control grid, and means responsive to the relative strengths of the incoming signals impressed on said speaker amplifier and of the signals generated by said microphone amplifier to control the bias on said grid.

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