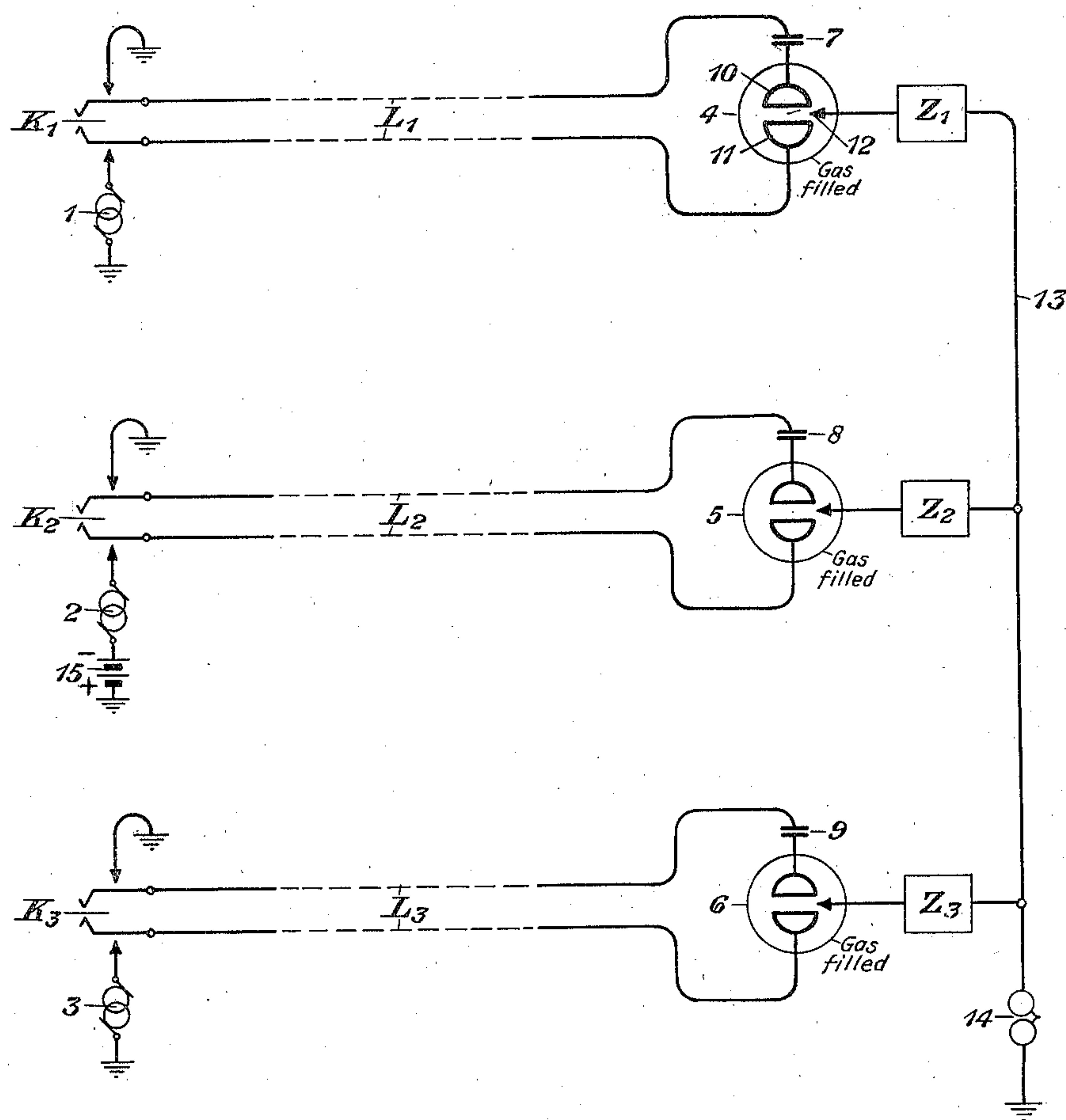


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SIGNALING SYSTEM
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SIGNALING SYSTEM

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1 Claim. (Cl. 179—84)

This invention relates to signaling systems and more particularly to arrangements for providing a plurality of signaling lines with individual visual signals and a common audible signal.

The arrangements of the invention are particularly adapted for signaling systems adapted to be utilized with telephone lines. It has often been found desirable in telephone systems, for example at an exchange or in a room where a plurality of lines terminate, to provide each of the lines with a common audible signal and individual visual signals. It is one of the primary objects of the arrangements of this invention to provide a means for furnishing a service of this type. In the arrangements of the invention this is accomplished by providing each line with a gas-filled discharge tube adapted to be operated in response to the signaling current transmitted over the line and which when operated will provide a visual signal individual to that line. All of the gas-filled discharge tubes would be connected to a common signaling circuit and the operation of any one of the tubes would cause the operation of a common audible signal therein. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawing, in the figure of which is shown a circuit diagram embodying a preferred form of the invention.

In the drawing are shown three signal lines such as L_1 , L_2 , and L_3 . At the distant end of these lines are shown means for applying thereto signaling currents. For example, the key K_1 might be used to apply alternating signaling current from the source I to the line L_1 ; the key K_2 might be used to apply to the line L_2 , alternating signaling current of the type known as A. C.—D. C. in which a battery B is connected between the alternating current source and ground; and the key K_3 might be used to apply signaling current from the source S to the line L_3 . Obviously other arrangements for applying signaling currents to the lines might be utilized. At the other end of each line there would be provided a gas-filled discharge tube. For example, there would be connected in the line L_1 a gas-filled discharge tube 4 in series with a condenser 7 ; in the line L_2 there would be connected a gas-filled tube 5 in series with a condenser 8 ; and in the line L_3 there would be connected a gas-filled tube 6 in series with the condenser 9 . The gas-filled tubes utilized are shown as of the type commonly referred to in the art as a cold cathode ionic tube of the double-gap type. Such tubes usually possess a cathode, coated preferably with some material to reduce the cathode fall, or activated, as this is termed, an auxiliary electrode, also

activated and so spaced from the cathode that the breakdown voltage between this electrode and the cathode is relatively low. In the tube 4 the cathode is designated 11 and the auxiliary electrode is designated 10 . The discharge path between the cathode and auxiliary electrode is spoken of as the control discharge path, or control gap. Tubes of this type are also provided with an anode, which has been designated 12 , so spaced from the cathode that the breakdown voltage therebetween is much greater than that from cathode to auxiliary electrode. The minimum voltage to sustain a discharge, once started, will be nearly the same for the two discharge paths, the main gap, or anode to cathode path being possibly 10 volts higher. In this type of tube it is found that if a voltage less than the breakdown, but above the sustaining voltage, is applied to the main gap, namely between cathode and anode, and a discharge is caused to pass through the control gap, a breakdown of the main gap will take place, being triggered off by the control gap. Accordingly, when signaling current is applied to any of the lines such, for example, as the line L_1 a discharge will take place across the control gap, namely, between electrodes 10 and 11 , and this will cause a discharge to pass across the main gap, namely, between electrodes 11 and 12 . The discharge across the control gap will be in the nature of a luminous discharge but will be slight in view of the current limiting condenser, but the discharge across the main gap will be large and will serve as an individual visual signal for the line L_1 . The discharge across the main gap will cause signaling current to be transmitted over the common conductor 13 to the common signaling apparatus 14 , shown for purposes of illustration as a ringer but which of course could be a relay, lamp or other apparatus. This will cause operation of the ringer 14 . In a like manner, signaling current applied to either of the other lines such as L_2 or L_3 will cause the operation of the tube 5 or 6 . Their operation will give an individual visual signal for each line and will also cause the operation of the common audible signal 14 .

It has been found that if the anodes of all of the tubes were connected directly to the common signal, the illumination of the individual tubes when signaling current was being sent over several of the lines simultaneously could not be depended upon, because if the voltage of the ringing current transmitted over the line first operated was equal to or higher than the voltage supply on another line, the voltage drop caused in the common circuit by the first applied ringing voltage would prevent tubes on the circuits from breaking down or obtaining enough current to illuminate properly. Accordingly, the arrangements of this invention avoid this diffi-

culty by providing in the individual anode circuit of each tube an impedance element. These individual impedance elements are shown in the drawing schematically as Z_1 , Z_2 , and Z_3 . These impedance elements, however, may be either an inductance, capacity or resistance, or a combination of them. A capacity may be preferable since it tends to resonate with the inductance of the ringing signal and thus increase the current therein. Thus if the instantaneous voltages in the circuits of lines L_1 and L_2 are assumed as given below, and the impedances Z_1 and Z_2 were omitted, the discharge tube operated first would determine the voltage across the ringer 14 and might prevent the second tube from breaking down.

Using the following symbols:

E_{L1}, E_{L2} = Instantaneous voltages of ringing current supply of lines L_1 and L_2

E_R = Instantaneous voltage across ringer 14

E_S = Sustaining voltage of main gap of discharge tubes of 4 and 5

E_B = Breakdown voltage of main gap of discharge tubes 4 and 5

E_X = Voltage available to breakdown tube 4

Then, since $E_S = E_B - 10$ volts, the conditions when ringing on L_2 are

$E_{L2} = E_R + E_S$ neglecting line drop.

If $E_{L1} = E_{L2}$, then if E_{L1} is applied after E_{L2}

$$E_X = E_{L2} - E_R \text{ or } E_S$$

Consequently E_X is insufficient to break down the tube 4 as it is 10 volts below the required voltage.

However, if the impedances Z_1 and Z_2 are introduced, the voltages across these will be E_{Z1} and E_{Z2} .

Then while ringing on L_2 ,

$$E_{L2} = E_R + E_{Z2} + E_S$$

If ringing is applied to L_1 , and E_{L1} is equal to E_{L2} the voltage available before breakdown on the main gap of tube 4 is:

$$E_X = E_{L2} - E_R = E_{Z2} + E_S$$

Assuming E_{Z2} is greater than 10 volts, or 20 volts $E_X = E_S + 20$ volts or sufficient to break down and maintain tube 4.

If for any reason a signal other than that provided by the luminous discharge is desired that is individual to each line, the impedances shown would take the form of relays, audible signals, lamps or other arrangements without interfering with the common ringing signal or the luminous discharges from the tubes.

Although a grounded return path for the ringing current through the common signal is shown, a metallic path could of course be used.

While the arrangements of the invention have been disclosed as embodied in certain specific forms which are deemed desirable, it is understood they are capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claim.

What is claimed is:

A telephone signaling system comprising a plurality of lines, means for applying telephone signaling current to each of said lines, a gas-filled discharge tube of the cold cathode double gap type connected to each of said lines, each of said tubes having two electrodes which form a control gap adapted to be discharged when signaling current is applied to the line and an anode electrode which together with one of said other electrodes forms a main gap adapted to be discharged and to give a luminous discharge when said control gap is discharged, a signaling circuit common to all of said lines, means for connecting said common signaling circuit to the anodes of each of said tubes whereby it will be operated when any of said tubes are discharged solely by said telephone signaling currents applied to said line, and individual impedance devices connected between each of said anodes and said common signaling circuit.

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