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D. H. YOUNG

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TELEPHONE SYSTEM

Filed May 5, 1944

2 Sheets-Sheet 1

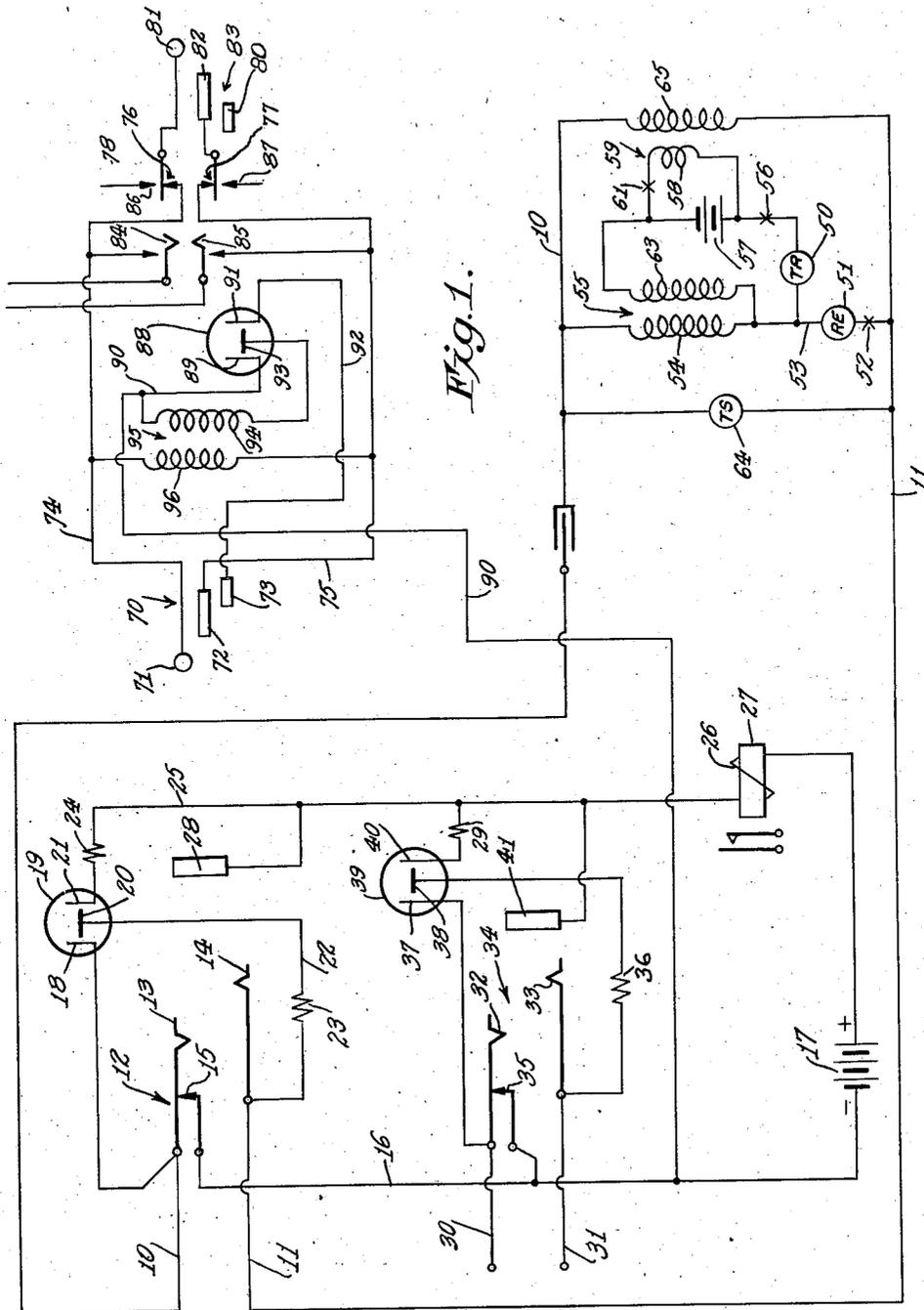


Fig. 1.

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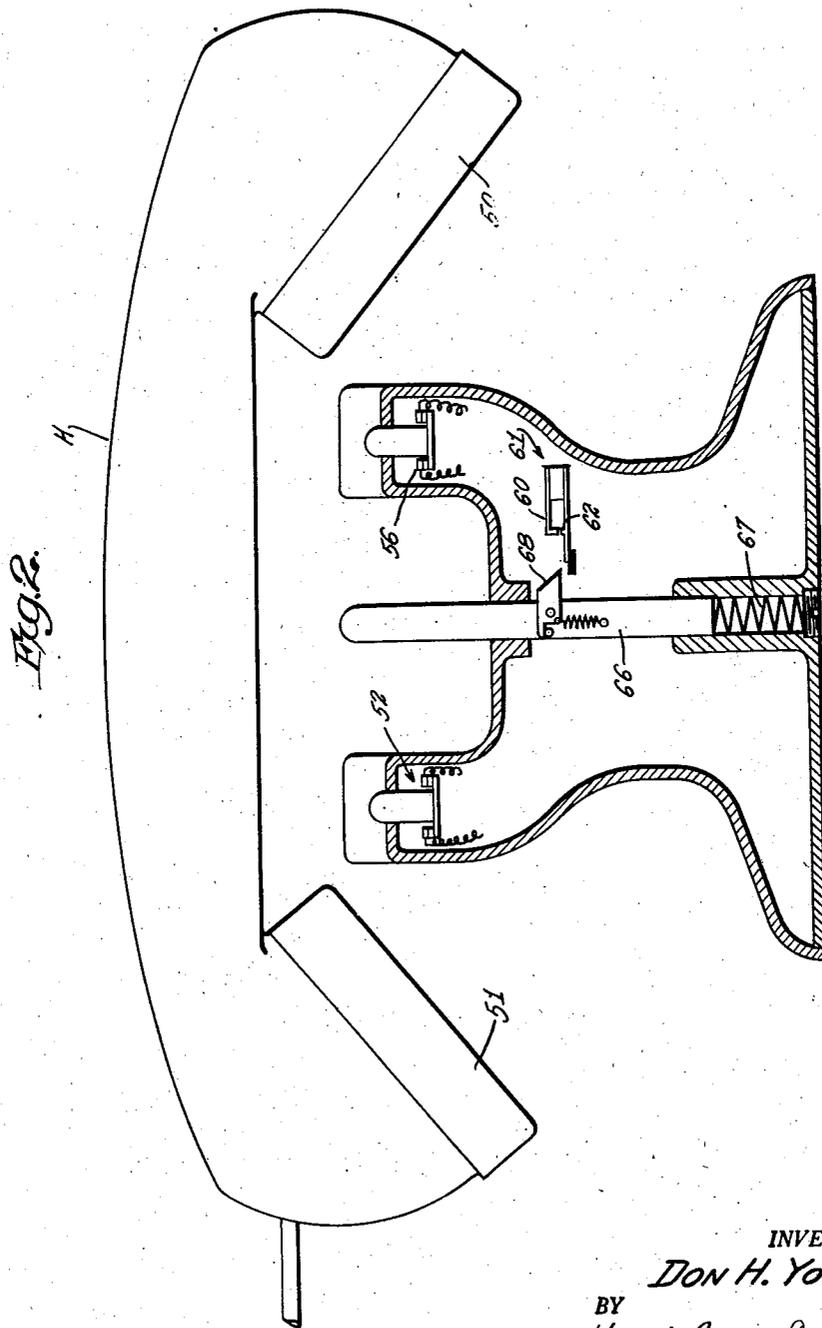
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2 Sheets-Sheet 2



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# UNITED STATES PATENT OFFICE

2,393,354

## TELEPHONE SYSTEM

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9 Claims. (Cl. 179--75)

This invention relates to telephone systems, and has particular reference to improvements in local battery telephone systems and the switchboards thereof.

Telephone systems and switchboards of the type referred to above are commonly used in small or rural communities and in military communication systems. These systems include a heavy hand-operated magneto at the switchboard and at each telephone for signalling. The high magneto voltage is fed over the telephone lines and is used to actuate a drop-type annunciator at the switchboard or a bell at the telephone.

Such systems are not as desirable as the more modern types of telephone systems used in the larger cities, but they are used by the armed forces and in rural communities for the reason that they will operate satisfactorily under conditions that would completely disrupt service with more sensitive and modern common battery systems. Thus, for example, the annunciators or the signalling means of a local battery type of system will not be actuated when the telephone wires are subjected to temporary short circuits or when the resistance of the wires is altered by temporary repairs.

The principal disadvantage of the local battery system is that the switchboards and the telephones are heavy, inconvenient and unsightly; the weight being a decided handicap for portable use, as in field telephone systems, and the appearance and inconvenience being undesirable to the user.

Moreover, the drop type annunciator has the disadvantages of being heavy, bulky, and operative only when the switchboard is set vertically. In other positions the annunciator may not operate, even when the coil associated therewith is energized by a signal from one of the telephones. In addition, many of the switchboards are not equipped with a signalling means for indicating the conclusion of a conversation and, therefore, the operator must cut in frequently to determine when the circuit should be disconnected.

An object of the present invention is to provide a telephone system having the advantages of the local battery type, but which is substantially free from the disadvantages of the other systems indicated above.

Another object of the invention is to provide a telephone system of the local battery type in which the signalling magnetos of the telephones may be eliminated.

Another object of the invention is to provide a telephone system of the local battery type in which the weight and size of the switchboard are reduced greatly and which is operable in substantially all positions.

A further object of the invention is to provide signalling means for a telephone system and actuating means therefor which effectively replace the conventional drop type of annunciator and magnetos without rendering the system so sensitive or fragile as to prevent its use even under the most adverse conditions.

Other objects of the invention will become apparent from the following description of a typical form of telephone system embodying the present invention.

In accordance with the present invention, the drop-type annunciators of the field or local battery switchboard are replaced by three-element, gas-type electronic tubes which can be caused to ignite and remain ignited by impressing momentarily a sufficiently high voltage on the proper elements. The potential required for igniting the tube and causing it to glow is different than the potentials that will cause the tube to continue to glow after ignition and is higher than any potential normally on the telephone lines. Therefore, the tube is not affected by short circuits, grounding or varying resistance in the lines. Similar tubes can be used in the supervisory circuits of the switchboard so that the supervisory signal may be operated automatically when the telephone receiver is returned to its hook or cradle.

In order to provide the necessary high potential for igniting the tube, without the use of a magneto, the telephones may be provided with vibratable or pulsating switches connected by means of a transformer to the lines so that when the telephone is to be used, the switch may be actuated to generate a pulsating current, and thereby increase the voltage on the lines sufficiently to cause the tube to glow and provide a visual signal.

The gas-type tubes are of a type that will continue to glow and transmit a current when ignited until the plate circuit is opened or the voltage in the circuit is reduced below a predetermined minimum. These tubes are considerably smaller and lighter than the drop-type annunciators commonly used, and for that reason, the size and weight of a switchboard can be reduced considerably. The tubes may be cushioned and placed behind protective shields so that they are protected against damage even when the

switchboard is dropped, as often happens in field service. Moreover, the switchboard is operative even when lying horizontally or inclined to the vertical, an obvious advantage, particularly in military operations when conditions do not always permit the switchboard to be placed advantageously.

The present invention simplifies and renders semi-automatic the operation of the usual local battery system while increasing its reliability and retaining all of the advantages of the local battery type of system.

For a better understanding of the present invention, reference may be had to the accompanying drawings, in which:

Figure 1 is a simplified diagrammatic showing of a circuit for two telephones, embodying the present invention;

Figure 2 is a sectional view of a typical form of telephone including a pulsating contact or pulsating switch for actuating the signalling tubes at the switchboard.

The embodiment of the invention chosen for illustration is disclosed in the drawings, as applied to a telephone system including a switchboard circuit having two, two-wire telephone lines connected therewith. It will be understood that the switchboard may be provided with connections for as many lines as may be required.

One of the lines consisting of the conductors 10 and 11 is connected to a jack 12 having two contacts 13 and 14 connected respectively to lines 10 and 11. Contact 12 of the jack is also connected to the cathode 18 of a gas type electronic tube 19. The jack contact 13 is normally in engagement with a contact 15 which is connected by a conductor 16 to one pole of a battery 17 or other source of direct current. The gas type electronic tube 19 is also provided with a grid 20 interposed between and in closely placed relation to the cathode 18 and the plate 21 of the tube.

The tube 19 is of a type which glows upon passage of a current between the cathode 18 and the plate 21, but which is normally inactive even though potentials are applied between the cathode 18 and the plate 21. When an additional potential is applied between the cathode 18 and the grid 20 the tube becomes active and current flows between the cathode 18 and the plate 21 causing it to glow. When the tube 19 is started, it will continue to glow until the battery circuit of the tube is opened or the voltage is reduced.

The grid 20 of the tube is connected by means of a conductor 22 through a resistor 23 to the contact 14 of the jack. The plate 21 of the tube 19 is connected through a resistor 24 and a conductor 25 to the other pole of the battery 17. The coil 26 of a relay 27 may be interposed for controlling the operation of an audible signal such as an alarm bell or buzzer (not shown) if desired. The jack 12 is provided with a third contact 28 for a purpose to be described later. This third contact 28 is connected to the conductor 25.

The conductors 30 and 31 of the second telephone line are similarly connected to the contacts 32 and 33 of a jack 34. The contact 32 of this jack is connected to the cathode 37 of the tube 39 which is similar to the tube 19. The contact 32 of the jack is engageable with contact 35 which is connected to the conductor 16. The jack contact 33 is connected through a resistor 36 to the grid 38 of the tube 39. The circuit is completed by connecting the plate 40 of the tube 39 through the resistor 29 to the conductor 25. The contact 41 of the jack 34 is connected to the conductor 25.

From the preceding description of the switchboard line circuit it will be apparent that the potential of the battery 17 will be impressed upon the cathodes 18 and 37 and the plates 21 and 40 of the tubes 19 and 39. It will also be apparent that the cathodes 18 and 37 and the grids 20 and 38 will be connected to the telephone lines. When a potential is impressed on the telephone lines and consequently on the cathode and grid of a tube 19 or 39, it will cause the gases in the tube to ionize, thereby causing the tube to glow. The tube will continue to glow until the battery 17 is disconnected from the tube.

The telephone circuits for the system are the same and only one of these will be described. The transmitter 50 and receiver 51 are illustrated diagrammatically as in a French type of handset (Figure 2) with the switch 52 interposed between the line 11 and the receiver 51. The opposite side of the receiver 51 is connected by means of a conductor 53, and the secondary winding 54 of a transformer 55 to the line 10. The transmitter 50 is connected by means of the conductor 53, a hookswitch 56 to one pole of a battery 57, through the other pole of the battery 57 to the primary winding 63 of the transformer 55 and to the other side of the transmitter 50 thereby constituting a talking circuit when hookswitch 56 is closed. One pole of the battery 57 is connected by means of a conductor to the primary winding 58 of a step-up transformer 59. The opposite end of the winding 58 is connected to one contact 60 of a pulsating switch 61 (Figure 2) which is normally spaced from the other contact 62 of the switch 61. The contact 62 is connected to the opposite pole of the battery 57. An audible signal member 64 is also connected to telephone line 10 and 11 to indicate incoming calls in the conventional manner.

As illustrated in Figure 2, the contact 62 of the switch 61 is resiliently supported and normally is spaced from the contact 60. The end of the contact 62 may be disposed adjacent to a rod 66 that is depressed by the weight of the handset H but is urged upwardly at all times by means of a spring 67. The rod 66 supports pivotally a pawl 68 that is arranged to tilt and pass by the contact 62 when rod 66 moves upwardly. The pawl 68 is so arranged that on downward movement of the rod 66 either by manually operating the rod with the finger or hanging up the handset H, the pawl 68 will engage contact 62 displace it downwardly and then release it so that the contact 62 can vibrate into and out of engagement with the contact 60. When a call is to be made, the handset H is lifted and the rod 66 is depressed manually to set the contact 62 into vibration.

Inasmuch as the switch 61 is in the circuit containing the battery 57 and the primary 58 of the transformer 59, a pulsating current is generated by vibration of the contact 62 which is stepped up in the secondary winding 65 to increase the potential applied to the grid 20 of the tube 19 sufficiently to ionize the gas therein and cause the tube 19 to glow on the switchboard. The relay 27 will be actuated by the flow of current to the tube 19 to actuate the audible or other signalling means.

The switches 52 and 56 are normally held open when the handset is on its cradle, but are closed when the handset is lifted to connect the transmitter 50 and receiver 51 to the lines 10 and 11.

The cord circuit for connecting the operator to the lines and for connecting the lines to each other is shown diagrammatically in Fig. 1. The

cord circuit includes a plug 70 having three contacts 71, 72 and 73 engageable respectively with the contacts 13, 14 and 28 of the jack 12 or the contacts 32, 33 and 41 of the jack 34. Upon insertion of the plug 70 in the jack 12, the contact 13 is disengaged from the contact 15. Similarly, when the plug 70 is inserted in the jack 34 the jack 32 is disengaged from the contact 35. In either case the potential applied to the cathode of the tube 19 and 39 is reduced to zero and the tube ceases to glow. The contacts 71 and 72 are connected by the conductors 74 and 75 to the operator's listening and ringing key 78 which can be moved to one of two positions normally. The conductors 74 and 75 are connected through normally engaged contacts 76 and 77 on the operator's listening and ringing key to the plug 83 having a dead contact 80, and two plug contacts 81 and 82. The operator's key can be moved to a ringing position which disengages the contacts 76 and 77 and connects the plug 83 to a ringing generator (not shown) by means of the contacts 86 and 87 so that a ringing signal can be applied to the plug contacts 81 and 82. The plug 83 also may be inserted in either of the jacks 12 or 34. The operator's ringing and listening key may be operated to another position which connects the operator's telephone set to conductors 74 and 75 by means of contacts 84 and 85 whereby the switchboard operator can converse either with a subscriber on either or both of plugs 70 and 83 whichever may be desired.

When a party on lines 10 and 11, for example, wishes to speak with another party the answering plug 70 is inserted in the jack 12, thus engaging the contact of the jack 13 with the plug contact 71 and contact 14 of the jack with plug contact 72 and contact 28 of the jack with plug contact 73, thereby connecting the lines 10 and 11 to the lines 74 and 75 in the cord circuit. The operator then operates the listening key to determine who the calling party desired to be connected with. Assuming, for purposes of illustration, that the party on lines 10 and 11 wishes to converse with the parties on lines 30 and 31 the calling plug 83 is then inserted in jack 34 thus connecting the plug terminal 81 with the jack terminal 32, the plug terminal 82 with the jack terminal 33 and the plug terminal 80 with the jack terminal 41.

In order to ring the party on the lines 30 and 31, an alternating or a pulsating current, supplied by a magneto, or any other source may be applied to the contacts 81 and 82 by means of the contacts 86 and 87, thereby actuating the signalling means 64 at the corresponding party's telephone. If desired, the signalling means 64 may be responsive only to a higher voltage than that supplied by the pulsing switch 61 so that the signal 64 can be actuated only by the operator.

When the conversation over the telephones is concluded, the operator may be advised by means of the tube 88 in the cord circuit. The tube 88 is connected in the circuit in such a way that it glows when a conversation is concluded and is extinguished when the plug 70 is withdrawn from the jack 12 or 34.

The cathode 89 of the tube 88 is connected by the conductor 90 to the conductor 16 and to one pole of the battery 17. The plate 91 is connected by the conductor 92 to the plug contact 73 and thus through the jack contact 28 or 41 to the conductor 25 when the plug 70 is inserted in the jack 12 or 34, thereby applying a potential across the cathode and plate.

The grid 93 is connected through the second-

ary winding 94 of the transformer 95 to the conductor 90. The opposite ends of the primary winding 96 of the transformer 95 are connected to the conductors 74 and 75. When the plug 70 is inserted, for example in the jack 12, and the telephone connected to the jack 12 is returned to its cradle, the pulsating switch 61 is actuated by returning the handset H to its cradle, a pulsating current is generated that is transmitted to the primary winding 96 of the transformer 95 to apply a sufficiently increased potential to the grid 93 to cause the tube 88 to glow. The tube 88 will continue to glow until the plug 70 is withdrawn from the jack 12, thereby disconnecting the plate 91 from the battery 17 and extinguishing the tube 88.

From the preceding description it will be apparent that the above-described local battery system is rendered semi-automatic in operation by providing signalling means that is operable without including magnetos or other heavy manually operated signal generators at the telephones. Also, the system permits elimination of heavy annunciators at the switchboard and the provision of an automatic supervisory signal in the cord circuit without the inclusion of troublesome relays. Moreover, alarm signals can be provided at the switchboard with only one relay 27, common to the entire switchboard, thereby reducing the probability of contact trouble in the system. Moreover, all of the advantages inherent in a local battery system are retained while the switchboard and the telephones may be improved in appearance, reduced in weight, and rendered more reliable.

It will be understood that the above described system is susceptible to considerable modification in the arrangement of the elements, the size of the system controlled by the switchboard and in the type of telephone sets and signalling means at the sets. Therefore, the above described example of a system embodying the invention should be considered as illustrative and not as limiting the scope of the following claims.

I claim:

1. A telephone system comprising a plurality of telephone sets, each having a transmitter and a receiver, a switchboard having a plurality of gas-type electronic tubes forming signalling means corresponding to each telephone set, each tube having a plate, a grid and a cathode, and being adapted to glow upon application of potentials of proper magnitude to the cathode, the plate and the grid, means applying a potential to said plate and cathode of insufficient magnitude to initiate the operation of the tube but of sufficient magnitude to continue the operation of the tube after it has been started, means electrically connecting each of said telephone sets to the grid of the corresponding tube, and means operable at said telephone set for supplying a sufficiently high potential to said grid over said electrically connecting means to ionize the gas in the corresponding tube and cause said tube to glow.

2. A telephone system comprising a plurality of telephone sets each having a transmitter and a receiver, a switchboard having a plurality of gas-type electronic tubes forming signalling means corresponding to each telephone set, each tube having a plate, a grid and a cathode, and being adapted to glow upon application of potentials of proper magnitude to the cathode, the plate and the grid, means for applying a potential to said plate and cathode, means electrically connecting each of said telephone sets to the

grid of its corresponding tube, and vibratable switch means operable at said telephone set for supplying a sufficiently high potential to said grid to ionize the gas in the corresponding tube and cause said tube to glow.

3. A telephone system comprising a plurality of telephone sets, each having a transmitter and a receiver, a switchboard having a plurality of gas-type electronic tubes forming signalling means corresponding to each telephone set, each tube having a plate, a grid and a cathode and being adapted to glow upon application of potentials of proper magnitude to the grid, plate and cathode, a separate jack at the switchboard for each of said telephone sets and connecting said telephone sets to said cathode and said grid of the corresponding tube, means for applying a potential to said cathode and said plate, means for supplying a potential to the plate and cathode of said corresponding tube of insufficient magnitude to cause said tube to glow, and means operable at each telephone set for supplying a potential to the grid of the corresponding tube of sufficient magnitude to cause the corresponding tube to glow.

4. A telephone system comprising a plurality of telephone sets, each having a transmitter and a receiver, a switchboard having a plurality of gas-type electronic tubes forming signalling means corresponding to each telephone set, each tube having a plate, a grid and a cathode and being adapted to glow upon application of potentials of proper magnitude to the grid, plate and cathode, a separate jack at the switchboard connected to each of said telephone sets, means electrically connecting said telephone sets to said cathode and to said grid of the corresponding tube, means including a pair of disengageable contacts in each of said jacks for applying a potential to said cathode and to said plate, means for supplying a potential to the plate and cathode of said corresponding tube of insufficient magnitude to cause said tube to glow, means operable at each telephone set for supplying a potential to the grid of the corresponding tube of sufficient magnitude to cause the corresponding tube to glow, an operator's telephone set at said switchboard having a plug to be received in any of said jacks, and means on said plugs for disengaging said disengageable contacts of the jack receiving the plug and extinguishing said tube.

5. A telephone system comprising a plurality of telephone sets, a switchboard for selectively connecting said telephone sets to each other, multiple element, gas-type electronic tubes at said switchboard corresponding to each telephone set, each tube being adapted to glow upon application of proper potentials to the elements thereof, means for applying to said elements potentials of insufficient magnitude to cause said tubes to glow but of sufficient magnitude to cause the tube to continue to glow after it has been started and means operable at said telephone sets for supplying a potential of sufficiently great magnitude to the corresponding tube to cause said tube to glow.

6. A telephone system comprising a plurality of telephone sets, a switchboard for selectively connecting said telephone sets to each other, three-element, gas-type electronic tubes at said switchboard corresponding to each telephone set, each tube being adapted to glow upon application of proper potentials to the elements thereof, means for applying to said elements potentials of insufficient magnitude to cause said tubes to glow, means operable at said telephone sets for supply-

ing a potential of sufficiently great magnitude to the corresponding tube to cause said tube to glow, an operator's telephone set at said switchboard, means for connecting said operator's set selectively to any of the other telephone sets, and means operable upon connection of said operator's telephone set to another telephone set for disconnecting the corresponding tube from at least one of said means for supplying potentials.

7. In a telephone system having a plurality of telephone sets, the combination of a switchboard having a plurality of three-element, gas-type electronic tubes, each corresponding to a telephone set and being adapted to ignite and glow upon application of potentials of proper magnitude to the elements thereof, means for applying to the elements of said tubes potentials of insufficient magnitude to ignite the tubes but sufficiently high to cause the tubes to continue glow after ignition, means operable at each telephone set for supplying a potential sufficient to ignite its corresponding tube, and means operable at the switchboard for disconnecting at least one element of the tube from the potential supplying means to extinguish a glowing tube.

8. In a telephone system having a plurality of telephone sets, the combination of a switchboard having a plurality of three-element, gas-type electronic tubes, each corresponding to a telephone set and being adapted to ignite and glow upon application of potentials of proper magnitude to the elements thereof, means for applying to the elements of said tubes potentials of insufficient magnitude to ignite the tubes but sufficiently high to cause the tubes to continue glow after ignition, means operable at each telephone set for supplying a potential sufficient to ignite its corresponding tube, an operator's telephone set at said switchboard, contact means for connecting said operator's set selectively to any of the other telephone sets and simultaneously disconnecting at least one element of the corresponding tube from the potential supplying means, and means including said contact means operable at said switchboard for connecting said other telephone sets selectively to each other.

9. In a telephone system having a plurality of telephone sets, the combination of a switchboard having a plurality of three-element, gas-type electronic tubes, each corresponding to a telephone set and being adapted to ignite and glow upon application of potentials of proper magnitude to the elements thereof, means for applying to the elements of said tubes potentials of insufficient magnitude to ignite the tubes but sufficiently high to cause the tubes to continue glow after ignition, means operable at each telephone set for supplying a potential sufficient to ignite its corresponding tube, an operator's telephone set at said switchboard, contact means for connecting said operator's set selectively to any of the other telephone sets and simultaneously disconnecting at least one element of the corresponding tube from the potential supplying means, and means including said contact means operable at said switchboard for connecting said other telephone sets selectively to each other, a three-element, gas-type electronic tube electrically connected to said contact means, means engageable with said contact means for connecting the last-mentioned tube to said means for supplying potentials and to said means operable at said telephone sets, whereby actuation of the last-mentioned means ignites and causes the last-mentioned tube to glow.

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**Disclaimer**

2,393,354.—*Don H. Young*, Valley Stream, N. Y. TELEPHONE SYSTEM. Patent dated Jan. 22, 1946. Disclaimer filed May 5, 1948, by the assignee, *Dictograph Products Company, Inc.*

Hereby disclaims claim 1 and claims 3 to 8 inclusive, of said patent.

[*Official Gazette June 8, 1948.*]