

Aug. 11, 1942.

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2,292,371

REPEATER CIRCUIT

Filed July 19, 1941

FIG. 1

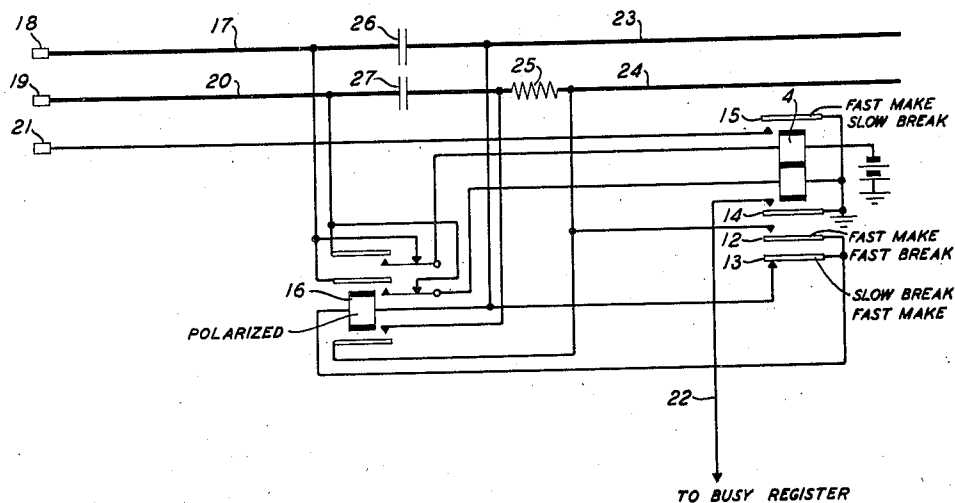
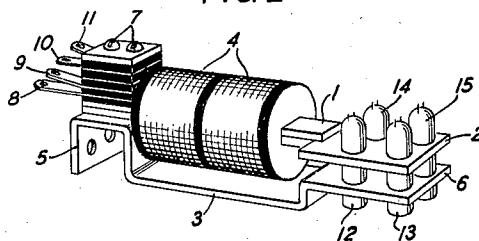


FIG. 2



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2,292,371

REPEATER CIRCUIT

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Application July 19, 1941, Serial No. 403,085

5 Claims. (Cl. 179-16)

This invention relates to telephone systems and, more particularly, to a repeater circuit for repeating dial switching impulses over the inductively separated sections of an interoffice trunk circuit.

In dial switching telephone systems the exchange area is usually divided into a plurality of offices and automatic impulse repeaters are introduced into the outgoing ends of trunks extending between offices to permit the use of two-conductor trunks to supply both the calling and called subscribers with talking battery from the local offices in which their lines terminate and to repeat dial impulses generated by the dial of the calling subscriber's substation to the office in which the wanted subscriber's line terminates to control the establishment of a connection to such wanted line. Repeater circuits used heretofore for accomplishing these functions have required several relays and, consequently, considerable relay wiring. A repeater circuit of this type is disclosed, for example, on page 70 of the second edition of Automatic Telephony by Arthur Bessey Smith and Wilson Lee Campbell and comprises six relays.

It is the object of the present invention to simplify the structure of a repeater circuit of this character by combining the functions of several relays, two of which have slow-operating characteristics, into fewer relay structures whereby a repeater circuit is secured which requires but two relays for performing all of the required functions.

This object is attained by the substitution of a relay of the type disclosed in the Patent No. 2,247,493 granted to H. C. Harrison and C. E. Pollard on July 1, 1941, for the line or pulsing relay and three other control relays, and in combining the back bridge and reversing relays into a single relay. The relay structure employed to replace the usual pulsing and associated relay has a single magnetic circuit including two parallelly disposed pole-pieces having sets of aligned openings therein in which switch elements of the magnetically operated mercury type are positioned. Each of these switch elements is provided with a pair of contact terminals. The terminals of one element are normally open but are closed quickly by a globule of mercury upon the energization of the relay windings and are opened slowly upon the deenergization of such windings. The terminals of each of two other elements are normally open but are closed quickly by a globule of mercury upon the energization of the relay winding and are opened

slowly upon the deenergization of the windings. The terminals of a fourth switch element are normally bridged by a globule of mercury and the circuit therebetween is opened slowly and closed quickly by the energization and deenergization of the relay windings.

For a more complete understanding of the invention reference may be had to the following detailed description taken in connection with the accompanying drawing in which:

Fig. 1 diagrammatically represents a repeater circuit in accordance with the present invention; and

Fig. 2 shows a mercury contact relay of the type employed as the combined relay structure of Fig. 1.

The relay of Fig. 2, and indicated by the reference numeral 4 in Fig. 1, is of the mercury contact type disclosed in the patent of H. C. Harrison and C. E. Pollard hereinbefore referred to, although it is to be understood any type of relay in which the several switch elements may have different operating and releasing time characteristics could be used. For example, a relay of the type disclosed in the application of C. E. Pollard, Jr., Serial No. 402,727, filed July 17, 1941, could also be used. The relay disclosed herein comprises a core 1 to the forward end of which is suitably secured a pole-piece plate 2 and to the rear end of which is secured a forwardly extending return pole-piece 3. The return pole-piece 3 is offset at its middle portion to furnish clearance for the two operating windings 4 surrounding the core 1, is bent at right angles at its rear end to form a mounting bracket 5 by which the relay may be secured to an apparatus rack and has its forward end 6 positioned parallel to and spaced from the pole-piece plate 2. Secured by screws 7 and insulatedly supported upon the rear end of core 1 are terminal lugs 8, 9, 10 and 11 to which the terminals of the two windings 4 are connected. Other terminal lugs may also be provided, if desired, for connection with the terminals of the mercury contact switch elements 12, 13, 14 and 15 positioned in the aligned openings in the pole-pieces 2 and 6.

As fully disclosed in the patent of H. C. Harrison and C. E. Pollard hereinbefore referred to, each of these switch elements comprises an envelope of glass or other suitable material, two electrodes or contact terminals sealed through the upper end thereof and extending downwardly into the inside of the envelope, a plunger armature freely slidable within the envelope and a

globule of mercury supported on the armature. The switch elements 12, 13, 14 and 15 may be of the respective types disclosed in Figs. 2, 9 and 6 of the aforementioned patent, the element 12 being arranged for a fast-make-fast-break of its normally open contacts, the element 13 being arranged for a slow-break-fast-make of its normally closed contacts and the elements 14 and 15 being arranged for a fast-make-slow-break of their normally open contacts.

Referring now to Fig. 1 in which a relay of the type disclosed in Fig. 2 is applied to simplify a repeater circuit, when a selector switch of an originating office seizes the multiple terminals of the outgoing end of the interoffice trunk in the outgoing end of which the improved repeater circuit is installed, a pulsing circuit is established from battery through the upper winding of relay 4, over the uppermost normal contacts of the combined back bridge and reversing relay 16, tip trunk conductor 17, tip bank terminal 18, thence over the connection set up by the selector switches of the originating office from the calling line, over the calling line loop, returning over the connection set up by such selector switches, ring bank terminal 19, ring trunk conductor 20, over the inner upper normal contacts of relay 16 to ground through the lower winding of relay 4. Relay 4 is energized over this circuit to establish connections between the contacts of its switch elements 12, 14 and 15 and to open the connection between the contacts of its switch element 13. The reversing relay 16 may be of the usual polarized type or may be of the polarized mercury contact type disclosed in the application of W. J. Leveridge, Serial No. 398,538, filed June 18, 1941, equipped with contact or switch elements of the type disclosed in the application of C. E. Pollard, Jr., hereinbefore referred to.

The establishment of a connection between the contacts of switch element 15 connects ground to the sleeve bank terminal 21 to mark the trunk as busy to other selector switches having access thereto and establishes circuits to hold previously operated selectors in their operated positions. The establishment of a connection between the contacts of switch element 14 connects ground to conductor 22 forming a part of the usual all-trunks-busy register circuit. The establishment of a connection between the contacts of switch element 12 bridges the winding of relay 16 across the outgoing conductors 23 and 24 of the interoffice trunk, over a circuit extending from the tip conductor 23 through the winding of relay 16 and the contacts of switch element 12 to the ring conductor 24. The connection between the contacts of switch element 13 is also opened at this time to remove the shunt from the winding of relay 16. Relay 16 being polarized, does not receive current, applied from the distant office over the trunk, in the proper direction through its winding to cause its operation at this time but the line relay of the incoming selector switch at the distant office in which the interoffice trunk terminates does operate preparatory to controlling the stepping of such selector switch in response to the next digit series dialed by the calling subscriber.

When the previously-traced pulsing circuit extending through the windings of relay 4 is opened in response to the operation of the calling subscriber's dial in accordance with the digit dialed for setting the incoming selector switch, the windings of relay 4 deenergize in response to each opening of the pulsing circuit and, since the

switch element 12 is of the type in which its contacts are interrupted quickly, the outpulsing circuit over conductors 23 and 24 of the interoffice trunk will be opened in response to each deenergization of the windings of relay 4 to thereby cause the stepping of the incoming selector switch. Switch elements 14 and 15 being of the type which are slow to break the connection between their contacts, will not have sufficient time during the intervals that the windings of relay 4 are deenergized during any impulse series to disrupt the circuits established therethrough. The switch element 13 being of the type which is fast to interconnect its contacts following the deenergization of the windings of relay 4, interconnects its contacts upon the first deenergization of the windings of relay 4 in response to the first impulse of the impulse series to shunt the winding of relay 16 to thereby improve the transmission quality of the out-pulsing circuit over the interoffice trunk.

Between successive impulses of an impulse series the windings of relay 4 reenergize to reclose the out-pulsing circuit over trunk conductors 23 and 24 but for intervals of insufficient duration to enable the switch element 13 to disrupt the circuit established over its contacts in shunt of the winding of relay 16. Thus during the repeating of each impulse series the contacts of switch elements 14 and 15 remain closed, the contacts of switch element 13 remain closed and the contacts of switch element 12 open and close in response to each impulse of a series. Upon the termination of each impulse series when the windings of relay 4 remain energized for a substantially longer period, the contacts of switch elements 12, 14 and 15 remain closed and the contacts of switch element 13 have sufficient time to open.

Following the repeating of the last dialed impulse series, in response to which the wipers of the connector switch are set upon the terminals of the wanted line, ringing current is applied in the usual manner to such line if it is found to be idle and when the called subscriber answers the direction of current flowing over the conductors 23 and 24 of the interoffice trunk is reversed. Since at this time the windings of relay 4 are steadily energized and the contacts of switch element 13 are therefore open to remove the shunt from the winding of polarized relay 16, relay 16 now energizes and at its upper continuity contacts reverses the connection of battery and ground applied through the windings of relay 4 to the conductors 17 and 20 of the trunk circuit for supervisory purposes. At its lower contacts, relay 16 short-circuits resistance 25 to remove such resistance from the talking circuit. The tip talking circuit now extends from conductor 17 through condenser 26 to conductor 23 and the ring talking circuit extends from conductor 20 through condenser 27 over the lower contacts of relay 16 to conductor 24, talking current being fed to the calling line from battery through the windings of relay 4 and over conductors 17 and 20, and talking current being supplied to the called line from the battery at the distant office in which such line terminates. At the end of the conversation when the calling subscriber restores his receiver to the switch-hook the windings of relay 4 deenergize thereby restoring all of the switch elements associated therewith to their normal condition whereupon the switch element 13 closes the shunt around the winding of relay 16 thereby causing it to release.

From the foregoing description of the invention, it will be apparent that a great simplification of the usual type of repeater circuit has been effected with a resultant economy.

What is claimed is:

1. In an impulse repeater trunk having its talking conductors inductively separated into incoming and outgoing sections, a control relay connected to the incoming section of said talking conductors, said control relay having a magnetic circuit and a plurality of switch elements, one of said elements being fast to operate and slow to release for connecting a busy potential to the incoming sleeve terminal and another of said elements being fast to operate and fast to release for controlling an out-pulsing circuit extending over the outgoing section of said talking conductors.

2. In an impulse repeater trunk having its talking conductors inductively separated into incoming and outgoing sections, a control relay connected to the incoming section of said talking conductors, said control relay having a magnetic circuit and a plurality of switch elements, one of said elements being fast to operate and slow to release for connecting a busy potential to the incoming sleeve terminal, a second of said elements being fast to operate and slow to release for closing one point in an all-trunks-busy register circuit and a third of said elements being fast to operate and fast to release for controlling an out-pulsing circuit extending over the outgoing section of said talking conductors.

3. In an impulse repeater trunk having its talking conductors inductively separated into incoming and outgoing sections, a supervisory relay operable over said outgoing section, and a control relay connected to the incoming section of said talking conductors, said control relay having a magnetic circuit and a plurality of switch elements, one of said elements being fast to operate and slow to release for connecting a busy potential to the incoming sleeve terminal, a second of said elements being fast to operate and fast to release for controlling an out-pulsing circuit extending over the outgoing section of said talking conductors and a third of said elements being slow to operate and fast to release for shunting said supervisory relay

from the outgoing circuit during out-pulsing.

4. In an impulse repeater trunk having its talking conductors inductively separated into incoming and outgoing sections, a supervisory relay operable over said outgoing section, and a control relay connected to the incoming section of said talking conductors, said control relay having a magnetic circuit and a plurality of switch elements, one of said elements being fast to operate and slow to release for connecting a busy potential to the incoming sleeve terminal, a second of said elements being fast to operate and slow to release for closing one point in an all-trunks-busy register circuit, a third of said elements being fast to operate and fast to release for controlling an out-pulsing circuit extending over the outgoing section of said talking conductors, and a fourth of said elements being slow to operate and fast to release for shunting said supervisory relay from the out-pulsing circuit during out-pulsing.

5. In an impulse repeater trunk having its talking conductors inductively separated into incoming and outgoing sections, a resistance connected in series with one of the talking conductors of said outgoing section, a polarized reversing relay operable over said outgoing section to reverse the direction of current flowing over the incoming section of said talking conductors and to shunt said resistance, and a control relay connected to the incoming section of said talking conductors over contacts of said reversing relay, said control relay having a magnetic circuit and a plurality of switch elements, one of said elements being fast to operate and slow to release for connecting a busy potential to the incoming sleeve terminal, a second of said elements being fast to operate and slow to release for closing one point in an all-trunks-busy register circuit, a third of said elements being fast to operate and fast to release for controlling an out-pulsing circuit extending over the outgoing section of said talking conductors, and a fourth of said elements being slow to operate and fast to release for shunting said supervisory relay from the out-pulsing circuit during out-pulsing.

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