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2,641,653

RINGER CIRCUIT USING COLD CATHODE TUBE

Filed April 5, 1950

2 Sheets-Sheet 1

FIG. 1

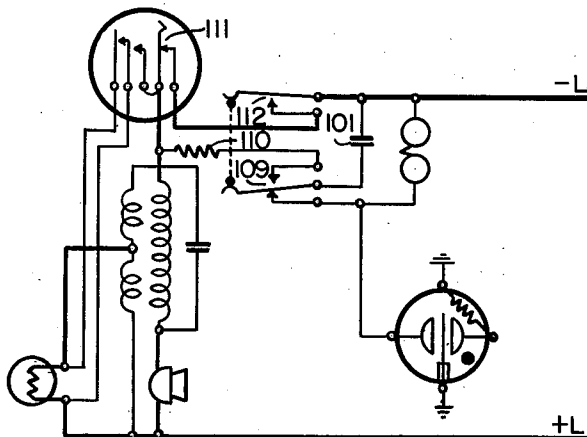
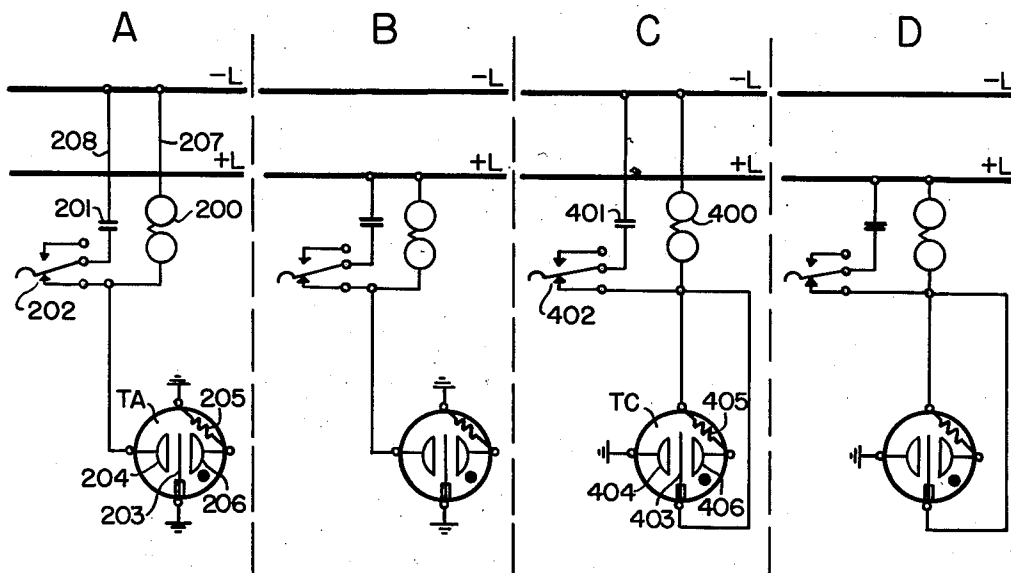


FIG. 2



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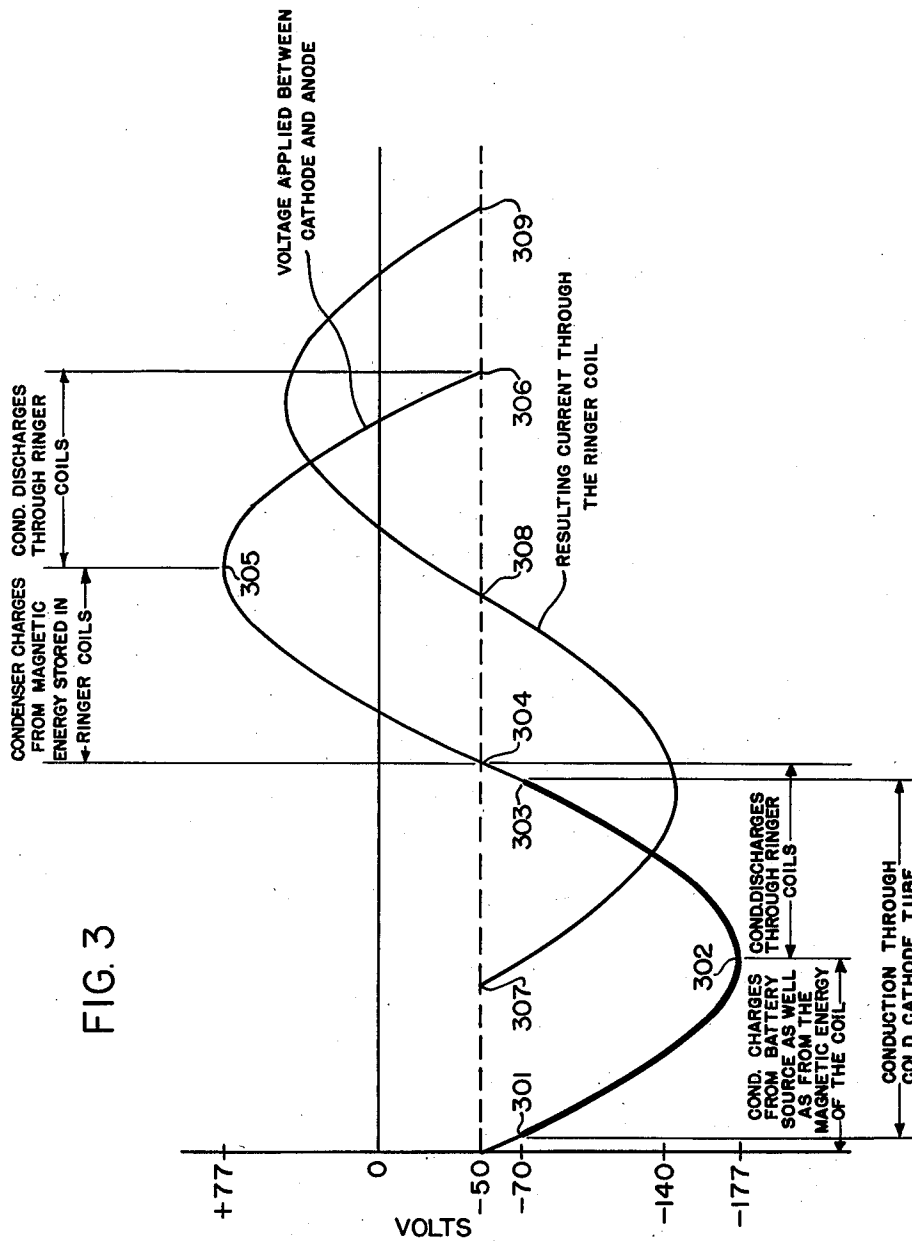
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RINGER CIRCUIT USING COLD
CATHODE TUBE

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Application April 5, 1950, Serial No. 154,107

9 Claims. (Cl. 179—86)

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This invention relates in general to selective signaling systems and more particularly to improvements in selective ringing systems for telephone lines whereby a more pleasing ring is effected.

Accordingly, an object of the invention is to improve the quality of the ring heard by the subscriber.

Another object is the provision of means whereby the number of types of substations stocked in any particular system, requiring various classes of service, is diminished appreciably.

A feature of the present invention is the arrangement of the substation circuit wherein some components are utilized for several various functions.

These and other objects and features are accomplished, according to the invention by the arrangement and combination of elements set forth in the following description, defined in the appended claims and illustratively exemplified in the accompanying drawings, in which:

Fig. 1 shows a substation circuit including the invention.

Fig. 2 shows the four various arrangements of the new and improved ringing circuit for a four party line, namely, A, B, C and D.

Fig. 3 shows a graphical analysis of the voltage and current waveforms associated with the operation of arrangement A of the new and improved ringing circuit.

In the present embodiment a well-known cold cathode gas filled tube is in series with a biased ringer and a condenser in parallel. The ringer coils inductance and condenser capacitance are of such values that the combination will resonate at 20 cycles per second. The well-known "superimposed pulsating" ringing current is required for selectivity and originates at the central office. The source comprises a conventional 20 cycle ringing generator in series with a source of direct voltage, resulting in a current which may be considered as an alternating current wave with its neutral axis displaced from the central line of the wave by the amount of the direct voltage. As the cold cathode gas filled tube is a rectifier, a proper combination of the ringing alternating voltage magnitude and the direct voltage magnitude will effect an interrupted flow of current through the tube. The first ringing cycle pulse through the tube will set the resonant circuit oscillating. Subsequent pulses, being at the resonant frequency, i. e. 20 cycles per second, will provide for the power loss in the resonating "tank" circuit and sustain os-

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cillations. The ringer assembly in this invention may be of the type disclosed in United States Patent No. 2,082,095, issued to H. A. Bredehoft, June 1, 1937.

The current through the ringer coils will therefore reverse in direction twice per cycle and, accordingly, actuate the armature and associated clapper to strike each of the gongs once per cycle. The pulse allowed to pass through the tube will, in relation to time, arrive during the half cycle the clapper is working against the tension of the bias spring. The ringer coils' magnetomotive force will thus be re-enforced during that half cycle. During the other half cycle, when the tube is non-conducting and no pulse is applied, the tension of the bias spring will assist the magnetomotive force, caused by the natural oscillation current, in actuating the clapper and striking the other gong. The two gongs are thus struck with approximately the same vigor causing resultant even sonic vibrations.

It should be understood that a gas filled cold cathode tube, used in the present embodiment, is not necessary to obtain the desired selective ringing operation. There are other devices that have non-linear, asymmetrical conductivity. Various types of rectifiers might be used, such as, the dry disc of selenium, copper oxide, copper sulphide, aluminum oxide and many others. The inventor does not wish to be limited merely thereto.

Referring now to the drawing a detailed description of the arrangement will now be given.

The substation in Fig. 1, with the exception of the new and improved ringing circuit included therein, is identical to the substation as shown in U. S. Patent 2,214,259, issued September 10, 1940, to Harold C. Pye. The ringing circuit shown at A in Fig. 2 is incorporated with the substation in Fig. 1 and will be considered first. With this arrangement, ringer 200 will operate only when a negative superimposed ringing voltage is applied from line —L to ground. In the present invention the direct voltage will be approximately 50 volts and the alternating 20 cycle ringing voltage approximately 90 volts R. M. S. The particular tube used consists of three electrodes: a starting anode, a main anode and a cathode. The tube does not conduct until the voltage applied between the starting anode and the cathode reaches approximately 70 volts. Once the tube is ionized by a minimum required voltage across the starting anode and cathode, the principal flow of electrons will be from the

cathode to the main anode. Assuming a positive voltage on the main anode and negative on the cathode the tube will conduct if it is 75 volts or higher. The voltage drop across the electrodes is practically independent of current flow.

In order to fully understand the operation of this circuit and referring to Fig. 3 one complete cycle of the ringing voltage will be considered. It will be remembered that for operation of ringer 200 the 90 volt R. M. S. ringing voltage is displaced from the zero (ground) reference by a negative 50 volts D. C. As the voltage from the central office battery source over line -L to ground will only be negative 50 volts at the beginning of a cycle the tube TA will not conduct. Negative 50 volts will be applied from line -L through ringer 200 to cathode 204. The starting anode 206 will be at ground potential through resistance 205. As the alternating ringing voltage from the source over line -L becomes more negative as can be seen from Fig. 3 the total voltage from cathode 204 to starting anode 206 will, of course, become more negative. When the value of the superimposed alternating ringing voltage is negative 20 volts, the total value across starting anode 206 and cathode 204 being negative 70 volts (301 on Fig. 3), tube TA will conduct. The 70 volts, as hereinbefore explained will be sufficient to ionize the gas and allow conduction from cathode 204 to the main anode 203. Thus when the tube TA is ionized a circuit will be completed for the coils of ringer 200, over the following path: ringer 200, cathode 204, through tube TA, main anode 203, ground, central office voltage source, line -L to ringer 200. At the same time condenser 201, being in parallel with the coils of ringer 200 and in series with normally closed switch-hook contact 202, will begin to charge. As the alternating voltage becomes increasingly more negative condenser 201 will continue to charge. The current flow through coils of ringer 200, lagging the voltage by slightly less than 90 degrees in well known fashion, will reach the value necessary for the magnetic force to overcome the bias spring tension and cause the clapper to strike the first gong. The alternating voltage will subsequently reach the peak negative value (302) and begin to rise. At point 302 in the voltage cycle all of the stored energy is in the condenser. The condenser 201 will now discharge through the coils of ringer 200. When the alternating ringing voltage rises to approximately negative 20 volts, total voltage being negative 70 volts (303), the tube TA will cease conducting. It will not conduct throughout the remainder of that half cycle or corresponding positive half cycle as the total voltage difference between cathode 204 and main anode 203 or starting anode 206 will always be less than the minimum required. The condenser 201 will, of course, discharge completely through ringer 200 transferring the stored energy from condenser 201 to the coils of ringer 200. At point 304 practically all of the stored energy is in the coils of ringer 200. The magnetic energy in the coils of ringer 200 will begin to charge condenser 201 to an opposite polarity than that hereinbefore described as can be seen from Fig. 3. The current flowing through the coils of ringer 200 will be in the same direction up to this point, i. e. approaching 305, as can be observed from the current waveform in Fig. 3 from points 307 to 308. Condenser 201 will then become fully charged from the magnetic energy of the coils (point 305 in the voltage cycle)

and as the tube TA is not conducting at this time condenser 201 will discharge through the coils of ringer 200 in the opposite direction. The lagging current, from point 308 to 309 in the current cycle, will now be in such a direction as to move the armature and associated clapper, aiding the bias spring in returning the clapper and striking the second gong. The condenser 201 will again be charged in the opposite direction by the magnetic energy of the coils of ringer 200, point 306 in the voltage cycle, and causes the initiation of a succeeding cycle. However, if the two elements, i. e. coils of ringer 200 and condenser 201, are properly "tuned" to 20 cycles per second the next pulse from the succeeding ringing cycle will arrive and re-enforce the voltage wave, providing a source of power for that dissipated in the resistance of the circuit. This operation will, of course, take place every cycle and is well known in the art as the "fly wheel" effect. Thus it can be seen that oscillation is the result causing each gong to be struck with the same strength—considerably different from the old "one-sided" operation wherein the bias spring is the chief force utilized in striking one of the gongs. It can also be seen that the striking is evenly spaced in time.

Operation of circuit arrangement B in Fig. 2 is exactly similar to that hereinbefore described for A with the exception that the negative superimposed ringing voltage is applied to line +L instead of line -L.

From the circuit arrangement C in Fig. 2 it can be seen that cathode 404 is at ground potential. Therefore, in order for tube TC to conduct, an alternating ringing voltage superimposed on a positive direct voltage will be required on starting anode 406. The positive half cycle will now increase the voltage on starting anode 406 to the point of ionization. Thus, with this arrangement, the "tuned" circuit, comprising the coils of ringer 400 and condenser 401, will receive pulses from tube TC during the positive half cycle to sustain the oscillation. It will be remembered that in operation of circuit arrangements A and B, pulses were received during the negative portion of the cycle.

Operation of circuit arrangement D in Fig. 2 is, of course, exactly similar to that hereinbefore described for C with the exception that the positive superimposed ringing voltage is applied to line +L instead of line -L.

Circuits A, B, C and D are also arranged to facilitate a very simple changeover to metallic or grounded ringing. Circuit A could be modified to metallic ringing by removing conductor 207 from line -L and connecting same to line +L. Grounded ringing over line -L could be effected by removing conductor 207 and grounding same. Accordingly, grounded ringing over line +L could be arranged by removing both conductor 208 and 207, connecting one to line +L and the other to a ground source. Similarly, circuits B, C and D could be modified. The tubes would, of course, not be required and should be removed. It can therefore be seen that one substation including these ringing circuit elements could be adapted for any type of service desired.

Referring now to Fig. 1 it can be seen that the necessary condenser 101, for accomplishing the improved quality ringing, will function in a different capacity once the switch-hook is raised. Contact 109 and 112 will then be made completing a shunt circuit for dial pulsing contact 111. Resistor 110 and condenser 101 will thus function

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as the well-known contact spark suppression circuit and also the line relay inductive peak voltage reducing circuit. This additional function of the condenser, as well as others, is explained in U. S. Patent 2,214,259, cited hereinbefore.

Having described my invention in detail, what I claim and desire to have protected by issuance of Letters Patent of the United States is:

1. In a telephone system, a line having a source of energy intermittently connected thereto, a tuned circuit comprising a condenser and the coil of a ringer included in a parallel connection with each other to thereby form an oscillating circuit and said tuned circuit also being connected in a series circuit including a portion of said line, said source and ground, and means connected in said series circuit for causing the intermittent connection of said energy source thereto to sustain oscillations of said tuned circuit, thereby operating said ringer.

2. In a telephone system including means for generating and transmitting pulsating current at a pre-determined frequency, a ringer coil and a condenser connected in a circuit with said current and tuned to resonate at said pre-determined frequency, an asymmetrical conducting device connected in said circuit in series therewith, connecting means connecting said generating means to said tuned combination, said asymmetrical device allowing pulses of current from said generating means to sustain oscillation of said condenser and ringer coil combination.

3. In a telephone system including means for generating and transmitting pulsating current at a pre-determined frequency; a ringer including a coil, an armature, a biased clapper and two gongs; a condenser connected in a circuit with said ringer coil and said circuit tuned to said pre-determined frequency; an asymmetrical conducting device connected in series with said coil and condenser combination, connecting means for connecting said generating means with said tuned combination, said asymmetrical device allowing an initial pulse of current from said generating means to set said tuned circuit oscillating and succeeding pulses to sustain the resulting oscillatory current, said ringer armature and associated biased clapper responding to said oscillatory current through said ringer coil and striking each of said two gongs alternately, said pulses arriving in time relationship when said clapper is working against its biased tension.

4. In a selective ringing system of the class wherein a superimposed alternating voltage on a direct voltage will cause operation of only one ringer of a plurality accessible on the same line, the improvement comprising, a tuned circuit tuned to a pre-determined frequency, including a condenser individual to each of said ringers and connected in parallel to the coil of such ringer, and means connected in said circuit for causing said two voltages to sustain oscillations of said tuned circuit, thereby operating said one ringer.

5. In a telephone system, a substation including a condenser, a ringer coil, a dial pulsing circuit, and switching means for connecting said condenser in parallel with said ringer coil at one

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time and at other times into said pulsing circuit.

6. In a telephone system as claimed in claim 5 said switching means comprising a switch-hook and a set of make and break contacts associated therewith.

7. In a telephone system, a two conductor party line, four substations for said party line; a condenser and a ringer coil connected in parallel with each other in a circuit including one conductor of said line and an asymmetrical conducting device connected in series with said parallel circuit for each of said substations; two of said ringer coil and condenser combinations connected to one conductor of said line in different manners, and two of the combinations connected to the other conductor of the line in different manners, the receipt of alternating currents superimposed upon either positive or negative direct current and applied to one or the other conductors of said line causing operation of one of said ringer combinations, whereby four party biased ringing may be effected.

8. In a telephone system; a ringer including a coil, an armature, an associated clapper and two gongs; a tuned circuit including a condenser and said ringer coil connected in parallel with each other in said circuit; means including said circuit and a source of energy intermittently connected thereto for establishing an oscillatory current through said circuit and said ringer coil, and means serially connected in said circuit for causing said intermittent connections of said energy to sustain said oscillations of said circuit, said armature and associated clapper actuated responsive to said oscillatory current for striking each of said two gongs alternately with the same vigor and timing.

9. In a telephone system including means for generating and transmitting pulsating current at a pre-determined frequency; a ringer including a coil, an armature, an associated clapper and two gongs; a circuit tuned to said pre-determined frequency and including a condenser and said ringer coil connected in parallel with each other in said circuit; an asymmetrical conducting device connected in series with said tuned circuit, said asymmetrical device allowing pulses of current from said means to sustain an oscillatory current through said ringer coil, said armature and associated clapper actuated responsive to said oscillatory current for striking each of said two gongs alternately with the same vigor and timing.

HAROLD C. PYE.

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