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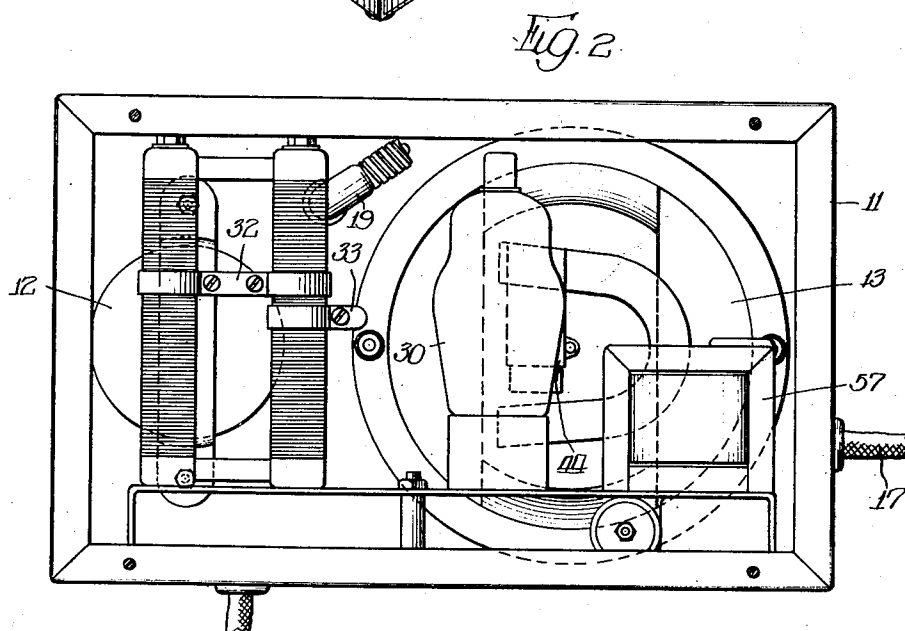
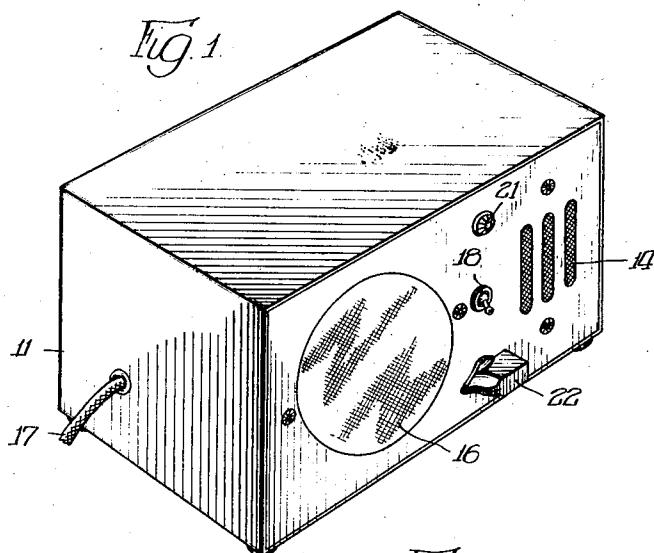
L. A. MOLIN ET AL

2,157,140

TRANSMITTING AND AMPLIFYING SYSTEM

Filed Sept. 26, 1936

3 Sheets-Sheet 1



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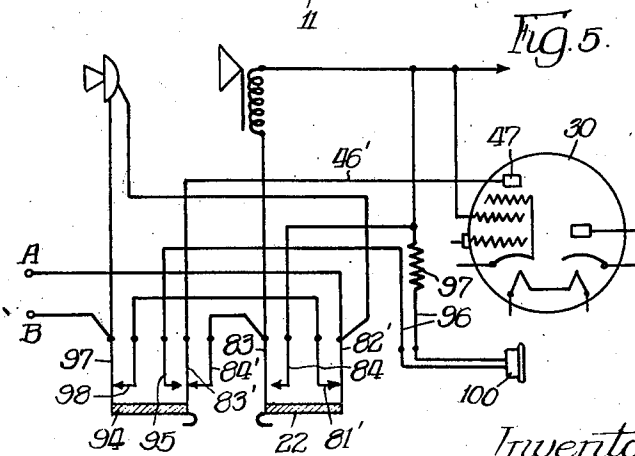
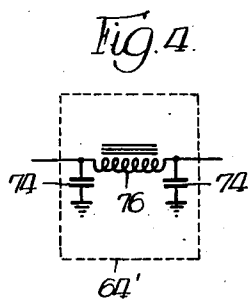
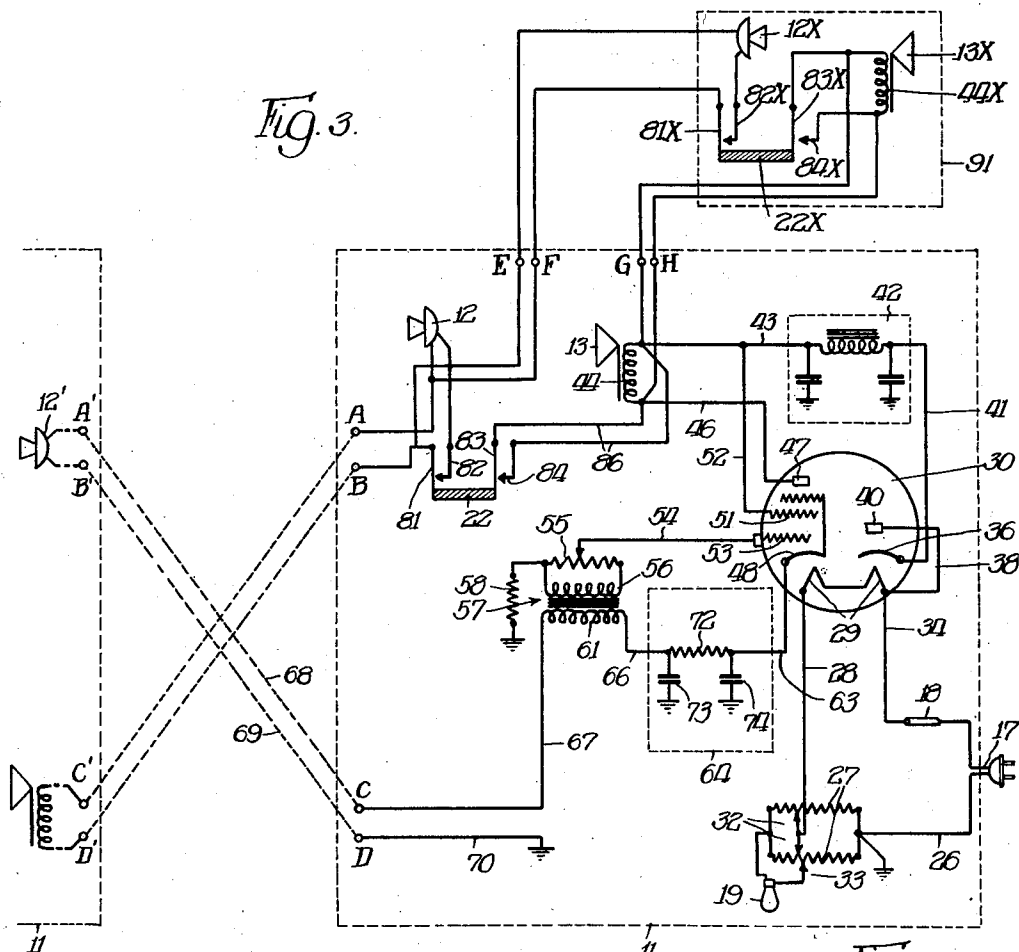
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TRANSMITTING AND AMPLIFYING SYSTEM

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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 6.

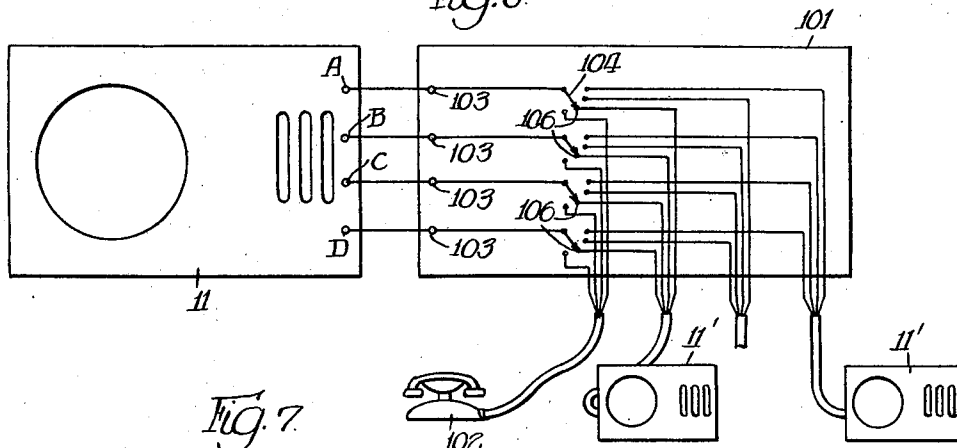
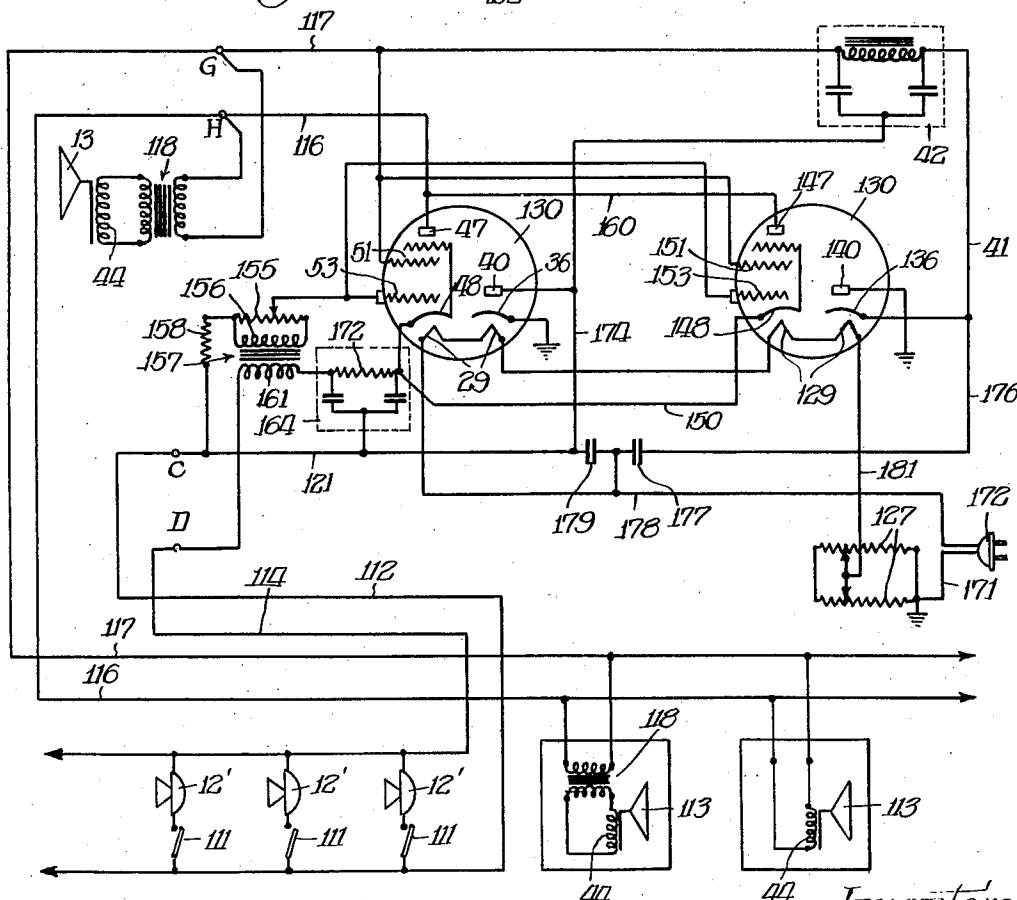


Fig. 7.



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UNITED STATES PATENT OFFICE

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TRANSMITTING AND AMPLIFYING SYSTEM

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Application September 26, 1936, Serial No. 102,821

14 Claims. (Cl. 179—1)

This invention relates to voice amplification and transmission and more particularly to a simplified sound amplifying circuit and to various uses thereof.

In its illustrated form the entire circuit may operate from an ordinary direct or alternating current supply with a single multipurpose tube, one portion of which serves as a rectifier and the other as an amplifier; two filters being provided, one for smoothing out the rectified current and the other between the microphone and the amplifying section of the tube for permitting independent modulations of the direct current which passes in series through the microphone, a primary transformer coil the amplifying tube and the loud speaker.

An important object of the invention is to provide a simplified circuit for amplifying sound in which the microphone and the loud speaker are operated by having the same current flow through both, although the modulations of this current are greatly amplified between the microphone and the speaker.

Another object of the invention is to provide a simplified interoffice communication system and one which will be at least as satisfactory as the more complicated and expensive systems heretofore known, and one which will do away with the batteries required by such systems heretofore.

Another object of the invention is to provide a simplified call system or public address system.

Still another object of the invention is to provide improved features of interconnecting office communicating or paging units.

Additional objects will be apparent from the following description and from the drawings, in which:

Fig. 1 is a perspective view of a unit embodying one form of this invention.

Fig. 2 is a rear view of the structure shown in Fig. 1.

Fig. 3 is a circuit diagram of the structure shown in Fig. 1, together with an extension station connected therewith, and indicating the connections to a distant unit.

Fig. 4 is a fragmentary circuit diagram of a filter unit which may be replaced for one shown in Fig. 3.

Fig. 5 is a fragmentary diagrammatic illustration showing a modification in which an ear-phone may be connected in place of the loud speaker.

Fig. 6 is a diagrammatic illustration of a switch-board for connecting a unit such as that shown in

Fig. 1 with any one of a plurality of similar units or telephone sets; and

Fig. 7 is a diagrammatic illustration of a circuit similar to that shown in Fig. 3, but using two tubes and connected as for a call system or a public address system.

Although this invention may take numerous forms, only a few have been chosen for illustration. The form illustrated particularly in Figs. 1 to 3 is shown as used in an intercommunicating system especially suitable, for example, for use in offices in which one unit is positioned on the executive's desk and another positioned on the desk of some other person in the organization.

The unit includes a case 11 carrying a microphone 12 for picking up and transmitting the sound waves of the person talking near this unit, and a loud speaker 13 for reproducing the voice of the speaker at the distant unit. The case is, of course, provided with a suitable opening or openings 14 for passing sound to the microphone and a suitable opening 16 for emitting the sound produced by the speaker. The unit is preferably also provided with a plug-in power cable 17 for plugging into a convenience outlet which may be the customary 110 volt circuit, either A. C. or D. C. A switch 18 is provided for turning the power on and off, and a pilot light 19 visible through a lens 21 in the casing is provided for indicating when the power is turned on. Another switch 22 is provided for connecting the unit for talking or listening alternatively.

The arrangement of the various parts of the circuit can be seen in Fig. 2, but the circuit as a whole will be made more clear by reference to Fig. 3, in which the unit of Figs. 1 and 2 is enclosed within the dotted line 11 (representing case 11). An identical distant unit is represented by 11' and a simple local extension unit by 91. From the cable 17 one wire 26 leads to a resistance unit which may comprise parallel resistance elements 27. A wire 28 connects these resistance elements 27 with the heaters 29 of the multipurpose tube 30, which is known on the market as type 12—A7. If desired, the wire 28 may be connected to the resistance elements 27 through adjustable taps 32. It should also be noted that the pilot light 19 may be connected across a portion of the resistance by the adjustable tap 33. The other side of the heaters 29 is connected to the supply cable 17 through a wire 34 and the switch 18. It is thus seen that whenever the switch 18 is closed, the heaters 29 are heated to heat the cathode 36 to maintain the set in condition for operation.

The multipurpose tube 30 has two independent sections, the section shown on the right-hand side of Fig. 3 being a rectifier section and that on the left-hand side being a pentode amplifier section. The plate circuits for the tube may be traced beginning with wire 34, which should be connected to the positive side of a direct current line and, of course, is inevitably positive during one-half of the cycle if connected to an alternating current line. Wire 34 is connected by wire 38 with plate 40 so that when wire 34 is positive an electronic current can be drawn from cathode 36 to plate 40, the cathode 36 being supplied with current through the wire 41. Since current can not flow in the other direction from plate 40 to cathode 36, the current in wire 41 is rectified in accordance with well known principles.

Also in accordance with well known principles, a filter 42 is provided for smoothing out the flow of current which in wire 41 is pulsating if the unit is connected to A. C. current, so that in wire 43 the flow of current may be smooth. Wire 43 is connected to the coil 44 of speaker 13 which is a magnetic type of speaker. This coil is connected by wire 46 to plate 47 of the pentode section of the tube 30. Plate 47 draws current from cathode 48 which is connected to ground in a manner to be described so that the plate circuit is completed through ground to wire 26.

The screen grid 51 of the tube 30 is connected by wire 52 to wire 43. A portion of the total cathode current of the pentode section passes to the screen grid and thence to wire 43, maintaining the screen grid at positive potential with relation to the other elements of the tube. This screen grid current flows through the microphone circuit but not through the speaker, hence providing a desirable surplus for the microphone circuit.

The control grid 53 of tube 30, which produces the voice modulations in the current flowing through the speaker 44, is connected by wire 54 to a volume control resistance 55 across a secondary coil 56 of transformer 57, one side of which may be connected through a resistance 58 to ground, as shown, to provide additional grid bias when necessary for a satisfactory tone. Current in the secondary coil 56 with a corresponding voltage on the control grid 53 is induced by primary coil 61 of the transformer 57 which in turn is controlled by the microphone 12' of the remote unit.

The microphones 12 and 12' are preferably a carbon resistance type of microphone and therefore a normally constant current should be provided to be passed through the microphone 12' and the primary coil 61 in series to be modulated by the microphone 12' in order to modulate the voltage on control grid 53 which in turn causes a reproduction of the sound by the speaker 13. It may be mentioned at this point that each of the units 11 and 11' is provided with four terminals A, B, C, and D. The terminals A and B of one unit are connected to the terminals C' and D' of the other unit, and the terminals A' and B' of the second unit are connected to terminals C and D of the first unit.

The current for the microphone and primary coil 61 may be called the microphone current and is provided by virtue of the fact that the microphone and coil 61 are connected in series between the cathode 48 and ground. This circuit may be traced from cathode 48 through wire 63, resistance 72 of filter 64, wire 66, coil 61, wire 67, terminal C, wire 68 extending between units, through local circuits adjacent microphone 12' to be described,

through the distant microphone 12', back through line wire 69, terminal D and wire 70 to ground.

It will be observed that when no sound is being picked up by the microphone 12', the same current passes through the microphone 12', through the primary coil 61, through the pentode section of the tube to plate 48 and through the coil 44 of the speaker. However, when sound is picked up by microphone 12', this modulates the microphone current which, as stated in the previous sentence, is the same current that passes through the speaker circuit. The current passing through the speaker circuit, however, has greatly amplified modulations as a result of the action of the control grid 53. To prevent conflict between the amplified modulations in the speaker circuit and the unamplified modulations in the microphone circuit, the filter 64 is provided. As shown in Fig. 3, this filter comprises a resistance 72, through which the microphone current flows to the cathode 48, and the condensers 73 and 74 which smooth out the pulsations on the opposite sides of the filter to prevent conflict between them. The condenser 74 is a by-pass for the audio-frequencies handled by the tube 30. Talking into the microphone 12' causes current variations on the microphone side of filter 64. These variations are induced into the secondary 56 and fed to the grid 53 to be amplified and reproduced in the speaker. The condenser 73 acts to smooth out these pulsations or variations and prevents their interference with the normal action of the tube.

In place of the resistance 72 there may be provided an inductance 76, as seen in Fig. 4. The inductance 76 may be the primary coil 61 of the transformer, if desired, in which case a single condenser on the cathode side of the transformer serves the dual purpose of by-passing audio-frequencies of the cathode plate to ground and of furnishing the additional current necessary for operation of the microphone. Such an arrangement is not preferred because of the desirability of using the resistance 72 to balance the various line loop resistances, and it would be undesirable to wind different sizes of transformers or chokes for this purpose.

This completes the fundamental circuit description, but there are various additional features used in conjunction with this fundamental circuit which should also be described. The most universally used of these additional features is probably the listening and talking switch although its form and operation vary in different systems.

In the form shown in Fig. 3, the listening and talking switch 22 has two contact arms 81 and 83. In most units the contact arm 81 will be in a position to render the microphone ineffective, it being shown normally open at the contact 82 for breaking the circuit to the microphone 12. The purpose of this is to prevent howling. If the microphone 12 and speaker 13 are both functioning at both ends of the line, howling may result in that sound produced by the speaker 13 will be picked up by the adjacent microphone and reproduced and again picked up at the remote unit. Obviously the contact arm 81 could close a shunt across the microphone instead of opening the circuit.

As shown in Fig. 3, the contact arm 83 of switch 22 is normally open and ineffective. This leaves the speaker 13 in condition to be actuated by the microphone at the remote point. When it is desired to talk over the microphone 12, the key 22 is operated to close the contact 81, thus placing

the microphone 12 in the circuit of terminals A and B which, being connected to terminals C' and D' of the remote unit, connect the microphone 12 to operate the speaker at the remote unit just as the microphone 12' operates the speaker 13 in the manner previously described. At the same time that contact 81 closes, contact 83 closes, thereby closing a shunt through wires 86 across the coil 44 of the speaker 13 to prevent howling in case both the microphone and the speaker at the other unit are operative. Of course, at either one of the units the contact arm 83 or its adjacent contact 84 may be omitted so that the speaker at that end will never be disconnected.

In Fig. 5 a modification is illustrated in which an auxiliary earphone is provided, together with a switching arrangement which will permit disconnecting the speaker so that the person having the earphone can listen with privacy. It will be understood that this is a fragmentary showing in which the remainder of the unit would be the same as the main unit shown within the dotted line 11 in Fig. 3. The lead 46' instead of extending from the plate 47 of tube 30 would extend to contact arm 83' of an earphone switch 94. Contact 83' is normally in contact with 84' to connect the speaker in the circuit as illustrated. When the earphone switch 94 is operated, contact arm 83' breaks with contact arm 84' to disconnect the speaker and connects with contact arm 95 to connect the earphone 100 through wires 96 and resistance 97, which is of proper value for limiting the current in the earphone to a satisfactory value, the earphone being perhaps of a thousand ohms resistance. At the same time that the earphone switch 94 is operated to connect the earphone in place of the speaker, it operates the contact arm 96 to break the contact 78 in order to break the shunt for the microphone so that the microphone will be connected. There is no danger of howling while a person is holding the earphone to his ears and so both the microphone and earphone may be connected at the same time as in the ordinary telephone.

When it is not desired to use the earphone, the talking switch 22 may be operated in the usual manner having substantially the same effect as in Fig. 3, the contact 83 closing when the switch operates for talking to shunt across the speaker by closing against the contact 84, thus rendering the speaker inoperative to prevent howling. The contact arm 82' has been shown normally closed against a contact 81' for closing a shunt across the microphone when the switch is not operated for talking. Shunting across the microphone, of course, has the same ultimate effect as disconnecting the microphone as shown in Fig. 3. In connection with switches 22 and 95 it should be understood that these switches would usually be operated optionally by a single key.

Another additional feature which may be used with the unit of Figs. 1 and 2 is an extension unit shown diagrammatically at 91 in Fig. 3. In this extension unit there is no source of power provided, the source of power in the main unit being utilized. A speaker 13X, a microphone 12X, a listening-talking switch 22X are the only necessary elements for this extension unit, and even the switch 22X may sometimes be omitted. The coil 44X of the speaker 13X is connected in parallel with the coil 44 of the main speaker and microphone 12X is connected through switch 22 in parallel with the main microphone 12. Thus, it is apparent that when a person at a

distant station talks into the microphone 12', after pressing his talking key, his voice will be reproduced both by speakers 13 and 13X. When an operator at the extension station 91 desires to reply, he merely shifts the key 22X which closes contact arm 81X against the contact 82X to connect the microphone 12X in the circuit of the distant unit. At the same time contact arm 83X will close against contact 84 to shunt the coil 44X so as to prevent howling.

It should be understood that in most installations, the extension unit 91 will not be desired, but Fig. 3 illustrates how simple it may be and how easily it may be attached. Where it is expected that extension units may be desired, terminals E, F, G, and H may be provided on the main unit for this purpose and these terminals as well as the terminals A, B, C, and D may be of the plug-in type, if desired.

In Fig. 6 is illustrated a switchboard 101 for connecting a unit 11 to any one of a plurality of different units, consisting of either units 11' similar to the unit 11 or telephone instruments 102. In the case of telephone instruments special signalling means may be provided, if desired, and any arrangement may be made for providing power for talking to the user of the telephone instrument, since such instruments do not normally include a source of power. The switchboard 101 may be provided with suitable terminals 103 for connection with the terminals A and B of the unit 11. To each of the terminals 103 a connection may be made to one of a bank of switches 104 which operate in unison to connect the four terminals 103 to four contacts, such as the contacts 106 which are all connected to one of the units 11' with the result that the units 11 and 11' are connected as shown in Fig. 3.

In Fig. 7 there is shown an amplifying circuit in which two tubes 30 and 130 are used in a generally parallel arrangement for increasing the output available for the speakers. This feature of parallel tubes may be used in the units shown in the preceding figures, if desired, although the two tubes will not ordinarily be necessary under the circumstances there illustrated. In Fig. 7 the two tube circuit has been illustrated as used in a call system suitable, for example, for paging a salesman in a store or a foreman in a plant.

For this purpose there may be provided a plurality of microphones 12' located at different points of convenience and each having associated therewith a normally open switch 111 so that by closing the switch at any microphone that microphone may be connected into the circuit. These microphones may be connected across wires 112 and 114 which may be plugged in at the terminals C and D. There may likewise be a number of loud speakers 13 and 113 connected in parallel across wires 116 and 117. The speaker 13 may be built into the unit and the other speakers may be connected to an extension line which may be plugged in at the terminals G and H. Each of the loud speakers may be provided with a transformer 118 which may have a ratio of 1 to 1, its sole purpose being to keep the speaker windings 44 out of the plate circuit if this be desired.

The fundamentals of this circuit are the same as in Fig. 3 even though two tubes 30 and 130 are provided. This may best be made clear by tracing the rectified portion of the circuit starting with common wire 121 and considering at first only the pentode section of tube 30. From wire 121 the rectified current passes through wire

112, through whichever microphone 12' has its switch closed, back to the unit through wire 114, through primary coil 161 of transformer 157, through resistance 172 of the special filter 164, through the cathode 48, thence by electronic discharge to plate 47 and wire 116, through the loud speakers (or the primary coils of the transformers 118 when such transformers are provided), back through wire 117, through the filter 42 to wire 41 and to the rectifying portion of tube 130. This rectified circuit is obviously substantially the same as that shown in Fig. 3, the same current passing through the microphones and the loud speaker circuit, interference between these two portions being prevented by filter 164.

There will normally be several loud speakers in parallel and it is for this reason and also to provide more volume in the loud speakers that the two tubes 30 and 130 are provided. The pentode sections of these tubes are connected in parallel. Thus, the secondary 156 of transformer 157 is connected to both control grid 53 of tube 30 and control grid 153 of tube 130. Resistances 155 and 158 correspond to the resistances 55 and 58 of Fig. 1. Likewise, screen grids 51 and 151 are both connected to wire 117. Furthermore, the electronic flow through the pentode sections of the two tubes is in parallel for cathode 148 is connected by wire 150 with cathode 48, and plate 147 is connected by wire 160 with plate 47.

The rectifier sections of the two tubes 30 and 130 are connected in an arrangement which doubles voltage when connected to an A. C. source of power, and since this arrangement is conventional it need not be described in detail.

The circuit of Fig. 7 with its two tube-rectification and with its two pentode sections in parallel provides ample power for operating several loud speakers, and the circuit is therefore adequate either for a call system or for a public address system. Both the circuit in Fig. 7 and the circuit of Fig. 3 combine the characteristic of extreme simplicity and low cost with high dependability and quality. This is largely accomplished by virtue of utilizing the same current in the microphone circuit and the loud speaker circuit, interference between the two portions of this combined series circuit being prevented by filter 164.

An important feature of both of the circuits of Figs. 3 and 7 is that the switch for the microphone is in the plate circuit of the tube and keeps this circuit open except when the system is actually in use. This increases the life of the tubes amazingly, it being estimated that they will last perhaps 300 times as long as they would otherwise. The system may be turned on, with the tubes heated, for eight hours or more a day, but the electronic circuit can flow from the cathode only during the time that the microphone circuit is closed for talking.

Although the various resistances, inductances, condensers, and the like may have a wide range of values and flexibility in this respect is one important feature of the invention, the following suitable values may be mentioned as one example of values which will be satisfactory.

In filter unit 42 the inductance may be a 500-ohm, 15-henry inductance. The condensers may be 8-microfarad, 600-volt condensers, although in the Fig. 3 form 175-volt condensers will be sufficient, and in view of the half wave character

of the rectification it is better that the right-hand condenser be at least 16-microfarad.

The resistance of the speaker coil or of the primary coil of the output transformer, if one is provided, together with the resistance of the remainder of the speaker circuit should be such that the plate current will not exceed 15-mills for the amplifier section of each tube. It follows that if several speakers are connected in-parallel the individual resistances should be higher than when only one speaker is connected. Furthermore, in Fig. 7 where two tubes are used, the total plate current may be 30-mills.

In the filter unit 64 the resistance 72 may be of 600 to 1000 or more ohms depending on the microphone circuit, and the relation of the resistance 72 to the current flowing through it should be such as to provide a proper grid bias. The condensers may be 50-volt condensers having a capacity of from 3 to 25 microfarads, the electrolytic type being preferred. The resistance of the microphone and the microphone leads including the wires between stations should be such that the external loop resistance does not exceed 1000-ohms. The volume control resistance 55 may desirably be 250,000-ohms and the grid leak resistance 58 may be anything up to about 1500-ohms. It may also be noted that the resistances 72 and 58 may be of extremely small current carrying capacity, a one-watt resistance being ample for resistance 72 and a 1/2-watt being ample for resistance 58. The power resistances 27, on the other hand, should together be capable of carrying 50-watts continuously and should have a resistance of 750-ohms, although if a fixed resistance is used it probably will not need to be so high.

In Fig. 7 condensers 177 and 179, which are in the nature of voltage doubling condensers, should be 20-microfarad, 200-volt electrolytic condensers.

The disclosures of this application are illustrative and the invention is not to be limited by them. In fact, if modifications or improvements are not at once obvious, they may be devised in the course of time to make additional use of the broad ideas taught and covered by this application. The claims are intended to point out novel features and not to limit the invention except as may be required by prior art. For example, it is contemplated to use the basic circuit of this invention as the amplifying circuit of a phonograph, and where the claims will otherwise read on such a circuit, the pick-up of a phonograph should be considered as the equivalent of a microphone.

We claim:

1. A sound amplifying system including a vacuum tube including cathode, plate, and control grid, a loud speaker having its operating coil connected to said plate, a microphone and a primary coil of a transformer connected in series to said cathode, said control grid being connected to the secondary of said transformer, and filter means between said cathode and said microphone and primary coil for preventing conflict between portions of the circuit on opposite sides of said filter means.

2. A single tube sound amplifying system comprising a tube having a rectifier section and an amplifying section; a series circuit including said rectifier section, a smoothing filter, a speaker operating coil, the amplifying section, a conflict preventing filter, a primary coil of a transformer, and a microphone, means for connecting said

circuit to a source of alternating current, and a circuit in parallel therewith for heating the cathodes of said tube, said amplifying section including a control grid and a secondary coil for said transformer connected to said control grid.

3. An intercommunicating system including a plurality of units, each unit including a microphone adapted for connection to one other unit, and a loud speaker adapted for connection to the other unit and at least one of said units including an amplifying circuit including means for connecting the microphone of one unit and the loud speaker of the other unit in series through an amplifying tube, and filter means for preventing conflict between the microphone portion of the circuit and the loud speaker portion of the circuit.

4. A sound amplifying system including a vacuum tube including cathode, plate, and control grid, a loud speaker having its operating coil connected to said plate, a microphone and a primary coil of a transformer connected in series to said cathode, said control grid being connected to the secondary of said transformer, filter means between said cathode and said microphone and primary coil for preventing conflict between portions of the circuit on opposite sides of said filter means, a normally open switch in series with said microphone whereby the life of the tube is extended by maintaining the cathode circuit open except when someone is talking, and means for heating said cathode even when said switch is open.

5. A sound reproducing system including an amplifying tube having a cathode, a cathode heater, a control grid and a plate therein, a reproducing circuit connected to said plate, a circuit including a resistance type modulator connected to said cathode, a source of direct current for causing a current to flow through said modulator to said cathode and through said reproducing circuit in series, means for impressing the modulations of said modulator on said control grid, a normally open switch in series with said modulator for disconnecting said cathode from said source of direct current except when said system is in use while permitting said cathode to remain heated ready for use whereby the life of the tube is greatly extended.

6. A translating and amplifying circuit including a device for translating sound impulses into electrical modulations and of a nature requiring the passage of current therethrough, a transformer including a primary winding connected to said translating device and a secondary winding, an electronic tube including cathode, control grid and plate; said cathode being connected in series with said primary winding and said grid being connected to said secondary winding, and means for heating said cathode and applying a voltage to said plate and said translating device for causing a current to pass through said translating device, said primary winding, and said cathode to said plate.

7. A translating and amplifying circuit including a device for translating sound impulses into electrical modulations and of a nature requiring the passage of current therethrough, a transformer including a primary winding connected to said translating device and a secondary winding, an electronic tube including cathode, control grid and plate; said cathode being connected to said primary winding and said grid being connected to said secondary winding, means for

heating said cathode and applying a voltage to said plate and said translating device for causing a current to pass through said translating device, said primary winding, and said cathode to said plate, and a filter interposed between said primary winding and said cathode for decreasing the modulations impressed on the current by the translating device.

8. A sound amplifying system including a vacuum tube including cathode, plate, and control grid, a loud speaker having its operating coil connected to said plate, and a microphone and a primary coil of a transformer connected in series to said cathode, said control grid being connected to the secondary of said transformer, whereby the same electrons pass through the microphone and the primary coil to the cathode, are discharged from the cathode to the plate and pass through the operating coil of the speaker to enable the microphone and the plate circuit of the tube to be jointly operated from a single source of high voltage direct current.

9. A translating and amplifying circuit including a device for translating impulses into electrical modulations and of a nature requiring the passage of current therethrough, a transformer including a primary winding connected to said translating device and a secondary winding, an electronic tube including cathode, control grid and plate; said cathode being connected in series with said primary winding and said grid being connected to said secondary winding, and means for heating said cathode and applying a voltage to said plate and said translating device for causing a current to pass through said translating device, said primary winding, and said cathode to said plate.

10. A translating and amplifying system including an initial translating device adapted to modulate a current, a second translating device, a coil for controlling said second translating device responsive to current modulations, an amplifying tube including a plate and a cathode connected in a plate circuit including in series, said coil, the initial translating device and a source of current, and control means acted upon by the plate circuit in response to the initial translating device for impressing a charge on the grid to control the flow of electrons in the plate circuit through the tube and said coil.

11. A translating and amplifying system including an initial translating device adapted to modulate a current, a second translating device, a coil for controlling said second translating device responsive to current modulations, an amplifying tube including a plate and a cathode connected in a plate circuit including in series, said coil, the initial translating device and a source of current, control means acted upon by the plate circuit in response to the initial translating device for impressing a charge on the grid to control the flow of electrons in the plate circuit through the tube and said coil, and filter means interposed in the plate circuit between said last named means, and said initial translating device on one side and the cathode and said coil on the other side for permitting fluctuations in the flow of current through the tube and coil substantially independently of fluctuations of current through the initial translating device.

12. A translating and amplifying system including an initial translating device adapted to modulate a current, a second translating device, a coil for controlling said second translating device responsive to current modulations, an am-

- plifying tube including a plate and a cathode connected in a plate circuit including in series, said coil, the initial translating device and a source of current, control means acted upon by the
- 5 plate circuit in response to the initial translating device for impressing a charge on the grid to control the flow of electrons in the plate circuit through the tube and said coil, and filter means interposed in the plate circuit between
- 10 said last named means, and said initial translating device on one side and the cathode and said coil on the other side for permitting fluctuations in the flow of current through the tube and coil substantially independently of fluctuations of current through the initial translating
- 15 device, said filter means including a condenser connected across the initial translating device and the point of actuation of the control means by the circuit.
- 20 13. A translating and amplifying system including an initial translating device, a second translating device, a coil for controlling said second translating device, an amplifying tube including a plate connected to the coil, a cathode
- 25 within the tube, a second coil connected to the cathode, means for causing current to flow

through said coils and through said tube, a control grid in said tube responsive to the initial translating device for controlling the flow of current through the tube, and means acted upon by said second coil and also utilized in controlling the flow of current through said tube. 5

14. A translating and amplifying system including a device of translating mechanical vibrations into electrical modulations and of a nature requiring the passage of current there- 10 through, a transformer including a primary winding and a secondary winding, an electronic tube including cathode, control grid and plate, and a second translating device for producing sound waves and controlled by a coil, said first 15 named translating device, said primary winding, the cathode and plate of the tube, and the coil all being connected in a series circuit with means for applying a voltage thereto for causing a current to flow through said first named translating 20 device, said primary winding, from said cathode to said plate, and through said coil in series, and said control grid being connected to said secondary winding.

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