

Nov. 29, 1932.

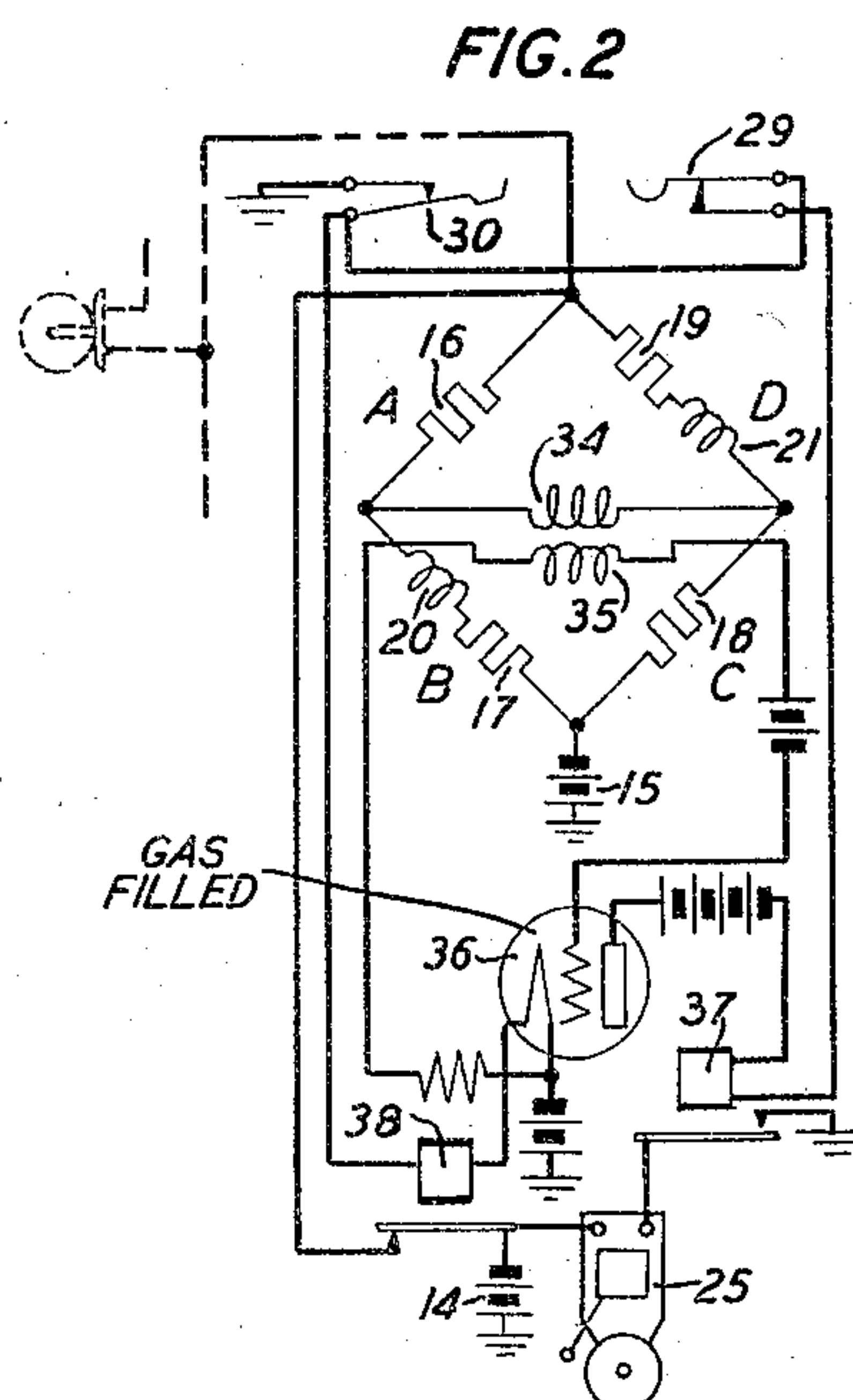
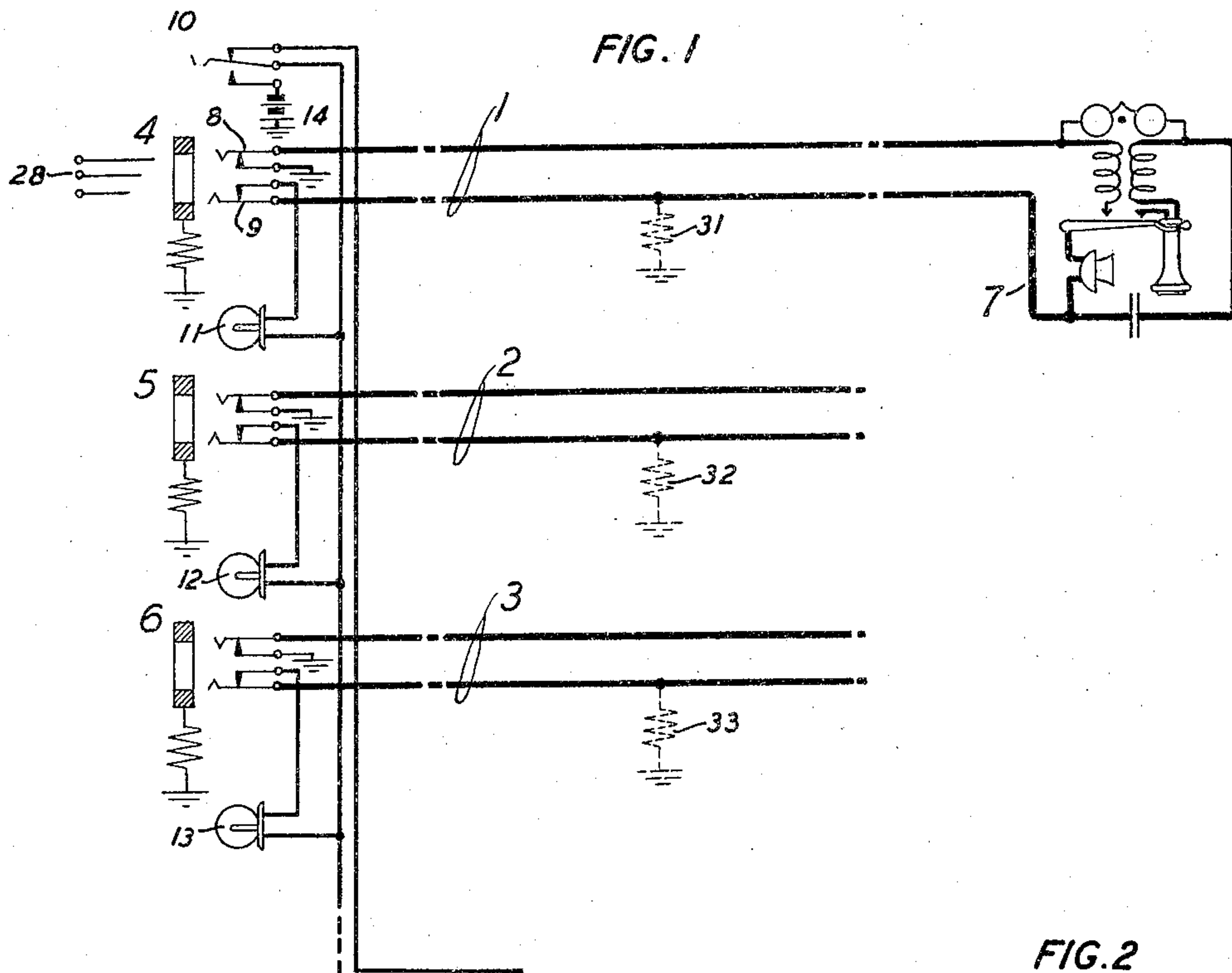
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1,889,053

ANNUNCIATOR SYSTEM

Filed March 22, 1932

2 Sheets-Sheet 1



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FIG. 3

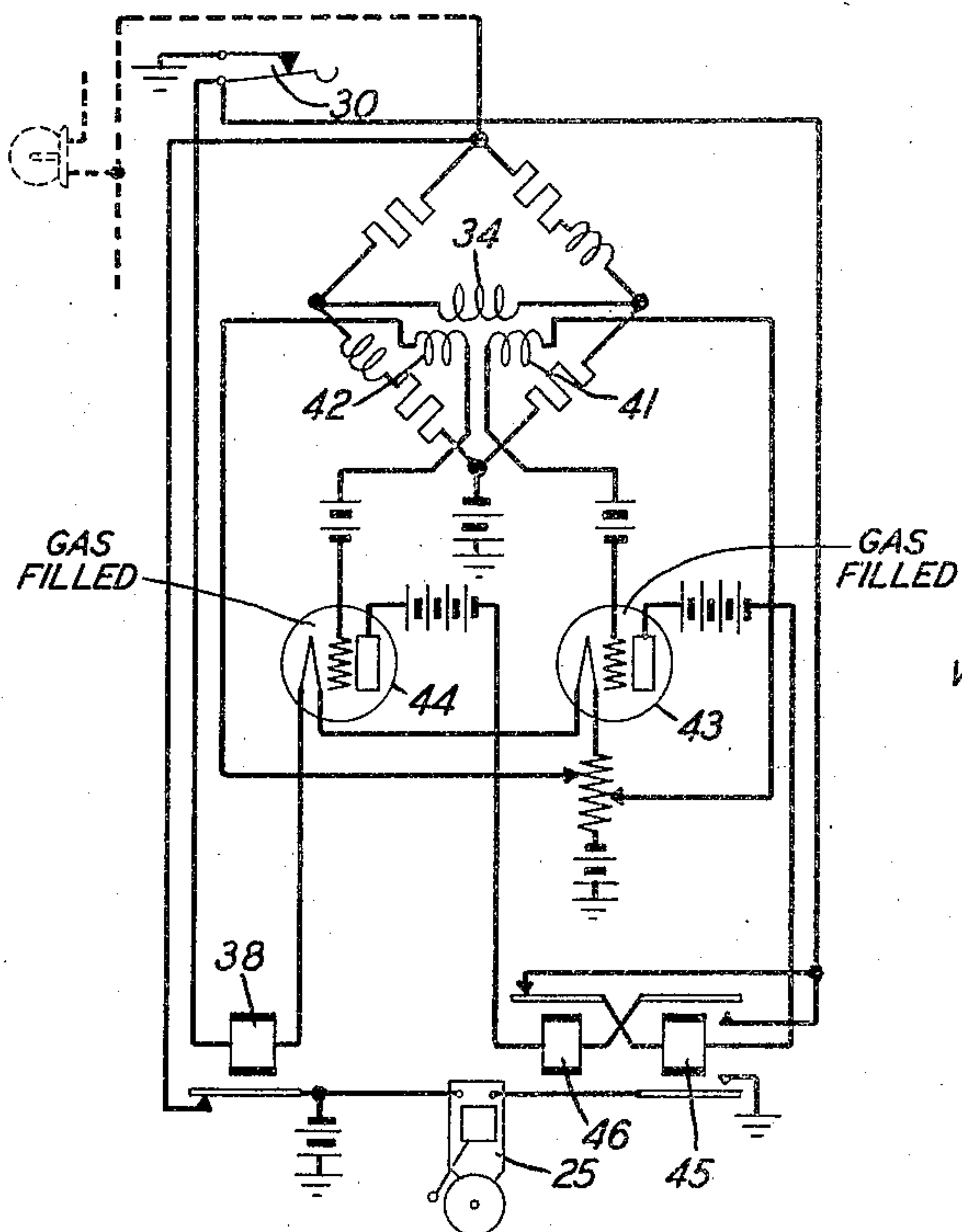


FIG. 4

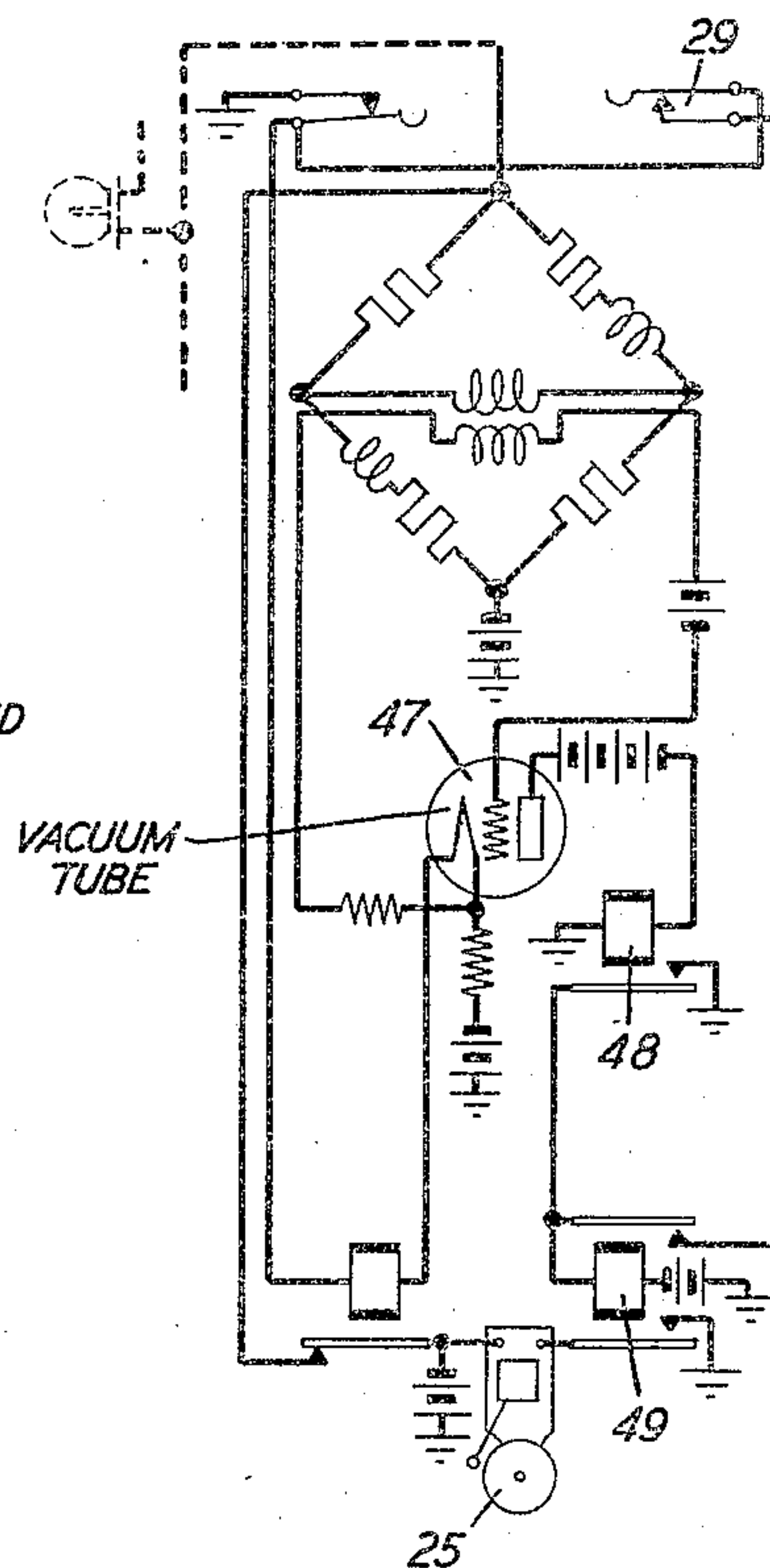


FIG. 5

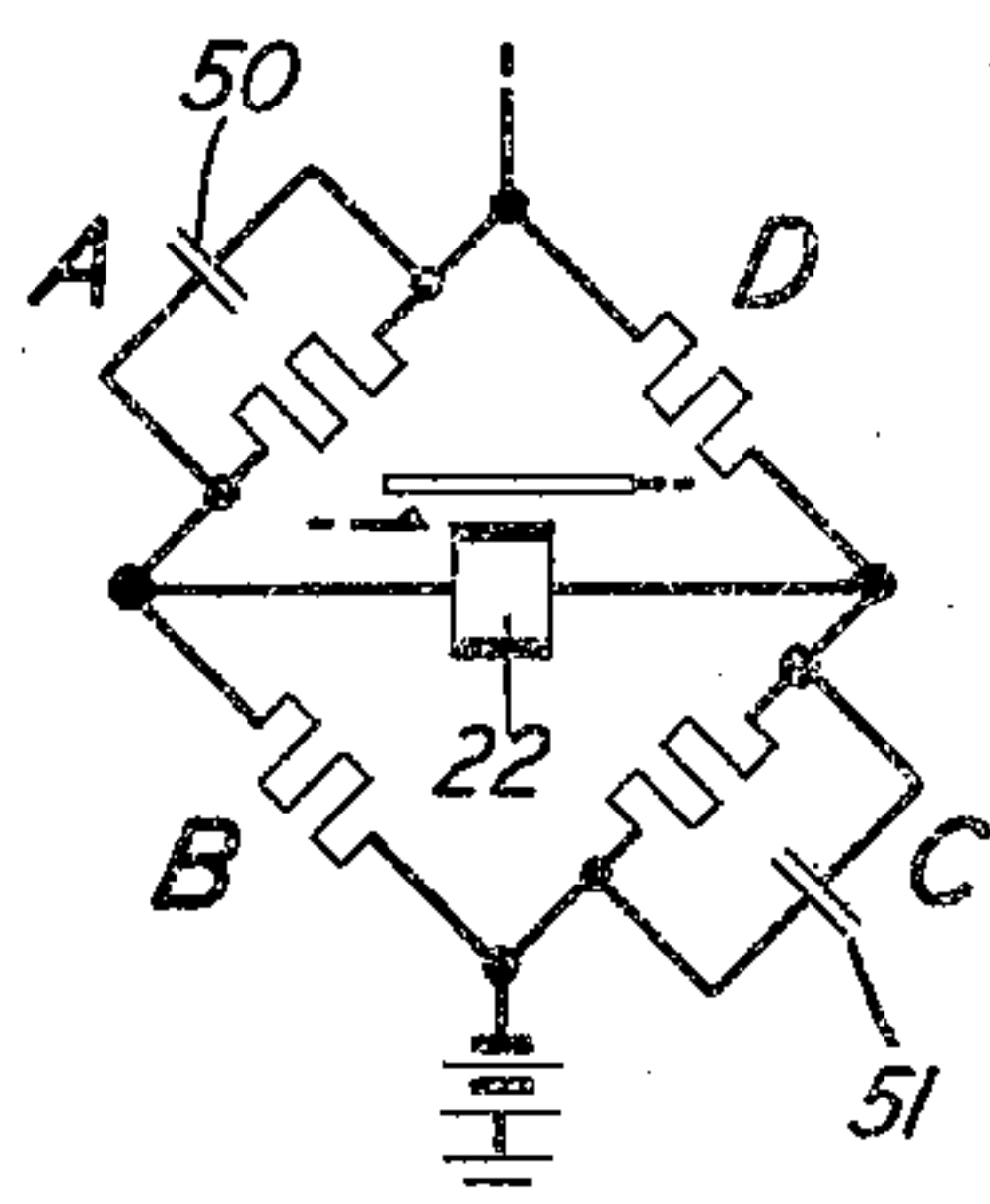
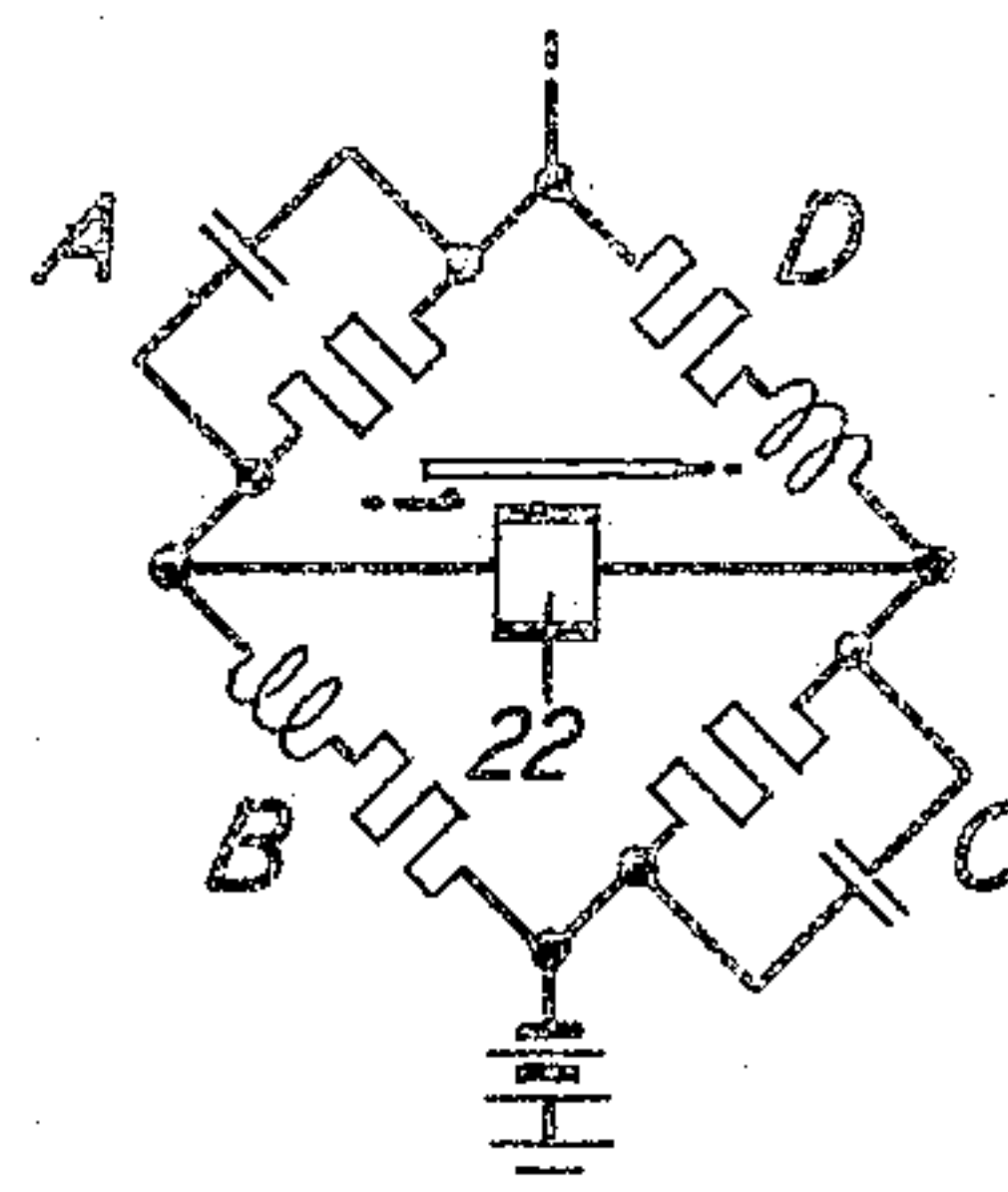


FIG. 6



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ANNUNCIATOR SYSTEM

Application filed March 22, 1932. Serial No. 600,534.

This invention relates to electric annunciator systems and more particularly to the annunciator systems employed in telephone exchanges to indicate to the operator that a subscriber desires a telephone connection.

The switchboard lamp signal associated with each subscriber's common battery line may be connected directly across the line in order to operate on the line current when a subscriber removes his receiver from the switchhook at his station or it may be controlled by a relay bridged across the line. The former method is most economical since the line relay is eliminated. Difficulties are encountered with this method, however, when it is desired to operate a pilot lamp or a night alarm signal common to a group of lines at the time any individual line lamp becomes lighted. If this common signal is placed in a common energizing circuit for all the lines it is liable to operate falsely on the combined leakage currents for these lines. The leakage current for any single line is usually not sufficient to operate the individual line signal but the combined currents for a group of lines may reach a considerable value which may be more than sufficient to operate the common signal falsely.

An object of the present invention, therefore, is to obtain the proper operation of an auxiliary signal common to a group of lines in spite of steady leakage currents in these lines.

A further object of the invention is to initiate operation of an auxiliary signal at the time an individual line signal operates.

A still further object is to initiate operation of an auxiliary signal when the line signal current changes from any steady value to a substantially different value.

A feature of the present invention whereby the foregoing objects are attained, resides in connecting a Wheatstone bridge, having a reactive element in at least one arm to unbalance it during a change in the current through said bridge, in series with the current source for energizing the signals. The detector arm of the bridge includes a device which is momentarily energized in response

to the initial current surge when a line signal is energized in response to a call.

The invention will be understood from the following description, together with the accompanying drawings in which several embodiments of the invention are illustrated.

Figure 1 shows the invention as applied to a night alarm circuit in a telephone exchange system.

Fig. 2 shows a modified form of the invention applied to the night alarm circuit.

Fig. 3 shows a modified form of the arrangement shown in Fig. 2 arranged to start a night alarm when a subscriber's line lamp circuit is energized and to release it when the circuit is deenergized.

Fig. 4 shows a modification of Fig. 2 in which a vacuum tube is used in place of a gas discharge tube.

Fig. 5 shows a modified form of Wheatstone bridge in which capacitative reactances are made use of instead of inductances.

Fig. 6 shows a Wheatstone bridge utilizing both capacitative and inductive reactances.

In Fig. 1 a subscriber's telephone line 1 is shown terminating at one end in the switchboard jack 4 and at the other end in the subscriber's station 7. Other telephone lines 2 and 3 extend from the switchboard jacks 5 and 6, respectively, to other subscribers' stations (not shown). The plug 28 of an operator's cord circuit is adapted to make connection with any line by insertion into the switchboard jack of that line. When inserted into a jack, the plug opens the spring contacts of said jack, for example, contacts 8 and 9 of jack 4. The tip side of line 1 is connected to ground through contacts 8 of jack 4. The ring side of the line is connected through contacts 9 of jack 4 to the line lamp 11. The respective sides of lines 2 and 3 are connected to ground and to the line lamps 12 and 13, respectively in the same manner. The circuits through the line lamps have a common terminal in night alarm key 10. While only three telephone lines with associated series line lamp signals are shown, any number may be connected in the same manner to key 10. The lower contact of key 10 is connected directly to battery 14. The

upper contact is connected to battery 15 through arms A and B, and C and D of the Wheatstone bridge.

The arms A, B, C and D are all of the same direct current resistance which is preferably very low but which may be of any desired value. The arms A and C contain only the equal non-inductive resistances 16 and 18, respectively. The arms B and D, however, contain inductances 20 and 21, respectively in addition to the equal resistances 17 and 19. The bridge is balanced for steady current therefore, the current dividing and flowing in equal parts through both sides of the bridge. No current flows through relay 22 of the detector arm under these conditions.

If the current through the bridge is suddenly changed, however, due to the completion of a circuit over a telephone line, for example, the time required to build up the current through the arms B and D, containing the inductive windings, will be longer than that required for the current to build up in the non-inductive arms A and C. Therefore, during the build-up period, a portion of the current from battery 15 will flow through the bridge in a path from battery, through arm C, relay 22 in the detector arm and through arm A to the circuit through key 10. This current will continue until the current in the arms B and D has built up to an amount equal to that in the arms A and C. The bridge will then be balanced with equal steady currents flowing through both sides and with no current flowing through the detector arm containing relay 22.

Relay 22 will close its contact 23 when it is momentarily energized in response to the current through the detector arm during the build-up period. Relay 24 is controlled by contact 23 and upon operation closes the circuit for the operation of the night alarm signal 25. When relay 24 operates, it locks up under control of relay 26. Relay 26 is in turn controlled by release key 27.

Each of the telephone lines 1, 2 and 3 may be partially grounded at points throughout their length due to faulty insulation or contact with grounded objects. Where such high resistance grounds occur on the ring sides of the lines as at 31, 32 or 33, there will be a leakage path from battery 14 or 15 depending upon the position of key 10 through the line lamps to ground at points 31, 32 and 33. If key 10 is on the upper contact, these partial grounds will cause a steady leakage current to flow through the Wheatstone bridge and the line lamps. Under normal conditions the current through any single line lamp will not be sufficient to light it, although the combined currents for all the line lamps which flow through the Wheatstone bridge may be greater than the energizing current required to light any single lamp. No current will flow through relay 22, however,

since the leakage current is steady and equal parts flow through both sides of the bridge.

The operation of the system shown in Fig. 1 is as follows: With night alarm key 10 on the upper contact, battery 15 is connected through the Wheatstone bridge, upper contact of key 10, line lamps 11, 12 and 13 and the ring contacts of jacks 4, 5 and 6, respectively to the ring sides of the lines 1, 2 and 3. With all the receivers on the switchhooks at the subscribers' stations, no current will flow back through the tip sides of the lines to ground and the only drain on battery 15 is the leakage current due to the partial grounds 31, 32 and 33. Upon the receiver at subscriber's station 7 being removed from the hook, however, a low resistance path is closed over line 1 to ground on contact 8. This causes a sudden increase in current through lamp 11 and the Wheatstone bridge. Lamp 11 thereupon is lighted. Due to the sudden increase of current in the bridge, a pulse of current is caused to flow through relay 22 in the detector arm. This momentarily closes contact 23 which closes an energizing circuit for relay 24. Relay 24 thereupon operates and locks up on a circuit from battery through its own winding, through its upper contact, through contact of relay 26 to ground. Relay 24 also closes its lower contact, energizing signal 25 over an obvious circuit. The attendant, upon being notified of an incoming call by the operation of signal 25 and the lighting of line lamp 11, inserts the plug 28 of her answering cord into jack 4 associated with line 1. Contacts 8 and 9 are thereupon opened and line lamp 11 goes out. After answering the subscriber at station 7, the attendant momentarily depresses release key 27 which closes an energizing circuit for relay 26 which operates and remains operated while the key is depressed. This opens the energizing circuit for relay 24 which releases, opening the night alarm signal circuit and further opening its own locking circuit at its own upper contact. When key 27 is released, relay 26 releases and the other relays and the signal remain unoperated.

When the subscriber at station 7 hangs up, the attendant removes plug 28 from jack 4 and contacts 8 and 9 are again closed. There will be a slight build-up of current through the bridge and lamp 11 due to the leak 31, but the pulse caused thereby in relay 22 will ordinarily not be sufficiently great to close contact 23 and cause false operation of night alarm signal 25.

Fig. 2 shows another arrangement for accomplishing the same result as that shown in Fig. 1. It is adapted to be connected through the line lamps to the telephone lines in the same manner. Keys 29 and 30 take the place of keys 27 and 10 of the arrangement shown in Fig. 1. If night alarm key

30 is operated, relay 38 opens the short circuit from battery 14 around the Wheatstone bridge allowing the energizing current for the line lamps to be supplied by battery 15 through the bridge.

The detector arm of the bridge contains a primary 34 of a transformer. The secondary 35 is connected in a circuit between the filament and grid of a gas or vapor filled discharge tube 36. When the filament of this tube is heated due to the closure of a circuit through key 30, no discharge will take place across the tube and through the plate circuit due to the negative potential on the grid. If the grid potential is momentarily made less negative due to an impulse in secondary 35 of the transformer, however, a discharge from the filament to the plate takes place causing a current in the plate circuit. This discharge will not be stopped, however, when the grid potential returns to the normal negative value, but must be stopped by the opening of the plate circuit at release key 29. A current in the plate circuit will operate relay 37 which closes an obvious circuit for the operation of signal 25.

The operation of the system shown in Fig. 2 is as follows: With night alarm key 30 operated, the filament of the discharge tube 36 is energized and heated and relay 38 is operated, removing battery 14 from the energizing circuit for the line lamps. If a subscriber lifts his receiver from the switch-hook, a low resistance circuit is closed over the line to ground and the line lamp is energized over a circuit from battery 15 through the Wheatstone bridge, through the line lamp and over the line to ground. The sudden build-up of current in the Wheatstone bridge causes an unbalance of current in its arms and a pulse of current, therefore, through the primary 34 of the transformer. This causes an impulse in the secondary 35 and the circuit connected thereto in such direction as to cause a momentary decrease in the negative potential on the grid. This causes a discharge to take place from the filament to the plate of the discharge tube and a current flows through the plate circuit from the plate, through the plate battery, relay 37, and key 29 to ground at key 30. After the impulse in secondary 35 has ended and the grid has returned to normal negative potential, the discharge from filament to plate continues due to the characteristic of the tube. The plate circuit being energized, relay 37 operates, closing a path for the operation of signal 25 over an obvious circuit. After the attendant has answered the call, she momentarily depresses key 29. This momentarily opens the plate circuit and stops the discharge. Relay 37 thereupon releases. When key 29 is released, the discharge is held in check by the negative grid potential.

In Fig. 3 two gas-filled discharge tubes are

shown each controlled from a separate secondary winding of a transformer located in the detector arm of a Wheatstone bridge. The transformer is so arranged that during a build-up of current through the bridge, the current passing through primary winding 34 will induce a potential difference across secondary winding 41 in such direction as to decrease the negative potential of the grid of tube 43, allowing a discharge to take place in this tube. At the same time the potential difference induced across secondary winding 42 is in such direction as to make the grid of tube 44 more negative, consequently allowing no discharge to start in this tube during a build-up of current through the bridge. If the current through the bridge is suddenly decreased, however, the grid of tube 44 will be made less negative and that of tube 43 more negative, thereby allowing tube 44 to discharge, providing its plate circuit is closed, but not allowing tube 43 to do so.

The plate circuit of tube 44 is normally open at the upper contact of relay 45. This relay is connected in the plate circuit of tube 43 and upon operating will close the plate circuit of tube 44 and also the energizing circuit for signal 25. Relay 46 is adapted to open the plate circuit of tube 43 and thereby deenergize relay 45.

The operation of the arrangement shown in Fig. 3 is as follows: When a momentary current flows through primary 34 of the transformer due to the build-up of current through the bridge as previously described, the grid of tube 43 is made less negative and a discharge starts between the filament and plate causing a current to flow in the plate circuit. Relay 45 operates on this current closing the plate circuit of tube 44 and an energizing circuit for signal 25 which operates to signal the attendant.

When the current through the bridge is stopped as previously described, a current flows through primary 34 in the opposite direction affecting secondary 42 which momentarily makes the grid of the tube 44 less negative. A discharge takes place causing a current to flow in the plate circuit of this tube, which is now closed since relay 45 is operated. Relay 46 operates on this current opening the plate circuit of tube 43. The discharge in this tube is thereby stopped and relay 45 is released. Relay 45 upon releasing opens the energizing circuit for signal 25 which is thereby stopped and also opens the plate circuit for tube 44. Relay 46 in this circuit is thereby deenergized and releases again closing the plate circuit of tube 43 at its back contact. Tube 43 does not again discharge, however, until its grid potential is again affected responsive to another incoming signal as previously described.

Fig. 4 shows a high vacuum tube 47 in place of the gas discharge tube shown in

Fig. 2. Relay 48 in its plate circuit upon operating will energize relay 49 which closes the circuit for energizing signal 25 and locks up under control of release key 29.

5 The operation of the circuit shown in Fig. 4 is as follows: With the filament of tube 27 energized and the grid at a sufficiently negative potential, little or no current will flow in the plate circuit. When the grid is momentarily made less negative, as previously described, the plate current momentarily increases sufficiently to operate relay 48. This relay in operating closes a circuit for the operation of relay 49 which pulls up closing the circuit for the operation of signal 25 and locking up under control of release key 29. When release key 29 is operated, relay 49 releases and signal 25 is stopped.

20 Fig. 5 shows a Wheatstone bridge which will serve the same purpose as the one shown in the previous figures. Arms A, B, C and D of this bridge are all of equal resistance but condensers 50 and 51 are shunted across the resistance in arms A and C, respectively. During build-up of current through the bridge, condensers 50 and 51 will become charged due to the potential drop across their terminals and the result will be in effect a momentary current from battery through arm C, through relay 22 and through arm A causing the relay 22 to operate.

30 Fig. 6 shows a combination of the bridge shown in Fig. 1 and that shown in Fig. 5. The condenser across arms A and B and the inductance in arms B and C cooperate to allow current to build-up quickly in arms A and B and to retard its rise in value in arms B and C.

40 Although this invention has been disclosed as embodied in a particular form and associated with a specific system and showing particular arrangements of parts, it is not so limited but is capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

45 What is claimed is:

1. Means to energize a circuit in response to a change in the current flowing in another circuit comprising a first circuit, a Wheatstone bridge in series therewith, a reactive element in at least one arm of said bridge, a second circuit, and means in the detector arm of the bridge responsive to a current impulse in said arm to cause energization of said second circuit.

2. In combination, a signal, an energizing circuit for the signal, a Wheatstone bridge in said circuit, a reactive element in at least one arm of said bridge adapted to substantially unbalance the bridge during a change in the current passing therethrough, a second signal, and means in the detector arm of said bridge to start operation of the second signal in response to a current in said arm.

65 3. In combination, a circuit containing a

Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, a reactive element in at least one of said arms to substantially unbalance the bridge during a change in the current flowing through said bridge, a second circuit, a detector arm in said bridge, and means in said arm to affect the current flow in said second circuit responsive to an impulse of current in said detector arm.

4. In combination, a circuit containing a Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, a reactive element in at least one of said arms to substantially unbalance the bridge during a change in the current flowing through said bridge, a second circuit, a detector arm in said bridge, means in said detector arm to cause closure of second circuit responsive to an impulse of current in one direction in said arm, and additional means in the detector arm to cause the opening of said second circuit responsive to an impulse of current in the opposite direction in said arm.

5. In combination, a circuit containing a Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, a reactive element in at least one of said arms to substantially unbalance the bridge during a change in the current flowing through said bridge, a second circuit, a detector arm in said bridge, and a relay in said detector arm to close said circuit responsive to an impulse of current in said arm.

6. In combination, a circuit containing a Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, a reactive element in at least one of said arms to substantially unbalance the bridge during a change in the current flowing through said bridge, a detector arm in said bridge, a grid controlled space discharge device, and means responsive to an impulse of current in the detector arm of said bridge to control the potential of the grid of said device.

7. In a telephone exchange system, a switchboard, telephone lines terminating at the switchboard, signals associated with each line, a Wheatstone bridge connected in a common energizing circuit for said signals, a reactive element in at least one arm of said bridge adapted to substantially unbalance the bridge during a change in the current passing therethrough, an auxiliary signal circuit, and electroresponsive means in the detector arm of said bridge to control the closure of said circuit.

8. In a telephone exchange system, a switchboard, telephone lines terminating at the switchboard, signals associated with each line, a Wheatstone bridge connected in a common energizing circuit for said signals, a reactive element in at least one arm of said

bridge adapted to substantially unbalance the bridge during a change in the current passing therethrough, an auxiliary signal circuit, a detector arm in said bridge, and a relay in said detector arm adapted to control the closure of said auxiliary signal circuit.

9. In a telephone exchange system, means to start operation of a night alarm when a line signal is energized, comprising a telephone line, a signal associated therewith, an energizing circuit for said signal, a Wheatstone bridge in the energizing circuit, a reactive element in at least one arm of said bridge, a night alarm, and a device in the detector arm of said bridge adapted to start operation of the night alarm in response to a current in said detector arm.

10. In an annunciator system, a plurality of signals adapted to be independently operated, a common source of electric current for energizing the signals, a Wheatstone bridge connected in series with said current source, a reactive element in at least one arm of said bridge, an auxiliary signal, a control circuit for said auxiliary signal, a detector arm in said bridge, and a relay in said detector arm adapted to close said control circuit.

11. In a telephone system, a subscriber's station, a switchboard, a line connecting the station with the switchboard, a lamp signal at the switchboard associated with the line, means responsive to the initiation of a call at the station to complete an energizing circuit for the lamp signal, a Wheatstone bridge having four side arms of substantially equal resistance connected in the lamp energizing circuit, a reactive element in at least one arm of said bridge, an auxiliary signal circuit, and a relay connected in the detector arm of said bridge adapted to control the closure of said auxiliary signal circuit.

12. In an annunciator system, a plurality of signals adapted to be independently operated, a common source of electric current for energizing the signals, a Wheatstone bridge connected in series with said current source, a reactive element in at least one arm of said bridge, an auxiliary signal, a grid controlled space discharge device, the plate circuit of said device comprising a control circuit for said auxiliary signal and electroresponsive means in the detector arm of said bridge to control the potential of the grid of said device.

13. Means to energize a circuit in response to a change in the current flowing in another circuit comprising a first circuit, a Wheatstone bridge in series therewith, an inductive element in at least one arm of said bridge, a second circuit, and means in the detector arm of the bridge responsive to a current impulse in said arm to cause energization of said second circuit.

14. In combination, a signal, an energizing circuit for the signal, a Wheatstone bridge in

said circuit, an inductive element in at least one arm of said bridge adapted to substantially unbalance the bridge during a change in the current passing therethrough, a second signal, and means in the detector arm of said bridge to start operation of the second signal in response to a current in said arm.

15. In combination, a circuit containing a Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, an inductive element in at least one of said arms to unbalance the bridge during a change in the current flowing through said bridge, a second circuit, a detector arm in said bridge, and means in said arm to affect the amount of current flowing in said circuit responsive to an impulse of current in said detector arm.

16. In combination, a circuit containing a Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, an inductive element in at least one of said arms to unbalance the bridge during a change in the current flowing through said bridge, a second circuit, a detector arm in said bridge, and a relay in said detector arm to close said second circuit responsive to an impulse of current in said arm.

17. In combination, a circuit containing a Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, an inductive element in at least one of said arms to substantially unbalance the bridge during a change in the current flowing through said bridge, a detector arm in said bridge, a grid controlled space discharge device, and means responsive to an impulse of current in said detector arm to control the potential of the grid of said device.

18. Means to energize a circuit in response to a change in the current flowing in another circuit comprising a first circuit, a Wheatstone bridge in series therewith having alternative inductive and non-inductive arms, a second circuit, and means in the detector arm of the bridge responsive to a current impulse in said arm to cause energization of said second circuit.

19. In a telephone exchange system, a switchboard, telephone lines terminating at the switchboard, signals associated with each line, a Wheatstone bridge having alternate inductive and non-inductive arms connected in a common energizing circuit for said signals, an auxiliary signal circuit, and electroresponsive means in the detector arm of said bridge to control the closure of said auxiliary signal circuit.

20. In combination, a circuit containing a Wheatstone bridge, four side arms in said bridge of substantially equal direct current resistance, a condenser shunted around the resistance in at least one of said arms to substantially unbalance the bridge during a

change in the current flowing through said
bridge, a second circuit, a detector arm in
said bridge, and means in said detector arm to
affect the current flow in said second circuit
5 responsive to an impulse of current in said
arm.

In testimony whereof, I have signed my
name to this specification this 21st day of
March 1932.

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STANLEY F. NELSON.

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