

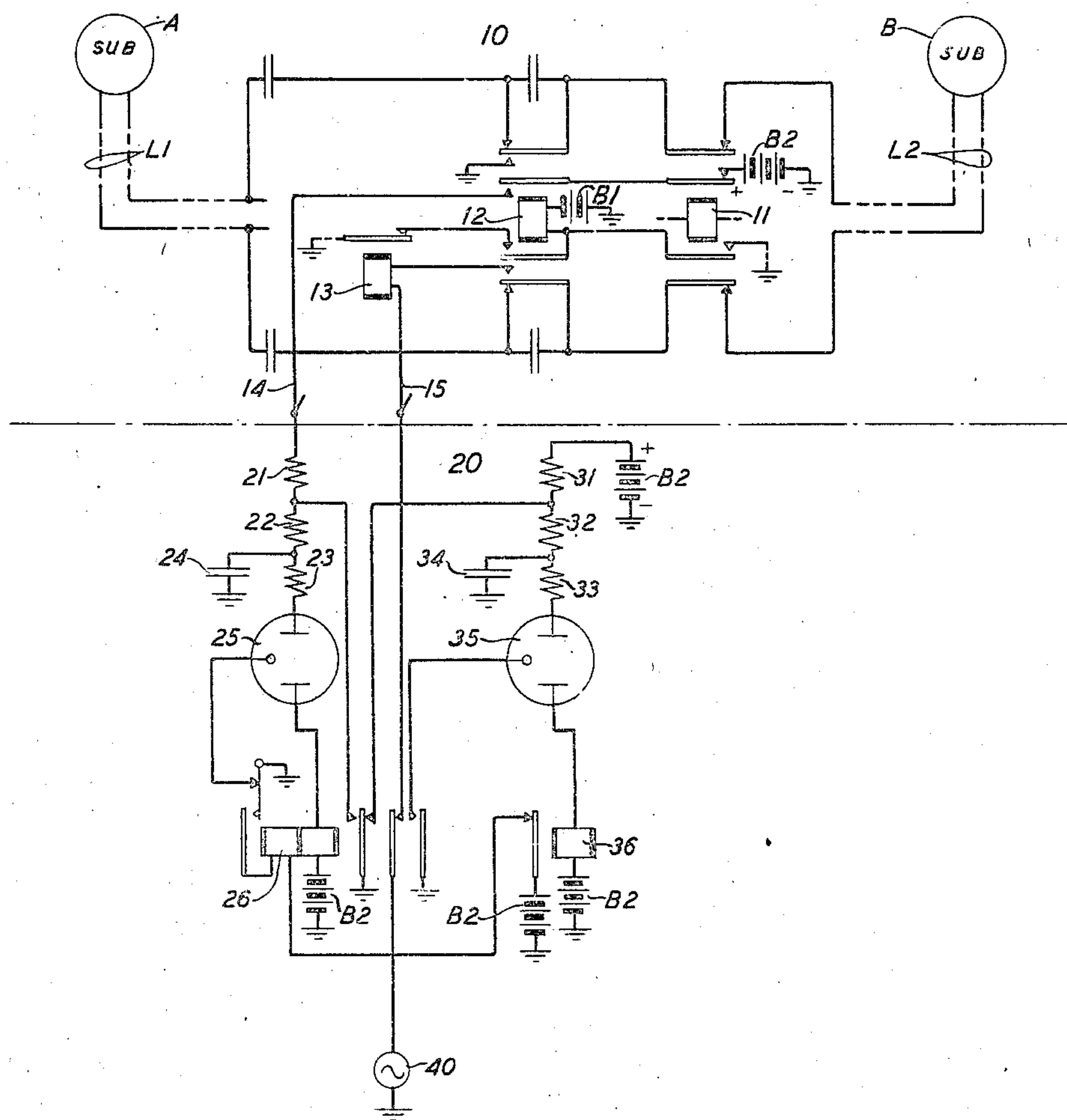
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TIME MEASURING DEVICE

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TIME MEASURING DEVICE

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1

This invention relates to timing and interrupting devices and particularly to such devices adapted for use in controlling the closing and opening of circuits in signaling and other electrical systems.

Objects of the invention are the decentralization of interrupter equipment provided in automatic telephone systems for controlling signaling current, the provision of electronic devices for measuring signaling intervals in place of power driven interrupters, the provision of an interrupter which immediately applies ringing current when a trunk with which it is associated requires ringing current, and the simplification and improvement of timing and interrupting means in signaling and electrical systems.

This invention is a timing and interrupting device comprising a pair of space discharge tubes, a pair of relays and means including a condenser associated with each tube and connected to delay the energization of the tube for a definite and desired predetermined interval of time. More specifically the condenser associated with one of the tubes is charged through a resistor until it reaches the breakdown voltage whereupon the tube is energized to operate the associated relay to start the charging of the condenser associated with the second tube. The condenser associated with the second tube is then charged through a resistor until it reaches the breakdown voltage whereupon the second tube is energized to operate the associated relay thereby to cause the release of the relay associated with the first tube and initiate another timing cycle. The intervals of time thus measured may be proportioned in any desired manner depending upon the values of the resistances and the capacity of the condensers; and the intervals may be utilized in any well-known manner for controlling the opening and closing of electrical circuits, for instance, those that are used in signaling telephone subscribers' stations.

A clear and complete explanation of the invention, its features and advantages will be facilitated by describing its application in the automatic telephone system shown schematically in the drawing which forms a part of this specification. The invention is however not limited in its application to the system shown but is generally applicable to electrical systems comprising timing and interrupter devices.

The drawing which consists of a single figure shows schematically an automatic telephone system comprising stations A and B, lines L1 and L2, incoming trunk circuit 10, a ringing current generator 40 and a timing and interrupting device 20

2

for timing the application of ringing current to a called subscriber's line.

In automatic telephone systems it is usual to provide a power driven rotary ringing machine for applying ringing current at intervals and for intervals of desired duration. In the system disclosed in the drawing the power driven interrupter device is replaced by a plurality of timing and interrupting devices, each device being common to a group of trunks and comprising a pair of three-element, cold-cathode, gas-filled, discharge tubes and a pair of relays. The telephone system may be a manual system or an automatic system employing any known type of switches and switch control. It may for instance be a system, employing switches of the cross bar type, such as is disclosed in the patent to Carpenter No. 2,093,117, September 14, 1937.

The incoming trunk circuit 10 is similar to that disclosed in the aforementioned Carpenter patent, only those portions of this trunk circuit being shown as are necessary for a complete description and understanding of applicant's invention as applied to signaling in an automatic telephone system. Relays 11, 12 and 13 of the trunk circuit 20 correspond respectively to relays 4523, 4524 and 4525 of the trunk circuit shown in Fig. 45 of the Carpenter patent.

When a connection has been established between the line L1 of a calling subscriber's station A, through intermediate switching apparatus (which is represented by broken lines) and incoming trunk circuit 10, and when the trunk circuit is connected to an incoming marker (not shown), relay 11 is operated in the manner in which relay 4523 is operated in the aforementioned Carpenter patent. When the called line has been tested and found idle and with relay 11 operated, a circuit is closed for operating the ringing control relay 12 in the same manner in which relay 4524 is operated in the aforementioned Carpenter patent. Relay 12 locks under control of relay 13 and partially closes the circuit for applying ringing current to the called line. After incoming and final switches (which are represented by broken lines) have been operated to extend the connection to the called line and after the marker has tested the continuity of this connection, relay 11 is released all in the manner described in the aforementioned Carpenter patent. The release of relay 11 closes a circuit for starting the operation of the timing and interrupter mechanism 20. This circuit is traced from the positive electrode of a battery B2 or other source of required voltage through the inner upper back contact of relay 11, inner upper front contact of

relay 12 and conductor 14 of trunk circuit 10, through resistors 21 and 22 and condenser 24 to ground. Condenser 24 is thus charged at a rate depending on its capacity and the resistance of elements 21 and 22 thereby delaying for a desired interval of time the application through resistor 23 to the control anode of tube 25 of a high enough voltage to break down the gap between the control anode and cathode of the tube. When breakdown occurs, the right winding of relay 26 is energized in series with the main anode and cathode of tube 25 to ground at the continuity back contact of relay 26. Relay 26 operates closing a locking circuit through its left winding and continuity front contact and the back contact of relay 36. The operation of relay 26 also connects ground to resistor 21 to short-circuit and thereby discharge condenser 24 and causes the deenergization of tube 25. The operation of relay 26 also disconnects ground from the cathode of tube 25, connects ground to the cathode of tube 35, and opens the normally closed short-circuit from resistor 31 to ground thereby starting the charging of condenser 34 at a rate determined by its capacity and the resistance of elements 31 and 32. At the end of a desired interval of time, the voltage built up across condenser 34 and applied through resistor 33 to the control anode of tube 35 causes breakdown of the gap between the control anode and cathode of the tube. When breakdown occurs, the winding of relay 36 is energized in series with the main anode and cathode of tube 35 to ground at a front contact of relay 26. The operation of relay 36 opens the locking circuit of relay 26 to cause the release of relay 26. The release of relay 26 disconnects ground from the cathode of tube 35 to cause the deenergization of the tube and the release of relay 36, and reconnects ground to resistor 31 to short circuit and thereby discharge condenser 34. The release of relay 26 also reconnects ground to the cathode of tube 25 and disconnects ground from resistor 21 thereby to again start the charging of condenser 24.

Thus tubes 25 and 35 and relays 26 and 36 are repeatedly alternately operated and released, the intervals of time during which relay 26 is released being measured by the charging of condenser 24 and the intervals of time during which relay 26 is operated being measured by the charging of condenser 34. Ringing current is thus intermittently transmitted from generator 40 through a back contact of relay 26, conductor 15, winding of relay 13, outer lower front contact of relay 12, lower back contact of relay 11, lower conductor of line L2, through the ringer at station B, upper conductor of line L2, outer upper back contact of relay 11 and outer upper front contact of relay 12 to ground. A usual ringing cycle consists of a two second ringing interval and a four second silent interval. When the call is answered at station B, relay 13 is operated thereby causing the release of relay 12. The release of relay 12 opens the connection between battery B2 and conductor 14 thereby to stop the operation of interrupter 20 unless some other trunk to which the interrupter is common is in the ringing condition; in which case, the interrupter continues to operate until charging voltage is disconnected from conductor 14 in each and all of these trunks. The release of relay 12 also opens the ringing circuit and closes the talking connection between stations A and B.

The number of trunks to which the interrupter 20 is common depends on the number of calls thereover during the busy hour; and the number

of trunks is small enough so that it will seldom happen that a second one of these trunks will require ringing current after a first trunk has started operation of the interrupter and before this first trunk has opened the ringing circuit due to answer at the called station or abandonment of the call by the calling subscriber. Thus on substantially all calls the interrupter immediately supplies ringing current to a trunk which is ready to apply ringing current to a called station. Furthermore since a plurality of such devices are provided in a central office, the failure of one of the devices affects only a small part of the calls whereas with ringing current supplied from a single, rotary, ringing machine, failure of the machine prevents the completion of all calls made while the machine is out of service; and since each interrupter 20 consists of only two tubes, two relays, two condensers and two resistance elements, this decentralization of the ringing supply is attained at a reasonable cost.

What is claimed is:

1. In combination, a first relay, a second relay, a circuit opened by the operation and closed by the release of said first relay, first and second space discharge tubes each having a starting gap and a main gap, said first relay having an operating winding connected in series with the main gap of said first tube for energization when the first tube is energized and said second relay having an operating winding connected in series with the main gap of said second tube for energization when the second tube is energized, a source of electromotive force for energizing said tubes, means connecting said source in series with the starting gap of said first tube while said first relay is not operated, means connecting said source in series with the starting gap of said second tube while said first relay is operated, a condenser connected across the starting gap of said first tube to delay energization of said first tube and first relay for a predetermined interval of time after the connection of said source in series with the starting gap of said first tube, a condenser connected across the starting gap of said second tube to delay energization of said second tube and second relay for a predetermined interval of time after connection of said source in series with the starting gap of said second tube, means including another winding of said first relay for holding said first relay operated until said second relay is operated, means short-circuiting the condenser connected across the starting gap of said second tube while said first relay is not operated, and means short-circuiting the condenser connected across the starting gap of said first tube while said first relay is operated.

2. The combination in a time measuring mechanism for alternately measuring first and second predetermined intervals of time of two space discharge tubes each comprising a cathode, control anode and main anode, means for applying an energizing potential across the cathode and control anode of the first tube, means comprising a first condenser connected in parallel with the control elements of the first tube for delaying the energization of the first tube for said first predetermined interval of time after application of said potential, means for applying an energizing potential across the cathode and control anode of the second tube, means comprising a second condenser connected in parallel with the control elements of the second tube for delaying the energization of the second tube for said second predetermined interval of time after application of said potential, a first relay, means con-

5

necting an operating winding of said first relay for energization in series with the main anode of the first tube when said tube is energized, a second relay, means connecting a winding of said second relay for energization in series with the main anode of the second tube when said second tube is energized, means short-circuiting said second condenser while said first relay is not operated and short-circuiting said first condenser while said first relay is operated, means locking said first relay operated independent of the energization of said first tube, means effecting the deenergization of said first tube when said first relay operates, means effecting the release of said first relay when said second relay operates, and means effecting the deenergization of said second tube and second relay when said first relay releases.

3. The combination in a time measuring mechanism for alternately measuring first and second predetermined intervals of time of two space discharge tubes each comprising a cathode, a control anode and a main anode, a first relay, a second relay, said first relay having an operating winding connected in series with the main anode of the first tube and said second relay having an operating winding connected in series with the main anode of the second tube, means applying an energizing potential across the cathode and control anode of said first tube while said first relay is not operated, means applying an energizing potential across the cathode and control anode of said second tube while said first relay is operated, a first condenser connected to delay the energization of said first tube and first relay for said first predetermined interval of time after application of said energizing potential to said first tube, a second condenser connected to delay the energization of said second tube and second relay for said second predetermined interval of time after the application of said energizing potential to said second tube, means comprising contacts of said first relay short-circuiting said first condenser while said first relay is operated and short-circuiting said second condenser while said first relay is not operated, means comprising contacts and a second winding of said first relay for locking said first relay operated independent of the energization of said first tube, and means com-

6

prising contacts of said second relay for effecting the release of said first relay when said second relay operates.

4. A circuit interrupter mechanism comprising first and second space discharge tubes each having a cathode and control and main anodes, a source of electromotive force for energizing said tubes, a first relay, said first relay having an operating winding and a locking winding, means including normally closed contacts of said first relay connecting said source and said operating winding in series with the cathode and main anode of said first tube and connecting said source in series with the cathode and control anode of said first tube, a first condenser connected in parallel with the cathode and control anode of said first tube to delay the energization of said first tube and operation of said first relay for a first predetermined interval of time, means including contacts of said first relay for closing a circuit for energizing said locking winding before the opening of said normally closed contacts effects the deenergization of said first tube and operating winding, means comprising normally open contacts of said first relay short-circuiting said first condenser while said first relay is operated, a second relay, means comprising normally open contacts of said first relay connecting said source and an operating winding of said second relay in series with the cathode and main anode of the second one of said tubes and connecting said source in series with the cathode and control anode of said second tube, a second condenser, means comprising said second condenser connected in parallel with the cathode and control anode of said second tube to delay the energization of said second tube and operation of said second relay for a second predetermined interval of time, means comprising normally closed contacts of said first relay short-circuiting said second condenser while said first relay is not operated, means comprising normally closed contacts of said second relay for effecting the release of said first relay when said second relay operates, and a circuit alternately closed and opened by said first relay.

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