July 15, 1941. K. L. MAURER 2,249,154

TELEPHONE RINGING SYSTEM

Filed Dec. 8, 1939

FIG. 1

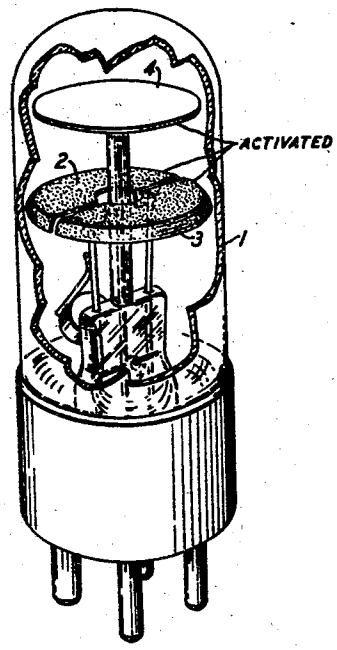
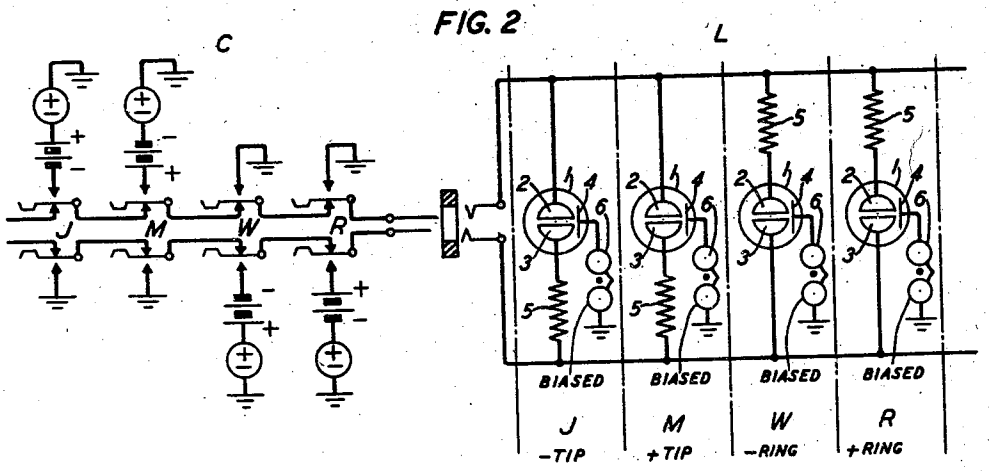


FIG. 2



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TELEPHONE RINGING SYSTEM

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4 Claims. (Cl. 179—86)

This invention relates to selective signaling systems and more particularly to selective ringing systems for telephone lines in which three-electrode cold cathode gas-filled tubes are employed and so connected with the line, ringers and ground that any one of four stations on a line can be selectively rung to the exclusion of the other three.

Arrangements of the above character, now in use, which employ rectifying gas tubes, are the most satisfactory under all but the most abnormal conditions, i. e., when the earth potential at the stations, or the induced potential from adjacent power lines, etc., is not sufficiently high, when added to the potential of the central office battery during the idle or talking condition of the line, to break down some or all of the control gaps of the station tubes which in practice requires about 70 volts. If such a breakdown occurs while conversation is in progress, such discharge will cause noise in the receivers of the parties talking. Further, if the interfering voltage occurs in the absence of ringing potential, it need only rise to a somewhat higher peak value to cause false operation of one or more of the bells connected to the line.

An object of the present invention is to provide an arrangement employing gas-filled tubes that will function in a satisfactory manner and obviate noise interference and false ringing under abnormally high ground and induced voltage conditions.

A feature of the present invention resides in employing three-electrode gas tubes in which the so-called main gap, i. e., the gap between the anode and either of the other two electrodes, is non-rectifying, i. e., will permit a current to flow in either direction with equal facility, in connecting the control electrode and cathode to the two sides of the line in series with a current limiting high resistance, and in connecting the anode to ground through a polarized and biased telephone ringer of a well-known type, the resistance at each station being connected between the tube and the side of the line which is opposite the side over which current must be transmitted to operate the respective ringer.

The invention will be understood from the following description and appended drawing which show a tube (Fig. 1) having the bilateral main gap characteristics previously mentioned and the method of connecting the tube with the line and ringer to avoid noise interference and false ringing (Fig. 2).

Referring to Fig. 1, the tube 1 is of the usual gas-filled type containing three electrodes, two of which, 2 and 3, are semicircular in shape and arranged in a plane transverse of the major axis of the tube with the straight edges of the electrodes close together (of the order of 1 millimeter). The circular edges are preferably turned downward in a small arc to prevent excessive blackening of the envelope or bulb adjacent to the electrode.

The upper or outer surface of the two electrodes, 2 and 3, are coated with alkaline earth compounds such as oxides of barium and strontium, and thereafter activated in the usual manner.

These two electrodes constitute the so-called control gap of the tube and in practice break down at or about 70 volts applied thereto.

The third electrode or anode 4 of the tube employed in the present invention, however, differs from the small untreated wire tip used in tubes now in commercial service and which gives these tubes a highly rectifying characteristic, in that the present anode is similar in shape, size and surface treatment to the other two electrodes, 2 and 3, whereby the gap formed between either electrode 2 or 3 and the anode 4 is capable of passing current in either direction with equal facility.

In the present commercial rectifying tubes the nominal main gap breakdown voltage, i. e., between the tip of the wire anode and either of the other electrodes in the absence of ionization, is of the order of 175 to 200 volts and the voltage necessary to sustain a discharge therebetween is of the order of 75 volts. These values could be the same and by proper design probably exceeded in the non-rectifying tubes of the present invention.

Now, referring to Fig. 2, C is a conventional cord circuit having four selective ringing keys, J, M, W and R which are adapted when individually operated to connect ground to either side of a connected line L and alternating ringing current in series with a so-called biasing battery to the other side of the line. For example, key J is adapted to ground the so-called "ring" conductor of the line and connect the negative pole of a biasing battery in series with a ringing generator to the "tip" side of the line and key R is adapted to ground the "tip" of the line and connect the positive pole of the biasing battery in series with the ringing generator to the "ring" side.

Connected across the line at the subscriber's stations J, M, W and R, in series with current

limiting resistances 5, are gas-filled tubes 1 of the type hereinbefore described having a main gap of bilateral conducting characteristics.

At stations J and M, i. e., the so-called "tip parties," one of the control gap electrodes 2 is connected directly to the tip conductor of the line and its opposing electrode 3 is connected to the ring conductor in series with the current limiting resistance 5 and at stations W and R, i. e., the so-called "ring parties," the location of the current limiting resistance is reversed, it being connected between the "tip" of the line and electrode 2, while electrode 3 is connected directly to the "ring."

Completing the circuit arrangement, polarized and biased telephone ringers 6, of conventional type, are connected between ground and the third electrode or anode 4 of the tube 1.

The operation of the circuit arrangement above described is as follows: If for example it is desired to ring the party R, i. e., the station which responds to positive pulsating current on the "ring" side of the line, the operator will close key R, thereby grounding the "tip" conductor of the line and connecting the positive pole of the biasing battery, in series with the ringing generator, to the "ring" side of the line.

It is assumed that the voltage of the combined battery and ringing generator, during a portion of each cycle, is sufficiently high (70 volts) to fire the control gap of the tube at each station whereby ionization takes place. When this occurs the main gaps of the tubes at stations W and R break down in the direction of electrode 3 to anode 4, assuming, of course, that the voltage is sufficiently high (75 volts), and current immediately flows to ground at each of these stations through the windings of the respective ringers. The ringer at station R is biased in the usual, well-known manner to respond to pulsating current in this direction but the ringer at station W is biased in the opposite direction and therefore does not respond.

Similarly, the ringer at station W will respond to connection of negative pulsating current to the ring conductor of the line by the operation of key W, but the ringer at station R, being positively biased, does not respond.

Due to the inclusion of the high value current limiting resistance 5 between the ring side of the line and electrode 3 at stations J and M, insufficient main gap current is permitted to flow to actuate the ringers at these stations. If, however, key M is operated, the "ring" side of the line is grounded and positive pulsating current is connected to the "tip" whereupon the control gaps of all tubes break down as before, causing ionization and current to flow across the main gaps at stations J and M. The ringer at station M is biased to respond to positive pulsating current and therefore the bell at this station will ring but the ringer at station J is biased in the opposite direction and therefore its bell will be silent. For the same reason as before mentioned, the main gaps of the tubes at stations W and R will not receive sufficient current, due to resistance 5, to operate the ringers at these stations.

From the standpoint of noise and false operation of the ringers during non-ringing intervals, due to induced or ground potentials, as previously discussed, the present arrangement is an improvement over the previous arrangement for the reason that the interfering voltage must reach the breakdown potential of the main gap before ionization occurs, which even in present tubes is of the order of 175 to 200 volts.

What is claimed is:

1. In a selective signaling system, a line, a plurality of telephone stations, a source of pulsating signaling current, means for selectively connecting either pole of said source to either side of the line and ground and the other pole of said source to the opposite side of the line, biased telephone ringers at each station adapted to respond to pulsating current flowing therethrough in a predetermined direction, a high resistance element and a three-element gas-filled discharge device comprising an anode and two other closely spaced electrodes associated with each ringer and so connected that said closely spaced electrodes are connected to opposite sides of the line in series with the respective high resistances, and said anodes are connected to ground in series with the respective ringers, said discharge devices being so constructed that a bilateral discharge path of substantially equal conducting characteristic exists between said anode and either of said other electrodes, and said resistances are connected in such a manner that at stations whose ringers are desired to respond to pulsating current applied to one side of the line, the respective resistances are connected between the tubes and the other side of the line.

2. In a four-party selective ringing telephone system, in combination, a plurality of subscribers' stations, a biased ringer, a high resistance element, and a gas-filled discharge device comprising an anode and two other closely spaced electrodes at each station, a source of pulsating ringing current for actuating said ringers, means for selectively connecting either pole of said source to either side of the line and ground and the other pole to the opposite side of the line, said discharge devices being so constructed that a discharge between the anode and either of said other electrodes encounters substantially the same impedance to the passage of current in either direction, a connection between each anode and ground including the respective ringer, and connections at each station between the respective opposing electrodes and opposite sides of the line, the connection to the tip of the line at two stations including the respective high resistance elements and at another two stations, said resistance elements being included in the connections to the ring side of the line.

3. In a four-party selective ringing telephone system employing positive and negative pulsating currents, and a three-electrode gas tube, a high resistance and a biased ringer at each station, characterized in this that the impedance of the discharge path between the anode and either of the other two electrodes of said tubes is substantially the same to current flowing therethrough in either direction, in connecting the anode of each tube to ground in series with its associated ringer, and in connecting the other two electrodes of each tube to opposite sides of the line in series with a high resistance, the resistances at the so-called ring stations being included in the connection to the tip of the line and at the tip stations the resistances are included in the connection to the ring side of the line, said resistances being of such a high value as to prevent sufficient current flowing therethrough to operate said ringers.

4. In a four-party selective ringing system, a line, four biased telephone ringers and a three-electrode gas tube associated with each ringer,

each tube comprising an anode and two other closely spaced cold electrodes so constructed as to provide a discharge path having substantially equal impedance in either direction between said anode and either of said electrodes, two of said ringers being connected between their respective anodes and ground in such a manner as to respond to pulsating ringing current in one direction and the other two ringers connected in a similar manner to respond to current in the opposite direction, a connection between the cold electrodes of each tube and opposite sides of the line, means for selectively grounding either side of the line and connecting pulsating ringing current of either polarity to the other side, and a high resistance associated with each tube and connected between one of its respective cold electrodes and the side of the line which will be grounded when ringing current of the proper direction to operate the corresponding ringer is connected to the other side of the line.

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