June 15, 1937. O. MYERS 2,084,104

SIGNALING SYSTEM

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FIG. 1

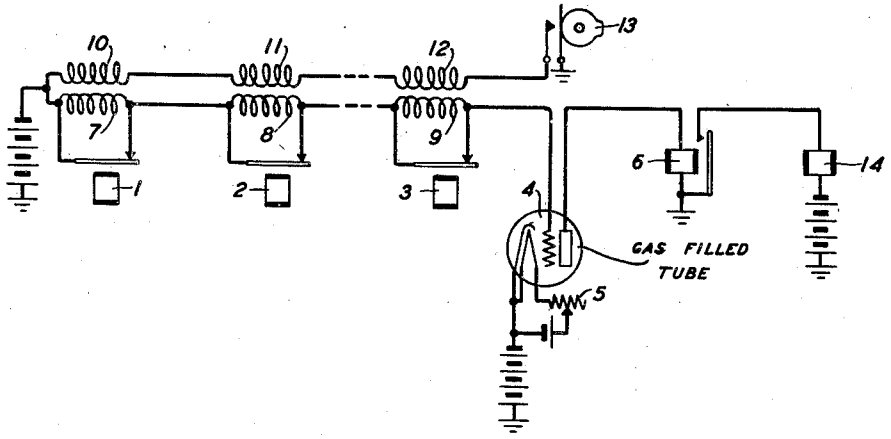
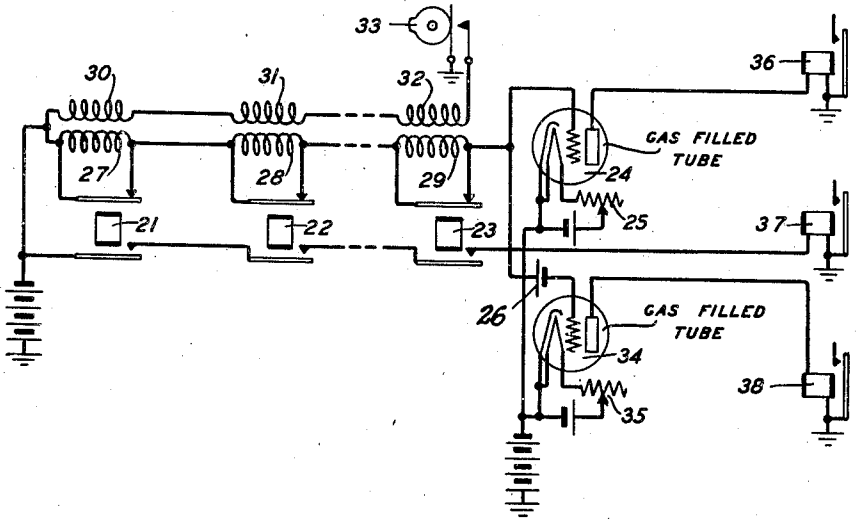


FIG. 2



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SIGNALING SYSTEM

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8 Claims. (Cl. 179—8)

This invention relates to a signaling system and more particularly to a system in which a registration is made when a predetermined plurality of circuits have been operated. For example, it is often desirable to make a peg count record each time that a predetermined number of circuits or apparatus are simultaneously in use in order that additional circuits or apparatus may be supplied to meet the demands for service. The invention has further application in telephone systems for registering when all or a predetermined number of trunks of a group accessible to an operator or to a selector switch become busy. This result can be accomplished by relays so margined that they will respond only to circuit conditions which indicate that predetermined numbers of circuits or apparatus have been taken for use, but due to the inherent limitations of relays as to their marginal response and the difficulties encountered in keeping such relays properly adjusted, the use of relays may not be entirely satisfactory. It is, therefore, the object of this invention to utilize the marginal characteristics of a gas-filled tube as a responsive medium for causing a registration when a predetermined number of circuits or apparatus have been taken for use.

In accordance with the present invention, a gas-filled tube is interposed between the device which registers the busy condition of a plurality of circuits and the circuits for which the registration is to be made. The tube is filled with a low pressure gaseous content which for the purposes of illustration may be neon, helium, argon, mercury vapor or combinations of gases of this group. The tube has a certain characteristic, namely, that the gaseous content will become ionized and thus conducting at a critical potential determined by the electrode design, the nature of the gaseous content and its pressure. As disclosed the tube is of the hot cathode type having a filament heated by direct or alternating current and a cathode heated conductively from the filament. Obviously, a hot cathode type of tube in which the filament, heated by direct current, serves as the cathode, or a cold cathode tube might be employed.

The anode of the tube is connected through the winding of a relay to the positive terminal of a source of potential so that the relay operates in the cathode-anode circuit of the tube when the tube ionizes. The relay may itself serve as a registering means and for that purpose may be in the form of a peg count meter or may in turn operate any auxiliary registering means such as a peg count meter. The grid of the tube is connected to a negative source of biasing potential through a chain circuit controlled by the several circuits comprised in the group whose busy condition is to be indicated or registered. This chain circuit includes serially connected secondary windings of a transformer, said windings being allocated respectively to the several circuits and being normally shunted if the corresponding circuits are idle. As each circuit of the group becomes busy a relay associated therewith opens the shunt around the corresponding secondary transformer winding. The primary winding of the transformer is connected from the negative terminal battery through an interrupter to the grounded terminal of the battery.

With all circuits of the group idle, full negative potential is applied over the chain circuit to the grid of the tube thus biasing the tube to such an extent that it is blocked from ionizing and since all secondary transformer windings are at the time shunted, the periodic interruptions of the primary circuit of the transformer are without effect. As soon as one of the circuits becomes busy and the relay thereof opens the corresponding shunt around a secondary winding then when the interrupter closes the circuit through the primary winding a surge of potential is induced in the secondary winding from which the shunt has been removed such as to lower the negative bias on the grid of the tube. In a similar manner as other circuits become busy the shunts are thereby removed from other secondary windings until a circuit condition is reached such that upon the closure of the primary circuit by the interrupter the surge of potential through the secondary windings then effective will be such as to lower the negative potential on the grid to a point where the tube will ionize and operate the meter or relay over the cathode-anode circuit of the tube. It is thus possible either by the selection of a tube that has a definite breakdown potential or by the proper selection of the transformer ratio to cause the tube to ionize and operate the associated relay or meter when any desired number of a group of circuits becomes busy. For example, in the circuit illustrated the tube might be caused to ionize only when all but one of the circuits have become busy and thus all but one of the secondary windings have been made effective.

As a further modification of the invention two tubes may be employed one of which may be arranged to ionize and operate an associated relay or meter when all but two of the associated

circuits become busy and the other of which will become ionized and operate its associated relay when all but one of the associated circuits become busy.

A clearer understanding of the invention may be obtained from a consideration of the following detailed description read in connection with the accompanying drawing in which:

Fig. 1 shown one modification of the invention illustrating the manner in which a signal is given when a predetermined number of a group of circuits are in a certain operating condition; and

Fig. 2 shows a further modification illustrating the manner in which signals are given when different predetermined numbers of a group of circuits are in a certain operating condition.

Referring first to Fig. 1, a plurality of circuits, the operating condition of which is to be indicated, are schematically illustrated by the relays 1, 2—3 which are individual thereto and become operated, for example, when the circuits are taken for use or are in a busy condition. These circuits might, for example, be trunks of a group accessible to either an operator or to selector switches for extending telephone connections.

For detecting when a predetermined number of the circuits are in a given condition, for example, a busy condition, a gas-filled tube 4 is employed. This tube has a filament heated, as disclosed, by current from a battery regulated by the rheostat 5 which heats the cathode conductively. Instead of a direct current source of heating current, alternating current from a commercial supply line could be used. The anode of the tube is connected through the winding of a relay 6 to the positive or grounded terminal of battery and upon the ionization of the gaseous content of the tube the cathode-anode circuit extends from the negative terminal of battery connected to the cathode, over the ionized path through the tube to the anode and thence through the winding of relay 6 to ground. The control electrode or grid of the tube is connected over a chain circuit, controlled by the several circuits of the group whose busy condition is to be detected, to the negative terminal of battery and is thus normally negatively biased, when all or less than a predetermined number of the circuits are idle, to a potential such that the tube is blocked against ionization.

The chain circuit extending to the grid of the tube includes therein the serially connected secondary windings, 7, 8—9 of a transformer whose corresponding primary windings 10, 11—12 are connected serially in a circuit from the negative terminal of battery through the contacts of interrupter 13 to the positive or grounded terminal of battery. It will, of course, be evident that instead of a plurality of primary windings, a single primary winding might be employed. With all of the circuts of the group idle, the secondary windings 7, 8—9 are each short-circuited by the back contacts of relays 1, 2—3, respectively, and full negative biasing potential is present on the grid of tube 4. Therefore, when the interrupter 13 closes the circuit through the primary windings of the transformer, the inductive surges of potential generated in the seconary windings are without effect.

As soon, however, as one of the circuits, for example, the circuit indicated by the relay 1, becomes busy and relay 1 is operated, the short circuit is removed from the secondary winding 7 and upon the next closure of the contacts of interrupter 13 a surge of potential is generated in the secondary winding 7 which will be of such polarity as to oppose the negative potential in the grid circuit thus lowering the negative bias on the grid to a slight extent. Similarly, when a second one of the circuits, for example, the circuit indicated by the relay 2 becomes busy and relay 2 is operated, the short circuit is removed from the secondary winding 8. When the interrupter now closes its contacts, a surge of potential is generated in both secondary windings 7 and 8 thus lowering the negative bias on the grid to a greater extent. In a similar manner as other circuits become busy the shunts are thereby removed from other secondary windings until a circuit condition is reached such that upon the closure of the primary circuit of the transformer by the interrupter 13, the surge of potential through the secondary windings from which the short circuits have been removed will be such as to lower the negative potential on the grid to a point where the tube will ionize and operate relay 6. Relay 6 upon operating may control any desired indicating device 14, such as a peg count meter, or may himself serve as the operating magnet of a meter.

When the tube has ionized and operated relay 6, it will remain in its ionized condition irrespective of the controlling circuit connected to the grid until the anode potential between the cathode and anode of the tube is reduced in any well known manner as by opening the external circuit to the anode.

It is thus possible either by the selection of a tube which has a definite breakdown potential, or by the proper selection of the transformer ratio to cause the tube to ionize and operate relay 6 when any desired number of the group of circuits become busy. For example, in the circuit illustrated, the tube 4 might be caused to ionize only when all but one of the circuits have become busy and thus the short circuits removed from all but one of the secondary windings of the transformer. Obviously, it is not necessary to the operation of the circuit that the circuits be taken for use or made busy in any definite order.

The circuit of Fig. 2 illustrates the manner in which indications may be made when different predetermined numbers of circuits become busy. In this modification of the invention the group of circuits is schematically indicated by the relays 21, 22—23 and two gas-filled tubes 24 and 34 are employed to detect when different predetermined numbers of the circuits are busy. The filament of tube 24 is heated by current from a battery regulated by rheostat 25, and the filament of tube 34 is heated by current from a battery regulated by rheostat 35. The cathodes of both tubes are heated conductively from the associated filaments. The cathode-anode circuit of tube 24 extends from the negative terminal of battery to the cathode, thence over the ionized path through the tube to the anode and through the winding of relay 36 to the positive or grounded terminal of battery and the cathode-anode circuit of tube 34 extends from the negative terminal of battery to the cathode, thence over the ionized path through the tube to the anode and through the winding of relay 38 to the positive or grounded terminal of battery.

The control electrode or grid of tube 34 is connected through battery 26 over a chain circuit controlled by the several circuits of the group whose busy condition is to be detected to the negative terminal of battery and is thus normally negatively biased when all or less than a prede-

termined number of circuits are idle to a potential such that the tube 34 is blocked against ionization. The grid of tube 24 is connected to negative battery over the same chain circuit, without battery 26 which renders the normal negative bias on the grid of tube 24 less than the normal negative bias on the grid of tube 34. For the purposes of illustration it will be assumed that the bias on the grid of tube 24 is such that the tube 24 will ionize when all but two of the group of circuits become busy and that the bias on the grid of tube 34 is such that the tube 34 will ionize when all but one of the circuits become busy.

The chain circuit includes therein the serially connected secondary windings 27, 28—29 of a transformer whose corresponding primary windings 30, 31—32 are connected serially in a circuit extending from the negative terminal of battery through the contacts of interrupter 33 to the grounded terminal of battery. With all of the circuits of the group idle, the secondary windings 27, 28—29 are each short-circuited over the back contacts of relays 21, 22—23, respectively, and full negative biasing potentials are applied to the grids of tubes 24 and 34. If at this time the interrupter 33 closes its contacts to energize the primary windings of the transformer, the surge of potential generated in the secondary windings is without effect since the secondary windings are short-circuited.

As soon, however, as one of the circuits, for example, the circuit indicated by relay 21, becomes busy and relay 21 is operated, the short circuit is removed from the secondary winding 27 and upon the next closure of the contacts of interrupter 33 a surge of potential is generated in the secondary winding 27 which is of such polarity as to reduce the negative bias on the grids of tubes 24 and 34. In a similar manner as other circuits become busy the shunts are removed from other secondary windings until a circuit condition is reached, for example, when all but two of the groups of circuits become busy, such that upon the next closure of the interrupter contacts the surge of potential through the secondary windings from which short circuits have been removed will be of such value as to lower the biasing potential on the grid of tube 24 to a point where the tube 24 will ionize and operate relay 36. Since, however, the grid of tube 34 is more negatively biased than the grid of tube 24, tube 34 will not ionize.

When, however, one more of the circuits of the group becomes busy and the short circuit is removed thereby from one more secondary winding of the transformer as when all but one of the circuits have become busy, the surge of potential generated in the secondary windings of the transformer upon the next closure of the contacts of interrupter 33 will be of sufficient value to lower the biasing potential on the grid of tube 34 to a point where tube 34 will ionize and operate relay 38.

When all of the circuits become busy and all of the associated relays 21, 22—23 are operated, a chain circuit is effective from battery over the lower contacts of each relay to ground through the winding of relay 37. Thus, the operation of relay 36 is indicative that all but two of the group of circuits are busy, the operation of relay 38 is indicative that all but one of the circuits are busy and the operation of relay 37 is indicative that all of the circuits are busy. Relays 36, 37 and 38 may control the circuits of peg count meters or any other desired responsive devices or they may themselves serve as magnets to operate meters. Obviously, lamps or other suitable indicating devices could be employed in lieu of relays 6, 36, 37 and 38 disclosed in the drawing.

It will be apparent from the preceding discussion that the invention affords a sensitive, accurate means for giving indications or to register data of the condition of a group of circuits or apparatus from which it may be determined whether additional circuit equipment is necessary. Further, the invention if applied to a direct trunk group extending from one office to another office of an exchange area would be effective for indicating to a sender when it would be desirable to reroute calls through a tandem office.

What is claimed is:

1. In a signaling system, a gaseous conductor tube having a control electrode, a cathode and an anode and having a definite breakdown potential, a responsive device in the cathode-anode circuit of said tube, means for normally negatively biasing said control electrode to a potential higher than the breakdown potential of said tube, and means for momentarily applying impulses of increasing potential to said control electrode in opposition to said biasing potential until said tube breaks down and operates said responsive device.

2. In a signaling system, a gaseous conductor tube having a control electrode, a cathode and an anode and having a definite breakdown potential, a responsive device in the cathode-anode circuit of said tube, means for normally negatively biasing said control electrode to a potential higher than the breakdown potential of said tube, and means including a transformer, the secondary of which is connected to said control electrode and the primary of which is interrupted periodically for momentarily applying impulses of increasing potential to said control electrode in opposition to said biasing potential until said tube breaks down and operates said responsive device.

3. In a signaling system, a gaseous conductor tube having a control electrode, a cathode and an anode and having a definite breakdown potential, a responsive device in the cathode-anode circuit of said tube, a circuit for said control electrode extending from a source of negative potential through the normally shunted serially connected secondary windings of a transformer for normally biasing said control electrode to a potential higher than the breakdown potential of said tube, a primary winding for said transformer connected to said source of potential, means for periodically closing the circuit through said primary winding to produce surges of potential in said control electrode circuit in opposition to said biasing potential and means for successively removing the shunts from said secondary windings whereby said surges increase in potential to such an extent that said tube breaks down and operates said responsive device.

4. In a signaling system for indicating when a predetermined number of a plurality of circuits become busy, a plurality of circuits, a gaseous conductor tube having a control electrode, a cathode and an anode and having a definite breakdown potential, a responsive device in the cathode-anode circuit of said tube, means for normally negatively biasing said control electrode to a potential higher than the breakdown potential of said tube, and means operative as said circuits successively become busy for momentarily apply-

ing impulses of increasing potential to said control electrode in opposition to said biasing potential until when a predetermined number of said circuits have become busy the biasing potential is reduced to the breakdown potential of said tube and said tube ionizes to operate said responsive device.

5. In a signaling system for indicating when a predetermined number of a plurality of circuits become busy, a plurality of circuits, a gaseous conductor tube having a control electrode a cathode and an anode and having a definite breakdown potential, a responsive device in the cathode-anode circuit of said tube, a circuit for said control electrode extending from a source of negative potential through the normally shunted serially connected secondary windings of a transformer for normally biasing said control electrode to a potential higher than the breakdown potential of said tube, a primary winding for said transformer connected to said source of potential, means for periodically closing the circuit through said primary winding to produce surges of potential in said control electrode circuit in opposition to said biasing potential, and means operative as each of said circuits becomes busy for successively removing the shunts from said secondary windings whereby said surges increase in potential until when a predetermined number of said circuits have become busy said tube breaks down and operates said responsive device.

6. In a signaling system for indicating when different predetermined numbers of a plurality of circuits become busy, a plurality of circuits, two gaseous conductor tubes having definite breakdown potentials and each having a control electrode, a cathode and an anode, a responsive device in the cathode-anode circuit of each tube respectively, means for normally negatively biasing the control electrode of each tube to a potential higher than the breakdown potential thereof, and means operative as each of said circuits becomes busy for altering the biasing potential on the control electrode of each tube until when a predetermined number of said circuits have become busy, the biasing potential of one of said tubes is rendered substantially equal to the breakdown potential thereof and said tube ionizes to operate the responsive device associated therewith and until when a further predetermined number of said circuits have become busy the biasing potential of the other of said tubes is rendered substantially equal to the breakdown potential thereof and said other tube ionizes to operate the responsive device associated therewith.

7. In a signaling system for indicating when different predetermined numbers of a plurality of circuits become busy, a plurality of circuits, two gaseous conductor tubes having definite breakdown potentials and each having a control electrode, a cathode and an anode, a responsive device in the cathode-anode circuit of each tube respectively, means for normally negatively biasing the control electrode of each tube to a potential higher than the breakdown potential thereof, and means operative as said circuits successively become busy for applying impulses of increasing potential to said control electrode in opposition to the biasing potential until when a predetermined number of said circuits have become busy the biasing potential of one of said tubes is rendered substantially equal to the breakdown potential thereof and said tube ionizes to operate the responsive device associated therewith and until when a further predetermined number of said circuits have become busy biasing potential of the other of said tubes is rendered substantially equal to the breakdown potential thereof and said other tube ionizes to operate the responsive device associated therewith.

8. In a signaling system for indicating when different predetermined numbers of a plurality of circuits become busy, a plurality of circuits, two gaseous conductor tubes having definite breakdown potentials and each having a control electrode, a cathode and an anode, a responsive device in the cathode-anode circuit of each tube respectively, a circuit extending from a source of negative potential through the normally shunted serially connected secondary windings of a transformer thence in parallel directly to the control electrode of one of said tubes and through an additional source of negative biasing potential to the control electrode of the other of said tubes for normally biasing said control electrodes to a potential higher than the breakdown potential of said tubes, a primary winding for said transformer connected to said source of potential, means for periodically closing the circuit through said primary winding to produce surges of potential in said control electrode circuit in opposition to said biasing potential, and means operative as each of said circuits becomes busy for successively removing the shunts from said secondary windings whereby said surges increase in potential until when a predetermined number of said circuits have become busy the biasing potential of said one tube is rendered substantially equal to the breakdown potential thereof and said tube ionizes to operate its associated responsive tube and until when a further predetermined number of said circuits have become busy the biasing potential of said other tube is rendered substantially equal to the breakdown potential thereof and said other tube ionizes to operate its associated responsive device.

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