

June 13, 1939.

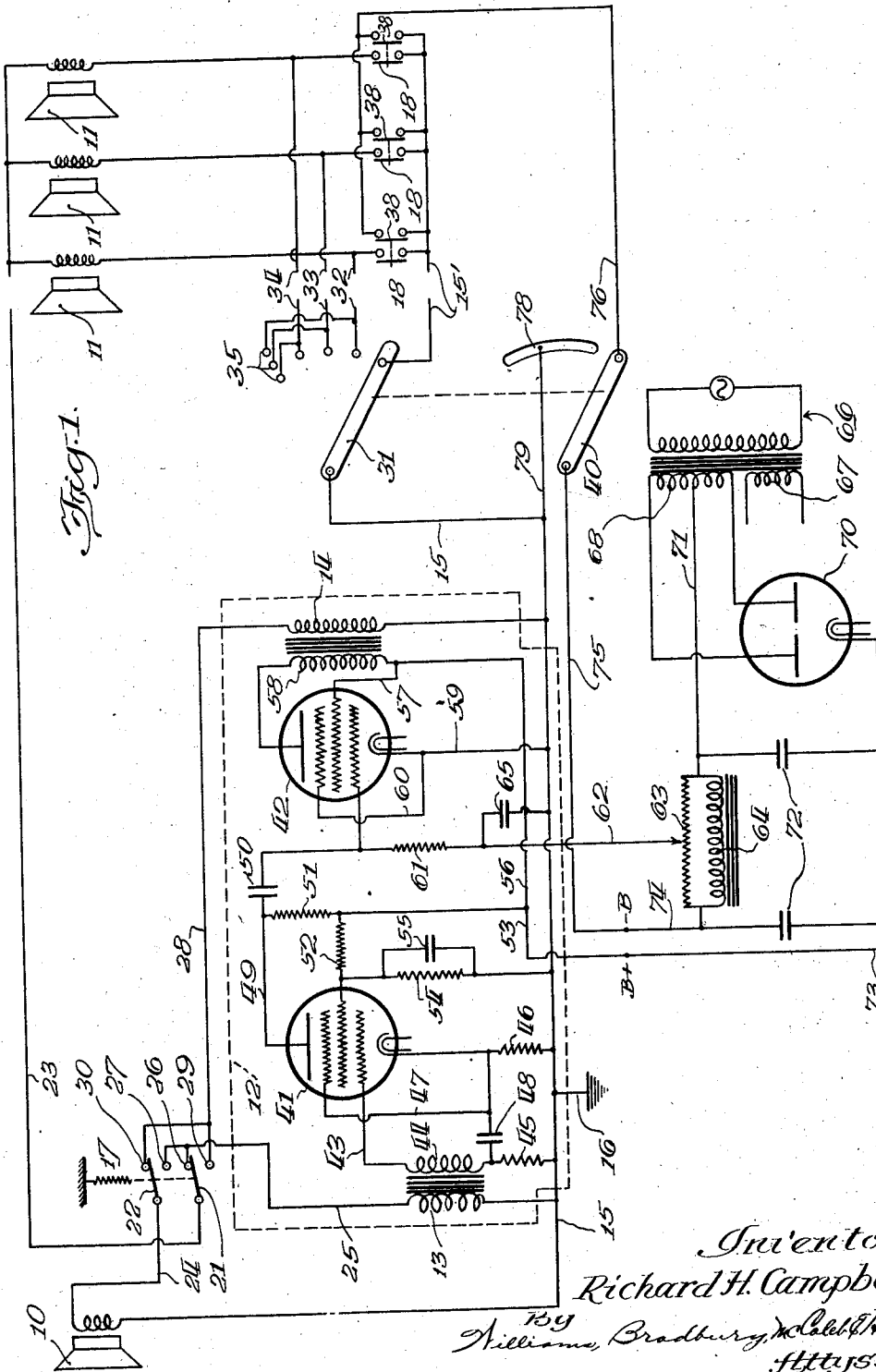
R. H. CAMPBELL

2,162,369

COMMUNICATION SYSTEM

Filed July 19, 1937

2 Sheets-Sheet 1



June 13, 1939.

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COMMUNICATION SYSTEM

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2 Sheets-Sheet 2

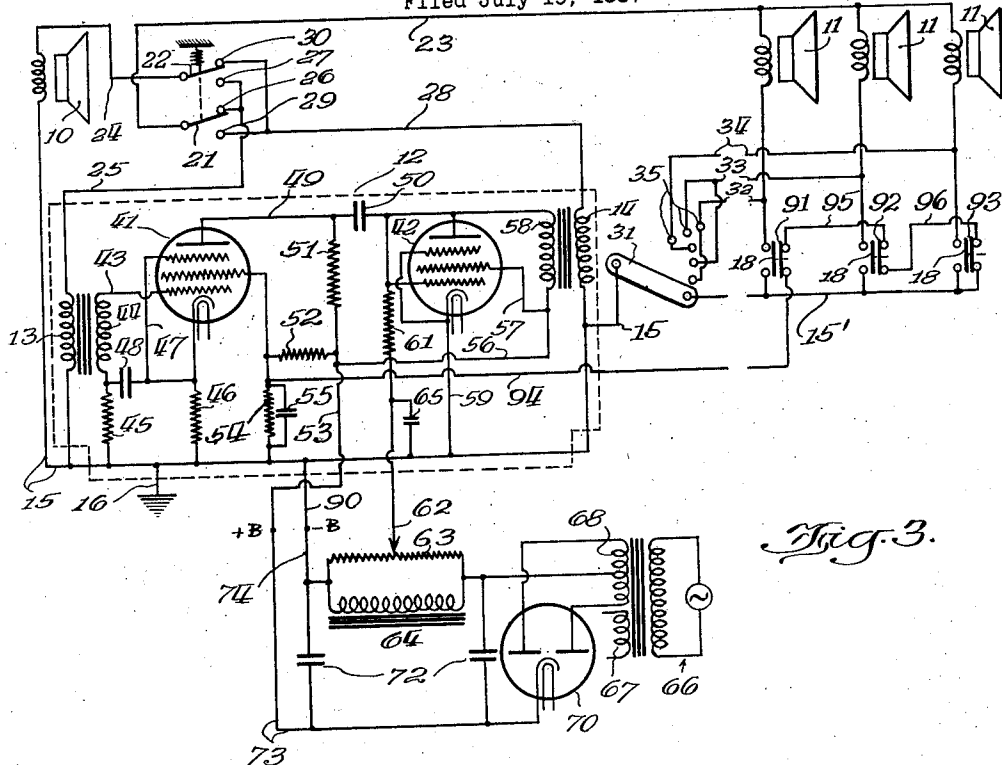
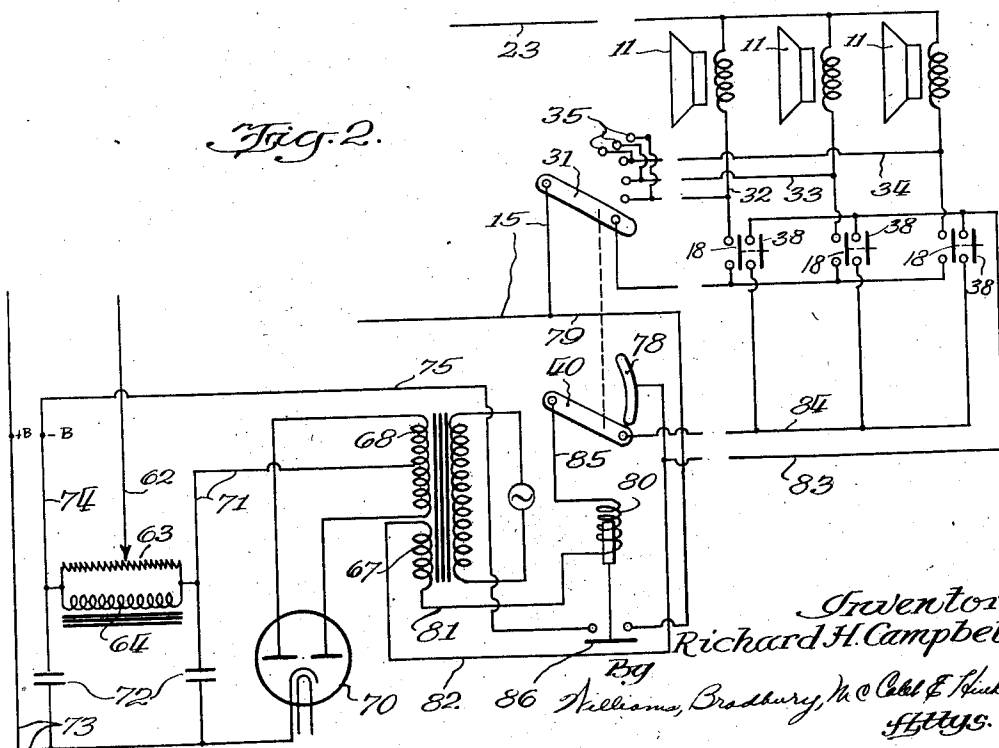


Fig. 3.

Fig. 2.



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COMMUNICATION SYSTEM

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Application July 19, 1937, Serial No. 154,344

23 Claims. (Cl. 179-1)

The present invention relates to communication systems and more particularly to intercommunication systems of the type comprising a central station and one or more remote stations.

One of the primary objects of the present invention is to provide a system with a simplified circuit arrangement normally conditioning the system for communication from one of the remote stations to the central station, but enabling an operator at the central station to control the direction of communication and to communicate with any one of the remote stations to the exclusion of the remainder.

Intercommunication systems of the type to which this invention relates, and comprising a central station and a plurality of remote stations each provided with suitable voice receiving and transmitting means and an amplifier to the input and output of which they are selectively connected, should be available for instantaneous operation. That is, an operator at either one of the remote stations, or at the central station desiring to communicate with the other should not be required to wait an appreciable length of time for the system to become operative. On the other hand, the system should not pick up and amplify local electrical disturbances.

It is, therefore, another object of the present invention to provide a communication system comprising an amplifier that is normally inoperative and, therefore, incapable of picking up and amplifying undesired electrical disturbances, but which is rendered operative whenever control means at one of the remote stations is operated to condition the system for communication with the central station or whenever control means at the central station is operated to condition the system for communication therefrom to any one, or more, of the remote stations.

The present invention is an improvement over the invention disclosed and claimed in my copending application Serial No. 150,951, filed June 29, 1937, entitled Communication apparatus and assigned to the assignee of the present application. This copending application is directed more particularly to the arrangement for selecting the stations with which it is desired to communicate and to the provision of control switches at both the central and remote stations.

Further objects and advantages of the present invention will become apparent from the ensuing description in the course of which reference is had to the accompanying drawings, in which:

Fig. 1 is a schematic diagram of one embodiment of my invention;

Fig. 2 is a schematic diagram illustrating a modification of the circuit arrangement shown in Fig. 1; and

Fig. 3 is a similar view illustrating still another modification of the invention.

Referring first to Fig. 1, the reference numeral 10 designates voice receiving and transmitting means such as a dynamic loudspeaker unit of the type employing a permanent magnet and a voice coil suspended in the field thereof, located at a station from which the communication system is to be controlled. This station may be aptly termed either a master or central station, and hereinafter will be referred to as a central station.

Loudspeaker units 11 similar in all respects to unit 10 are located at one or more remote stations between which and the control station it is desired to communicate.

The fluctuations in current produced in speaker units when acting as transmitters are amplified by an amplifier 12 of a construction that is to be described in detail shortly. The amplifier comprises the usual input transformer having a primary coil 13 and an output transformer having a secondary coil 14, each of which has one end thereof connected to a common conductor 15 which is suitably grounded as at 16.

A selectively operable master switch 17 is provided at the central station for connecting the speaker unit 10 thereto to either the output or input of the amplifier, and at the same time either condition the remote speaker units 11 for connection to the input of the amplifier through normally open push button switches 18 at the remote stations or directly connect them to the amplifier. Switch 17 is biased by suitable means, such as a spring, to a normal position in which the speaker unit 10 is connected to the output, and units 11 are conditioned for connection to the input of the amplifier by their respective switches 18, whereby any of the remote stations may communicate with the central station.

The switch 17 is a double pole double throw switch connected for operation as a reversing switch and, in order to provide a system using a minimum number of conductors, the switch blades 21 and 22 thereof are connected by conductors 23 and 24 to the speaker units 11 and 10, respectively. The input coil 13 is connected by a conductor 25 to the interconnected contacts 26 and 27 and the output coil is connected by conductor 28 to the interconnected contacts 29 and 30 of the reversing switch.

In the normal position of switch 17 the voice coil associated with speaker unit 10 is connected across the output of the amplifier through conductors 24, 28 and switch blade 22 in engagement with contact 30 and a direct connection through common conductor 15. In the displaced position of the switch the coil is connected across the input through conductors 24, 25 and switch blade 22 in engagement with contact 27.

In the normal position of switch 17 the voice coils associated with remote speaker units 11 are

conditioned for connection to the input of the amplifier by the push button switches 18 at the various remote stations through conductors 23 and 25 and switch blade 21 in engagement with contact 26. When closed, the switches 18 complete the circuit to the ground conductor 15 through an extension 15' of the latter and a plural position selector switch 31 at the central station normally occupying a position in which it connects conductors 15 and 15'.

The plural position selector switch 31 is provided to enable the operator at the central station to communicate with any one or all of the remote stations. When the operator desires to communicate with one station, he can do so and exclude all others from the conversation.

In the illustrated embodiment of the invention the three remote stations 11 are connected by conductors 32, 33, and 34, to separate contacts adapted selectively to be engaged by the switch 31. Thus, whenever the switch 31 is operated to connect a circuit from the common conductor 15 to any of the three last mentioned conductors, one of the remote stations 11 is connected to the common conductor 15, and the station selected is placed in communication with the central station. At this time the direction of communication is controlled solely by the operator at the central station, and further operation of the switch 18 does not affect the system in any way, because conductor 15' is no longer connected to the common conductor 15. When the operator at the central station desires to talk, he places switch 17 in its displaced position, thereby connecting speaker 10 to the input and the selected speaker 11 to the output. The connection of speaker 10 has been traced previously and the connection to the selected speaker 11 extends from the output coil 14 through conductor 28, switch 21 in engagement with contact 29, conductor 23, to the voice coil of the speaker and thence back to the output through one of conductors 32, 33 or 34, switch 31 in contact therewith, and conductor 15. When the operator at the central station desires to listen, he simply releases switch 17 which then returns to its normal position in which the speaker 10 is connected to the output coil and the selected speaker 11 to the input coil, through the circuits described above.

To enable the central station to communicate simultaneously with all remote stations, the selector switch is operable to another position in which it engages a group of contacts 35 each connected to a voice coil of one of the loudspeaker units 11. When the selector switch 31 is operated to this last position, all of the remote stations are connected directly to the amplifier so that conversation may be carried on between any one or all of the remote stations and the central station under the control of the operator at the central station.

When the amplifier 12 of the communication system is conditioned for instantaneous operation with both the cathode and anode circuits energized and the speaker units connected to the terminals of the amplifier, there is a possibility that local disturbances will be impressed upon the input of the amplifier and consequently create undesired noise at the central station. In the present embodiment, this undesired operation of the system is avoided by normally disconnecting the anode circuit of the amplifier so that the amplifier is normally inoperative. However, in order to avoid any delay before communication can be established, the cathodes of the electron

discharge devices of the amplifier are maintained at operating temperatures at all times.

The amplifier control is also so arranged that the amplifier may be placed in operative condition by the operators at the various remote stations or by the operator at the central station.

This control is achieved by means of a normally open switch 38 at each remote station and a switch 40 at the central station. The switches 38 are mechanically connected with the push button switches 18 and are, therefore, operable simultaneously with the latter, and the switch 40 is similarly arranged with respect to the selector switch 31. Before describing the details of the amplifier circuit and its power supply, it may be well to note that when the system is in its normally condition, the normally open anode circuit of the amplifier may be completed through the switches 38 by operators at the remote stations and through the power control switch 40 by the operator at the central station.

While the principles of the present invention may be embodied in communication systems utilizing various types of amplifiers, the amplifier 12 of Fig. 1 has been illustrated as comprising a pair of vacuum tubes 41 and 42. The control electrode of vacuum tube 41 is connected by a conductor 43 to one terminal of the secondary coil 44 of the input transformer, the other terminal of the coil being connected to common conductor 15 through a resistor 45. The cathode of the tube is connected to ground through the cathode biasing resistor 46 to which the suppressor grid is connected by a conductor 47 in accordance with well known principles. A bypass condenser 48 is placed in a circuit connecting the junction of coil 44 and resistor 45 to the junction of the suppressor grid and cathode. The anode of tube 41 is connected to the control grid of tube 42 through a conductor 49 having interposed therein a blocking condenser 50.

Suitable potentials are impressed upon the anode and screen grid through the plate resistor 51 and screen grid resistor 52, respectively. These potentials are obtained from a suitable power source to be described shortly through a conductor 53, leading to the positive B terminal. The values of the potentials impressed upon the plate and screen grid are determined further by a resistor 54 connecting the screen grid to conductor 15 and forming part of the direct current circuit of the power supply. A screen grid bypass condenser 55 is connected in shunt with the resistor 54.

The screen and plate of the tube 42 are supplied with potentials from the positive B terminal by a conductor 56, connected to the screen through a branch conductor 57, and to the plate through the output transformer primary coil 58, associated with the output coil 14. The cathode is connected directly to the common conductor 15 by a conductor 59 and the suppressor grid is connected to the cathode by a conductor 60. The control electrode of tube 42 is suitably biased through a grid biasing resistor 61 connected through conductor 62 to potentiometer resistance 63, connected in turn across the terminals of the choke coil 64 forming part of a rectifier. Conductor 62 is connected to conductor 15 through a by-pass condenser 65.

The power is supplied to the amplifier from any suitable alternating current source through the transformer 66, having associated therewith a secondary winding 67 connected in circuit with the various cathode heaters and a secondary

winding 68, having its end terminals connected to the anodes of a rectifier tube 70. In accordance with the usual practice the midpoint of the secondary winding 68 is connected by a conductor 71 to a filter comprising the choke coil 64 and a pair of condensers 72 connected across the conductor 71 and a conductor 73 leading from the cathode of the rectifier tube to the positive B terminal. The end of the choke coil remote from the rectifier is connected by a conductor 74 to the negative B terminal.

The cathodes are normally heated to their operating temperature so that the amplifier is in condition for instantaneous operation whenever a circuit is established from the source of power to the anodes of the tubes. Hence, since the positive B terminal is at all times connected to the screen grids and plates of tubes 41 and 42, the amplifier is rendered operative whenever the negative B terminal is connected to the grounded conductor 15. As stated above, this connection may be made by the operator at the central station through switch 40 and operators at the remote stations through switches 38.

When the system is in its normal condition, the operators at the remote stations can render the amplifier operative by closing switches 38, thereby connecting the negative B terminal to ground through conductor 75, switch 40 in its normal position, a conductor 76 connected in parallel to one contact of each of the switches 38, the other contacts of which are connected to conductor 15 through conductor 15' and switch 31.

When the system is in normal condition the operator at the central station is able to place the amplifier in operative condition by actuation of selector switch 31 to establish a circuit between conductor 15 and any of the conductors 32 to 34, inclusive, or into engagement with contacts 35. This operation of switch 31 effects operation of switch 40 into engagement with an arcuate contact bar 78 connected by a conductor 79 to a common conductor 15. Whenever the switch 40 engages the contact bar 78 the negative B terminal is connected to the ground directly through the switch 40, contact bar 78 and conductor 79.

In operation the transformer 66 is connected to a suitable source of alternating current through a switch (not shown) providing a means for controlling the energization of the entire system. Immediately upon the connection of the primary winding of the transformer to the source of power, the cathode heaters are supplied with energy through the secondary winding 67 and the secondary winding 68 is also energized. Under normal conditions the rectifier is not operative because the direct current circuit therefor is broken at the switches 38. This direct current circuit extends from the cathode of the rectifier tube through conductor 73 to the positive B terminal and from there through conductor 53, resistors 52 and 54 in series to the ground conductor 15. The ground return extends from the common conductor 15 to the conductor 75 either through the conductor 15' leading to the remote station, or the branch conductor 79 leading to the contact bar 78.

Under the normal conditions presently being considered, the ground return is completed through switches 38 whenever an operator at any one of the remote stations closes one of them to establish communication with the central station. The return extends from a switch 38 through conductor 76, switch 40, conductor 75, to

the negative B terminal, and from thence to the midpoint of the secondary winding 69 through the conductor 74, the choke coil 64, and the conductor 71. Thus when an operator at a remote station wishes to communicate with the central station, he merely closes the switch 18—38 thereby completing the connection of the speaker unit 11 at the remote station to the input of the amplifier, and placing the amplifier in operation. The amplifier is operative immediately and no delay in establishment of communication occurs.

If the operator at the central station desires to communicate with only that remote station calling him, he operates a switch 31 to establish a circuit with that station through one of the conductors 32, 33, or 34. Upon this actuation of switch 31, the switch 40 is simultaneously operated to establish a ground return to the rectifier through the conductor 79 and contact bar 78, thereby maintaining the amplifier in operative condition as well as connecting the loudspeaker at the selected remote station directly to the ground conductor 15. Thereafter the central station and remote station may communicate with each other, the direction of communication being under the full control of the operator at the central station who operates the master switch 17 to its displaced position to talk to the remote station and allows the master switch to return to its normal position whenever he desires the operator at the remote station to talk to him.

It should be noted that when the master switch is operated for communication with any one of the remote stations, the remaining stations are excluded from the system.

When the operator at the central station wishes simultaneously to communicate with all stations he operates the selector switch 31 into engagement with contacts 35, thereby connecting all the speakers 11 in parallel. Simultaneously with this operation the switch 40 is operated to establish the previously described ground return to render the amplifier operative.

The modified form of the invention illustrated in Fig. 2 differs from the modification of Fig. 1 in that the completion of the normally open ground return circuit from the rectifier to the amplifier is controlled by means of a relay adapted to be energized from either the central or remote stations. The relay, indicated generally by reference numeral 80, is adapted to be energized from an alternating current source of power, preferably the cathode heater transformer winding 67. One terminal of the winding is connected by a conductor 81 directly to the relay winding and the other terminal is connected by a conductor 82 to the contact bar 78 and by a branch conductor 83 to one terminal of each of the switches 38 at the various remote stations. The other terminals of the switches 38 are connected by a conductor 84 to a contact adapted to be engaged by the control switch 40 in its normal position. The other end of the switch 40 is connected by a conductor 85 to the other terminal of the relay winding.

The relay 80 has associated therewith a normally open switch 86 adapted to close a circuit directly across conductors 75 and 79 to complete the ground return whenever the relay 80 is energized.

The operation of the communication system illustrated in Fig. 2 is substantially the same as that of the previously described modification. Thus, when any of the operators at the remote

stations desire to communicate with the central station they simply operate the push button switches 18—38 at the remote station to their closed positions. With the switches 31 and 40 in their normal positions, this operation of the switches 18—38 results in the connection of the remote speaker to the input and the energization of the relay 80 to complete the ground return for the rectifier.

The energizing circuit for the relay extends from one terminal of the winding 67 to the relay through conductors 82, 83, switch 38 in its closed position, conductor 84, switch 40 in its normal position, and conductor 85, and from the other terminal of the relay 80 to the secondary winding through conductor 81.

Whenever the operator at the central station desires to communicate with a selected one or all of the remote stations, he simply operates switch 31 to the desired position. Upon such operation of the switch 31, the switch 40 engages the contact bar 78, thereby connecting the relay winding directly across the terminal of the secondary winding 67 through conductors 81, 82 and 85.

The modification of the invention illustrated in Fig. 3 differs from the previously described modifications in that the grid bias of one of the tubes of the amplifier is governed to control the operative condition of the amplifier.

Under normal conditions the amplifier is rendered inoperative by connecting the screen grid of tube 41 to ground, thereby rendering the tube 41 non-conductive. Whenever the amplifier is to be used the aforementioned connection is broken and the proper potential applied to the screen grid to render tube 41 conductive and the amplifier operative. This arrangement, like the previously described arrangements, conditions the amplifier and communication system for immediate transmission of speech in either direction.

Referring now specifically to Fig. 3, the system illustrated therein comprises an amplifier 12 having its cathode heaters and anodes energized in such manner as to render the amplifier ready for immediate operation whenever the proper potential is applied upon the screen grid of tube 41 as described hereinafter. For this reason the negative B terminal is connected directly to the common conductor 15 through conductor 90.

The amplifier circuit connections are substantially the same as those of the previously described modifications, the only difference residing in the provision made normally to connect the screen grid directly to ground by short circuiting resistor 54.

Inasmuch as the positive B terminal is connected to the plates of tubes 41 and 42 through circuits including conductors 53 and 56, it is evident that the rectifier is operative and its output impressed across the plates and grids of the tubes. The rectifier circuit extends from the positive B terminal through conductor 53, resistor 52 directly to the negative B terminal through the short circuit around resistor 54 to be described shortly. Since the negative B terminal is grounded, the screen grid of tube 41 is normally at ground potential to render the tube non-conductive, but this does not materially affect the operation of the rectifier because the screen grid resistor 52 is of a high value (in the neighborhood of 250,000 ohms) in accordance with usual practice.

The resistor 54 is normally short circuited

through a circuit including the selector switch 31 at the central station, and series connected normally closed switches 91, 92 and 93 at each of the remote stations and operable simultaneously with switches 18 thereat. One terminal of the resistor 54 is connected directly to common conductor 15, as in the previous modifications, but the other terminal has an additional connection through conductor 94 to one contact of switch 91. The other contact of switch 91 is connected by conductor 95 to one contact of switch 92, the other contact of which is connected to one contact of switch 93. The remaining contact of the latter is connected directly to conductor 15' to complete the series connection of the switches.

The operation of the system as a whole is substantially the same as that of the previously described modifications, and consequently it is deemed necessary only to describe the operation whereby the amplifier is rendered operative under either the control of the operator at the central station, or the operator at any one of the remote stations.

With the transformer 66 connected to a suitable source of power and the various switches in their normal and illustrated positions, any one of the operators at the remote stations is able to establish communication with the central station and render the amplifier operative by operation of switches thereat to their displaced positions. Thus when the operator at the first station operates switch 18—91 to its displaced position, the speaker unit 11 thereat is connected by switch 18 to the input of the amplifier, and the switch 91 breaks the short circuit across resistor 54. Accordingly, the proper operating potential is impressed upon the screen grid and the amplifier rendered operative.

When the operator at the central station responds to a call from the first station, he operates switch 31 to establish a circuit from conductor 15 to conductor 32, thereby rendering the circuit including the switch 18—91 ineffective and likewise removing the short circuit across resistor 54 which, as described above, comprises switch 31 in its normal position. The operator at the central station controls the direction of communication at all times, and when a conversation is concluded he returns switch 31 to its normal position, thereby again conditioning the system for a call from any one of the remote stations upon operation of the switches thereat.

Thus, as in the previous modifications, either the operator at the central station, or any one of the remote stations is able to establish communication immediately upon operation of a single switch at his station.

While only three remote stations have been illustrated in the description of the invention, it is apparent that the number of stations can be altered at will merely by modifying the number of contacts associated with switch 31 and, in the case of the two first described modifications, the length of the contact bar 78. Furthermore, the invention is applicable to a system using an amplifier having more than two stages of amplification and it is not necessary that the grid potential of the tube in the first stage be controlled to control the operative condition thereof.

What I claim as new and desire to secure by United States Letters Patent is:

1. A two-station intercommunicating system, including in combination, voice receiving and transmitting means at each station, an amplifier, 75

means including a reversing switch at one station for selectively connecting the voice receiving and transmitting means thereat directly to the output and input of the amplifier and conditioning the voice receiving and transmitting means at the other station for connection to the input and output of the amplifier, and control means at the second station for completing the connection of the voice receiving and transmitting means at said station to the amplifier.

2. A two-station intercommunicating system, including in combination, a loudspeaker unit of the type adapted to function as a microphone and loudspeaker and comprising a voice coil at each station, an amplifier of the type having one terminal of its input and output connected to a common conductor, means including a reversing switch at a first station and a single conductor leading therefrom to one terminal of the voice coil associated with each speaker for alternately connecting the said terminals of said coils directly to the other terminals of the input and output of the amplifier, a direct connection from the other terminal of the voice coil at the first station to the common conductor whereby the connection of the speaker unit at the first station to the amplifier is controlled by said reversing switch, and a circuit including a normally open switch at the second station for connecting the other terminal of voice coil of the speaker thereat to the common conductor.

3. A two-station intercommunicating system, including in combination, a loudspeaker unit of the type adapted to function as a microphone and loudspeaker and comprising a voice coil at each station, an amplifier having one terminal of its input and output connected to a common conductor, means including a reversing switch at a first station and a single conductor leading therefrom to one terminal of the voice coil associated with each speaker for alternately connecting said terminals of the coils directly to other terminals of the input and output, said reversing switch being biased to connect the voice coil at the first station to the output and that at the second station to the input, a direct connection from the other terminal of the voice coil at the first station to the common conductor and a normally open switch for connecting the other terminal of the voice coil at the second station to the common conductor, whereby the system is normally conditioned for communication from the second station to the first upon closure of the normally open switch.

4. An intercommunicating system, including in combination, a central station, a plurality of remote stations, voice receiving and transmitting means at each station, an amplifier, means including a reversing switch at the central station for selectively connecting the voice receiving and transmitting means thereat directly to the output and input of the amplifier and simultaneously conditioning the voice receiving and transmitting means at the remote stations for connection to the input and output of the amplifier, and control means at each remote station for completing the connection of the voice receiving and transmitting means thereat to the amplifier.

5. An intercommunicating system, including in combination, a central station, a plurality of remote stations, voice receiving and transmitting means adapted to function as microphones and loudspeakers at each station, an amplifier, means including a reversing switch at the central station for selectively connecting the voice receiving

and transmitting means thereat directly to the input and output and simultaneously partly conditioning the voice receiving and transmitting means at the remote stations for connection to the output and input of the amplifier, means including a selector switch at the central station for selectively completing conditioning of the voice receiving and transmitting means at the remote stations to the amplifier, and control means at each remote station for completing the connection of the voice receiving and transmitting means thereat to the amplifier.

6. An intercommunicating system, including in combination, a central station, a plurality of remote stations, speaker units adapted to function as microphones and amplifiers at each station, an amplifier having one of its input and output terminals connected to a common conductor, means including a reversing switch connected to the other terminals of the input and output, a first conductor leading therefrom to the speaker unit at the central station and a second conductor leading therefrom to all the remote speakers for selectively connecting the conductors to the output and input, said switch being biased to a normal position in which the first conductor is connected to the output and the second conductor to the input, a direct connection from the speaker at the central station to the common conductor, said common conductor having an extension to the remote stations that is adapted to be connected to the previously mentioned portion thereof, a plural position selector switch at the central station adapted in one position to connect the extension to the common conductor, a branch circuit comprising a normally open switch at each remote station for completing the connection of the speakers thereat to the input of the amplifier when the reversing switch is in its normal position and the selector switch is in its said one position, and branch circuits leading directly from speakers at each remote station to the plural position selector switch whereby the latter may be selectively operated directly to connect the speakers at the remote stations to the amplifier and the communication to the selected station controlled solely by the reversing switch.

7. A multiple station intercommunicating system, including in combination, voice receiving and transmitting means adapted to function as microphones and loudspeakers at each station, amplifier means normally in an inoperative condition, control means at a first station for selectively connecting the voice receiving and transmitting means thereat to the output and input of the amplifier means and for conditioning the voice receiving and transmitting means at a second station for connection to the input and output of the amplifier, and control means at the second station for simultaneously completing the connection of the voice receiving and transmitting means thereat to the amplifier and rendering said amplifier means operative.

8. A multiple station intercommunicating system, including in combination, voice receiving and transmitting means adapted to function as microphones and loudspeakers at each station, amplifier means normally in an inoperative condition, control means at a first station for selectively connecting the voice receiving and transmitting means thereat to the output and input of the amplifier and for partly conditioning the voice receiving and transmitting means at a second station for connection to the input and output of the amplifier, and means including a se-

lector switch at the first station adapted selectively to complete the connection of the voice receiving and transmitting means at the remote stations for rendering the amplifier operative upon such connection.

9. An intercommunicating system, including in combination, a central station, a plurality of remote stations, voice receiving and transmitting means adapted to function as microphones and loudspeakers at each station, amplifier means normally in an inoperative condition, means including a control switch at the central station for selectively connecting the voice receiving and transmitting means thereat to the output and input of the amplifier means and for partly conditioning the voice receiving and transmitting means at the remote stations for connection to the input and output of the amplifier, means including a selector at the central station selectively operable to complete the connection of any one or all of the voice receiving and transmitting means at the remote stations to the amplifier, and additional switch means operable simultaneously with the selector switch when the latter is operated to select any one of the stations for rendering said amplifier means operative.

10. An intercommunicating system, including in combination, a central station, a plurality of remote stations, loudspeakers adapted to function as microphones and loudspeakers at each station, amplifier means including one or more electron discharge devices normally in an inoperative condition, control means at the central station for selectively connecting the loudspeaker thereat to the output and input of the amplifier means and for simultaneously partly conditioning the loudspeakers at the remote stations for connection to the input and output of the amplifier, said control means being biased to a normal position in which the loudspeaker at the central stations is connected to the output and the loudspeakers at the remote stations partly conditioned for connection to the input, a plural position selector at the central station adapted in a first position to complete the conditioning of the loudspeakers at the remote stations for connection to the amplifier and in the remaining positions to complete the connection of these loudspeakers to the amplifier, control means at each remote station for completing the connection of the loudspeakers thereat to the amplifier when the selector is in its first position, means effective upon operation of the selector to any one of its said remaining positions for rendering said amplifier operative, and means operable simultaneously with each of said remote station control means for rendering said amplifier operative when the selector is in its first position.

11. A multiple station intercommunicating system, including in combination, a central station, one or more remote stations, a loudspeaker adapted to function as a microphone and loudspeaker at each station, an amplifier including electronic devices comprising cathodes normally in condition for instantaneous operation and anodes normally disconnected from a source of potential whereby said amplifier is normally inoperative, control means at the central station for selectively connecting the loudspeaker thereat to the output and input of the amplifier and conditioning the loudspeakers at the remote stations for connection to the input and output of the amplifier, and control means at the remote stations for simultaneously completing the connection of the speakers thereat to the amplifier and connecting

the anodes to the source of potential to render said amplifier operative.

12. A multiple station intercommunicating system, including in combination, a central station, one or more remote stations, a loudspeaker adapted to function as a microphone and loudspeaker at each station, an amplifier including electronic devices comprising cathodes normally in condition for instantaneous operation and anodes normally disconnected from a source of potential whereby said amplifier is normally inoperative, control means at the central station for selectively connecting the loudspeaker thereat to the output and input of the amplifier and conditioning the loudspeakers at the remote stations for connection to the input and output of the amplifier, and additional control means at the central station for simultaneously completing the connection of any or all of the remote stations to the amplifier and connecting the anodes to the source of potential to render said amplifier operative.

13. A multiple station intercommunicating system, including in combination, a central station, one or more remote stations, a loudspeaker adapted to function as a microphone and loudspeaker at each station, an amplifier including electronic devices comprising cathodes and anodes, a source of potential, a transformer comprising a primary winding, a secondary winding for heating said cathodes to render the amplifier ready for substantially instantaneous operation, means including a second secondary winding and a rectifier normally disconnected from but adapted to be connected to said anodes to render the amplifier operative, control means at the central station for selectively connecting the loudspeaker thereat to the output and input of the amplifier and conditioning the loudspeakers at the remote stations for connection to the input and output of the amplifier, a switch at each remote station for completing the connection of the speaker thereat to the amplifier, and means including a switch operable simultaneously with the last mentioned switch and a relay connected thereby across the terminals of the first mentioned secondary winding for connecting the rectifier to the anodes, whereby said amplifier is rendered operative upon closure of the switches at the remote stations.

14. A multiple station intercommunicating system, including in combination, a central station, one or more remote stations, a loudspeaker adapted to function as a microphone and loudspeaker at each station, an amplifier including an electronic device comprising a cathode, an anode and a control electrode, a source of potential for said amplifier, means including a normally closed circuit for controlling the potential impressed upon the control electrode of said device for normally rendering said device inoperative, control means at the central station for selectively connecting the loudspeaker thereat to the output and input of the amplifier and conditioning the loudspeakers at the remote stations for connection to the input and output of the amplifier, and control means at each remote station for simultaneously completing the connection of the speaker thereat to the amplifier and breaking said normally closed circuit for rendering said amplifier operative.

15. A multiple station intercommunicating system, including in combination, a central station, one or remote stations, a loudspeaker adapted to function as a microphone and loudspeaker at each station, an amplifier including electronic devices comprising cathodes, anodes and control

electrodes, a source of potential for said amplifier, means including a normally closed circuit for controlling the potential impressed upon a control electrode of one of said devices for normally rendering said device inoperative, control means at the central station for selectively connecting the loudspeaker thereat to the output and input of the amplifier and conditioning the loudspeakers at the remote stations for connection to the input and output of the amplifier, and additional control means at the central station for simultaneously completing the connection of any of the remote stations to the amplifier and breaking said normally closed circuit for rendering said amplifier operative.

16. A multiple station intercommunicating system, including in combination, a central station, one or more remote stations, a loudspeaker adapted to function as a microphone and loudspeaker at each station, an amplifier including an electronic device comprising a cathode, an anode and a control electrode, a source of potential for said amplifier, a common grounded conductor, a plural position selector switch at the central station, means including said selector switch in its normal position and series connected switches at the remote stations for normally connecting said control electrode to ground to render said device nonconductive, branch conductors leading to the selector switch from the loudspeakers at the remote stations and adapted to be engaged thereby in its positions other than said normal position for connecting the loudspeakers to the amplifier, whereby said short circuit is broken to render said device conductive upon operation of said selector switch from its normal position, means including other branch conductors and normally open switches at each remote station for connecting the loudspeakers thereat to the amplifier through said selector switch in its normal position, each of said last mentioned switches being operable simultaneously with one of said series connected switches, whereby said short circuit is broken to render said device conductive upon operation of said last mentioned switches to connect the remote loudspeakers to the amplifier.

17. An intercommunicating system, including in combination two or more remotely located stations, voice receiving and transmitting means of the type adapted to function as a microphone and loudspeaker at each station, an amplifier, means including a reversing switch at one station for selectively connecting the voice receiving and transmitting means thereat directly to the output and input of the amplifier and conditioning the voice receiving and transmitting means at the other stations for connection to the input and output of the amplifier, and control means at the said other stations for completing the connection of the voice receiving and transmitting means at said stations to the amplifier.

18. An intercommunicating system, including in combination two or more remotely located stations, voice receiving and transmitting means at each station, an amplifier, a communication control switch at one station for controlling the connection of the voice receiving and transmitting means to the amplifier, switch means at said one station selectively operable from a predetermined position to complete the connection of the voice

receiving and transmitting means at the other stations to the amplifier, and control means at each of said other stations for completing the connection of the voice receiving and transmitting means thereat to the amplifier through said switch means when the latter is in said predetermined position.

19. In a multiple station intercommunicating system, the combination including normally inoperative amplifier means, a plurality of interstation conductors, means for selectively connecting said interstation conductors to said amplifier, and means operable simultaneously with said last-mentioned means for rendering operative said amplifying means.

20. In a multiple station intercommunicating system, the combination including normally inoperative amplifier means, a plurality of interstation conductors, selector means at one station for selectively connecting interstation conductors to said amplifier, said selector means being operable to and normally occupying a position in which said conductors are disconnected from said amplifier, means at another station for connecting that station to the amplifier through said selector means, and means operable simultaneously with said last-mentioned means for rendering operative the amplifier means.

21. In a multiple station intercommunicating system comprising a central station and a plurality of remote stations, the combination including normally inoperative amplifier means at the central station, voice receiving and transmitting means at the central station normally connected to the amplifier, voice receiving and transmitting means at each of the remote stations, and means including a switch at each remote station for simultaneously connecting the voice receiving and transmitting means thereat to the amplifier means and rendering the amplifier means operative.

22. In an intercommunicating system the combination including an amplifier, a source of power for said amplifier, a voice reproducer located remote from the amplifier and adapted to be connected to said amplifier, a switch near said reproducer for connecting it to the amplifier, and other switch means operable simultaneously with said first mentioned switch for connecting said amplifier to said source of power.

23. In a multiple station intercommunicating system of the loudspeaking type, the combination including, an amplifier including electronic devices comprising cathodes and anodes, a source of potential, a transformer comprising a primary winding adapted to be energized from said source and a secondary winding for heating said cathodes to render said amplifier ready for substantially instantaneous operation, means including a second secondary winding and a rectifier normally disconnected from but adapted to be connected in circuit to said anodes to render the amplifier operative, a plurality of interstation conductors, means for selectively connecting said interstation conductors to said amplifier, and means including a switch operable simultaneously with said last-mentioned means for completing the circuit from said rectifier to said anodes for rendering the amplifier operative.

RICHARD H. CAMPBELL.

DISCLAIMER

2,162,369.—*Richard H. Campbell*, Racine, Wis. COMMUNICATION SYSTEM. Patent dated June 13, 1939. Disclaimer filed November 27, 1944, by the assignee, *Webster Electric Company*.

Hereby enters this disclaimer to claim 22 of said patent.

[*Official Gazette December 19, 1944.*]