

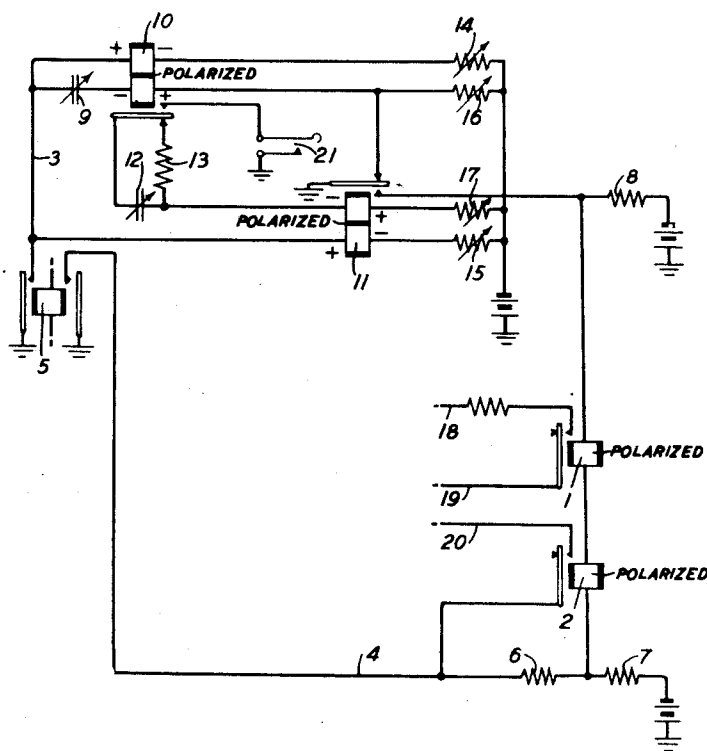
Oct. 19, 1937.

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2,096,029

SIGNALING SYSTEM

Filed Dec. 18, 1936



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2,096,029

SIGNaling SYSTEM

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Application December 18, 1936, Serial No. 116,528

8 Claims. (Cl. 175-373)

This invention relates to a system for producing and controlling the frequency of electrical impulses.

In the signaling art and particularly in circuits for testing the functioning of the circuits of telephone systems it is often desirable to produce impulses accurately timed as to their closed and open periods. It is therefore the object of the present invention to provide circuit facilities, simple in construction and reliable in operation, whereby impulses may be generated at any desired speed and having any desired ratio between their closed and open periods.

The impulse generator in accordance with the present invention is of particular utility in producing impulses, simulating those generated by the usual subscriber's dial, for testing the originating senders of telephone exchange systems which normally respond to impulse series dialed by subscribers to register the designations of wanted lines and to control the establishment of connections. It is to be understood, however, that the invention is not limited to such specific use, but has the more general utility of generating impulses of determined characteristics.

The impulse generator comprises two differentially wound polarized relays which mutually control each other, a condenser associated with each relay and adjustable resistances associated with the circuits extending through the windings of the relays. One of the relays has its first or operating winding connected between ground and a source of battery potential through one of the adjustable resistances and its second or control winding connected between ground and the source of battery potential through a condenser and a second of the adjustable resistances. The second of the relays has its first or operating winding connected between ground and the source of battery potential through a third of the adjustable resistances and its second or control winding connected from the source of battery potential through a fourth of the adjustable resistances to a condenser normally shunted by a resistance over the back contact of the first relay. The second or control winding of the first relay is also normally shunted by ground applied over the back contact of the second relay. A start relay for applying operating ground to the impulse generator and a start key are also provided. The second relay also upon each operation thereof closes over its front contact a work circuit to which impulses generated by the interaction of the two relays are to be applied.

Having now described in a general manner the

association of apparatus comprising the improved impulse generator of this invention, it is believed that a clearer comprehension thereof and of the manner in which it functions may be had by referring to the following detailed description taken in connection with the accompanying drawing.

The impulse generator has been disclosed in connection with the dial pulsing circuit of an originating or subscriber's sender test circuit, only relays 1 and 2 of which having been disclosed. These relays are both polarized, relay 1 controlling the transmission of impulses to the sender under test and relay 2 controlling the operation of counting relays to count the impulses transmitted in each series in accordance with the setting of digit keys in the sender test circuit. Inasmuch as the invention is not concerned particularly with the functioning of relays 1 and 2, it will be sufficient to say that these relays follow the impulses generated by the impulse generator.

When the impulse generator is to be conditioned to generate impulses, ground is connected to conductors 3 and 4 in any desired manner as by the operation of start relay 5. With ground connected to conductor 4 a circuit is established therefrom through resistance 6 and thence by parallel paths through resistance 7 to battery and ground and through the windings of polarized relays 2 and 1 and resistance 8 in series to battery and ground, but the current flowing through the windings of relays 1 and 2 is not in such a direction as to cause their operation. With ground connected to conductor 3, a discharge path for condenser 9 is effective from conductor 3 through the lower or control winding of polarized relay 10 to ground at the back contact of polarized relay 11 and condenser 9 immediately discharges. Condenser 12 is at the time in a discharged condition since a discharge path therefor is completed over the back contact of relay 10 and through resistance 13.

When ground is connected to conductor 3, operating circuits for both relays 10 and 11 are also established, the circuit for relay 10 extending from ground on conductor 3, through the upper or operating winding of relay 10 and through adjustable resistance 14 to battery and ground and the circuit for relay 11 extending from ground on conductor 3, through the lower or operating winding of relay 11 and through adjustable resistance 15 to battery and ground. Relays 10 and 11 now both operate, but relay 10 immediately releases as soon as relay 11 operates and removes ground po-

tential from the point between the lower winding of relay 10 and adjustable resistance 16, since charging current now flows through the lower winding of relay 10 over a path from ground on conductor 3, through condenser 9, the lower winding of relay 10, adjustable resistance 16 to battery and ground in a direction to overcome the energizing effect of current flowing through the upper winding of relay 10. However, as soon as the surge of charging current dies out, the upper winding of relay 10 takes control and relay 10 reoperates.

With relay 11 operated ground is connected over its front contact to a point between resistance 8 and the windings of relays 1 and 2 whereupon these relays now receive current in the proper direction through their windings to cause their operation. Pulsing relay 1 upon operating now closes the pulsing circuit over conductors 18 and 19 and counting relay 2 prepares a circuit over conductor 20 for counting the impulses.

To start pulsing the key 21 is operated and, with relay 10 operated, a charging circuit for condenser 12 is established from ground over the contacts of key 21, the front contact of relay 10, through condenser 12, the upper or control winding of relay 11 and through adjustable resistance 17 to battery and ground. Since the windings of relay 11 are differentially wound, relay 11 releases while current is flowing through its upper winding to charge condenser 12. The capacitance of condenser 12 and the resistance of resistance element 17 may be suitably adjusted to control the period during which relay 11 remains released and, since upon the release of relay 11, relays 1 and 2 both release, the pulsing circuit over conductors 18 and 19 is therefore opened for a period determined by such adjustments of condenser 12 and resistance 17.

As soon as relay 11 releases the discharge path for condenser 9 is established from ground on conductor 3, through condenser 9 and the lower winding of relay 10 to ground at the back contact of relay 11 and the discharge current from condenser 9 now flows in such a direction through the lower winding of relay 10 as to hold relay 10 operated.

When relay 11 again operates, as soon as the charging current through condenser 12 dies down, relays 1 and 2 again operate, relay 1 upon operating reclosing the pulsing circuit. Relay 11 also renders the previously traced charging circuit for condenser 9 effective. While current for charging condenser 9 is flowing through the lower winding of relay 10, relay 10 releases. The capacitance of condenser 9 and the resistance of resistance element 16 may be suitably adjusted to control the period during which relay 10 remains released. With relay 10 released the discharge path for condenser 12 is closed over its back contact and condenser 12 discharges through resistance 13.

When relay 10 again operates, as soon as the charging current through condenser 9 dies down, the charging circuit for condenser 12 is reestablished over its front contact, the contacts of key 21 and through the upper winding of relay 11 and relay 11 again releases followed by the release of relays 1 and 2 and the reopening of the pulsing circuit. Thus, the period during which the pulsing circuit is maintained closed between impulses is measured by the period during which relay 10 remains released and until relay 11 starts its release period as determined by the adjustment of the capacitance of condenser 9 and resistance of resistance element 16.

Relays 10 and 11 now continue to operate and release, as above described, as long as the key 21 remains operated, relay 11 upon each operation causing the operation of relays 1 and 2 to close the pulsing circuit and upon each release causing the release of relays 1 and 2 to open the pulsing circuit. Thus, the ratio of the open to closed periods of the impulses transmitted by relay 1 is controlled by the ratio of the release period of relay 11 to the release period of relay 10. To change this ratio and the speed at which impulses are generated, resistances 14 to 17, inclusive, and condensers 9 and 12 may be adjusted in any desired manner. For example, each resistance, such as 14, may comprise a plurality of units of different resistance value and each condenser, such as 9, may comprise a plurality of units of different capacitance which may be selected by keys in accordance with the pulsing speed or ratio of open to closed periods of the impulses to be applied to the work circuit.

What is claimed is:

1. A circuit interrupter comprising two polarized relays each having an operating winding and a control winding, a source of current, circuits for maintaining a constant flow of current from said source through the operating windings of said relays, and a circuit for the control winding of each relay including a condenser controllable by the other of said relays.
2. A circuit interrupter comprising two polarized relays each having an operating winding and a control winding, a source of current, circuits for maintaining a constant flow of current from said source through the operating windings of said relays, a condenser associated with each relay, a charging path for each condenser extending from said source of current through the control winding of the relay with which it is associated, and means controlled by each relay for rendering the condenser charging path through the control winding of the other relay effective.
3. A circuit interrupter comprising two polarized relays each having an operating winding and a control winding, a source of current, circuits for maintaining a constant flow of current from said source through the operating windings of said relays, a condenser associated with each relay, a charging path for each condenser extending from said source of current through the control winding of the relay with which it is associated, means in each of said charging paths for controlling the charging rate of the condenser connected therein, and means controlled by each relay for rendering the condenser charging path through the control winding of the other relay effective.
4. A circuit interrupter comprising two polarized relays each having an operating winding and a control winding, a source of current, circuits including adjustable resistances for maintaining a predetermined constant flow of current from said source through the operating windings of said relays, a condenser associated with each of said relays, a charging path for each condenser extending from said source of current through the control winding of the relay with which it is associated, an adjustable resistance in each of said charging paths for controlling the charging rate of the condenser connected therein, and means controlled by each relay for rendering the condenser charging path through the control winding of the other relay effective.
5. A circuit interrupter comprising two polarized relays each having an operating winding

and a control winding, a source of current, circuits including adjustable resistances for maintaining a predetermined constant flow of current from said source through the operating windings of said relays, an adjustable condenser associated with each of said relays, a charging path for each condenser extending from said source of current through the control winding of the relay with which it is associated, and means controlled by each relay for rendering the condenser charging path through the control winding of the other relay effective.

6. A circuit interrupter comprising two polarized relays each having an operating winding and a control winding, a source of current, circuits for maintaining a constant flow of current from said source through the operating windings of said relays, a condenser associated with each relay, a charging path for each condenser extending from said source of current through the control winding of the relay with which it is associated, a discharge path for each of said condensers, and means controlled by each relay for establishing the charging and discharging paths for the condenser associated with the other relay.

7. A circuit interrupter comprising two polarized relays each having an operating winding and a control winding, a source of current, circuits for maintaining a constant flow of current from said source through the operating windings of said relays, a condenser associated with each of said relays, a charging path for each condenser extending from said source of current through the control winding of the relay with which it is associated, means controlled by the operation of each relay for rendering the con-

denser charging path through the control winding of the other relay effective, a discharge path for each of said condensers, and means controlled by the release of each relay for rendering the discharging path of the condenser associated with the other relay effective.

8. A circuit interrupter for producing impulses at a predetermined rate, each impulse having a predetermined ratio of closed to open period, comprising a first and a second differentially wound polarized relay, each having an operating winding and a control winding, a source of current, means for establishing operating circuits from said source through the operating windings of said relays, a first and a second condenser, a charging path for said first condenser extending from said source of current through the control winding of said first relay and a discharging path therefor extending through the control winding of said first relay and over the back contact of said second relay, a charging path for said second condenser extending from said source of current through the control winding of said second relay and over a front contact of said first relay and a discharging path therefor extending over the back contact of said first relay, and an impulsing circuit controlled over the front contact of said second relay, whereby each relay controls the release of the other, the time during which said first relay is released determining the closed period of each impulse and the time during which said second relay is released determining the open period of each impulse.

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