Oct. 11, 1938. M. HEBEL 2,133,055

TELEPHONE SYSTEM

Filed Sept. 14, 1936

Fig. 1

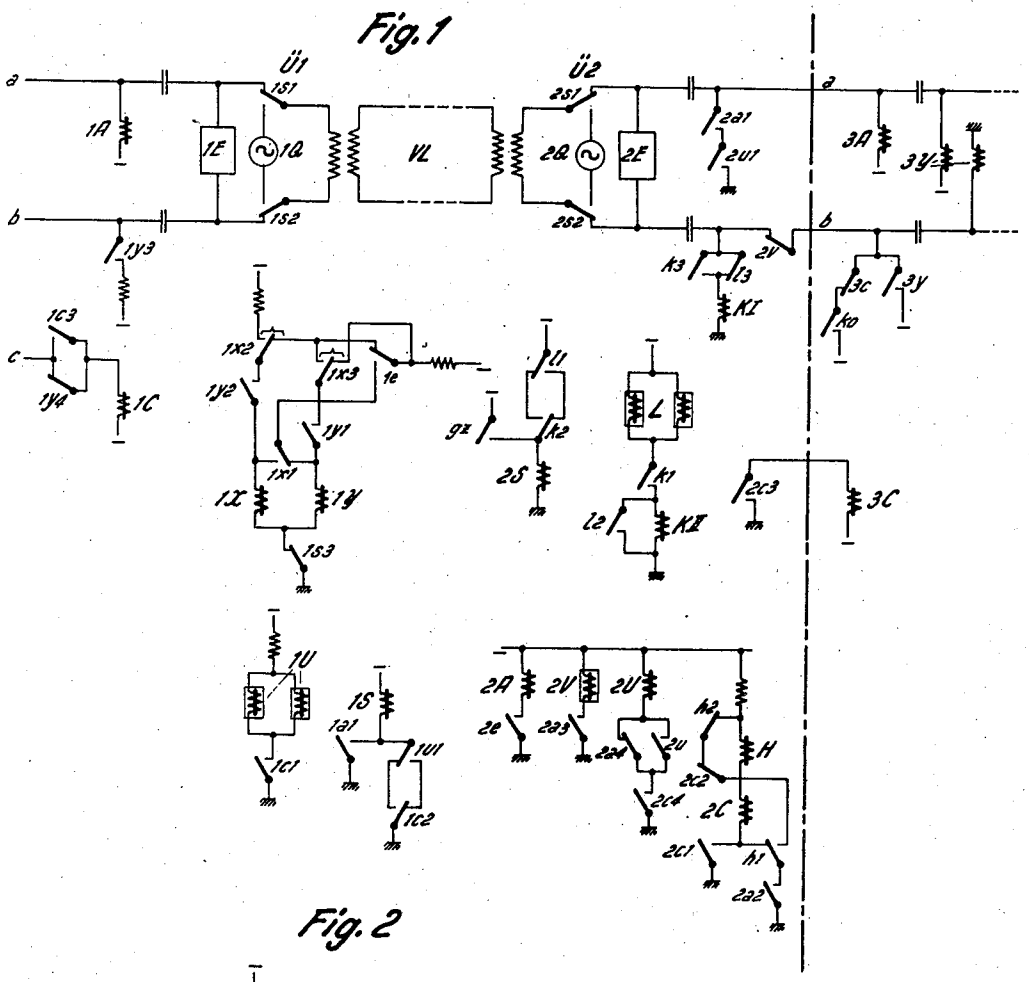
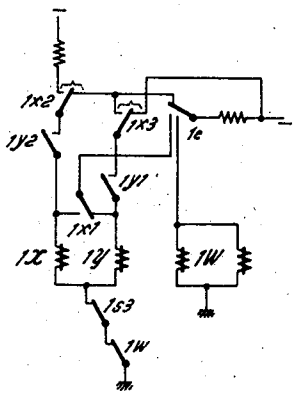


Fig. 2



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Patented Oct. 11, 1938

2,133,055

UNITED STATES PATENT OFFICE

2,133,055

TELEPHONE SYSTEM

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Application September 14, 1936, Serial No. 100,671
In Germany February 12, 1936

12 Claims. (Cl. 179—16)

The invention relates to a circuit arrangement for selector operated telephone installations working in conjunction with a number of exchanges connected to each other by inductively coupled two-wire trunks. In circuit arrangements of this kind, repeaters are arranged at the ends of the trunk line by means of which the line is inductively connected to the circuit in the exchange. These repeaters comprise switch means which transfer the outgoing and incoming impulses respectively to the line and to the circuit in the exchange.

It is already known to connect the switch means belonging to the repeaters at the outgoing end of the line and serving to transfer the current impulses to the line permanently to one wire of the speech circuit in the exchange and to construct the switch means which receive backward signals over the line in such a manner that these are transmitted over another wire of the speech circuit. In this known arrangement, however, the repeaters are not correspondingly constructed at the incoming end of the line. At that end, the switch means of the repeater are actuated by the next selector.

In accordance with the invention, the repeater at the incoming end of the trunk line is provided with switch means for the retransmission of incoming signals received from the trunk line and with switch means for receiving backward signals and transmitting them over the trunk line. The first of these switch means are connected so as to transmit the signals solely over one of the wires of the speech line of the exchange at the incoming end and the second are connected to the other wire so that incoming signals are transmitted exclusively over one wire and backward signals exclusively over the other. Furthermore, the switch means provided for the transmission of the backward signals are arranged so as to co-operate with an auxiliary relay in such a manner that at the beginning and at the end of each backward signal received over a wire they transmit an alternating current impulse over the trunk. With this construction of the repeater at the incoming end of the line, it is possible for signals in one direction in the exchanges to run always over the one and same speech wire, and signals in the other direction to run always over the other speech wire, so that even in the case of connections made through a series of exchanges, the repeater at the incoming end of the first line can readily co-operate with the repeater at the out-going end of the next line. The transmission of a short alternating current impulse at the beginning and at the end of each backward signal makes it possible to repeat over the line by means of short alternating current impulses all important information from the called subscriber's exchange, such, for example, as the length of time during which the called subscriber's receiver remained removed, the time during which the selectors in the exchange at the incoming end are inaccessible and during which the repeater at the outgoing end must be prevented from being seized.

In order that the invention may be thoroughly understood and be more readily carried into effect, an example of construction in accordance therewith will now be described with reference to the accompanying drawing, in which:—

Figure 1 illustrates a circuit diagram for an arrangement in accordance with the invention, and

Figure 2 a modification of the arrangement of Figure 1.

When the repeater U1 at the outgoing end of the trunk VL is seized, the relay 1C is energized by means of the auxiliary *c*-wire. The contact *1c1* closes the circuit for a slow-to-respond relay 1U, and the contact *1c2* the circuit for the transmitting relay 1S while the contact *1c3* ensures the energization of the relay 1C. The relay 1S responds and, by means of its contacts *1s1* and *1s2*, connects the source of alternating current 1Q to the line for the duration of the delay in the response of the relay 1U. As soon as this relay 1U pulls up, the circuit of the relay 1S is interrupted at the contact *1u1*. The alternating current impulse thus sent out through the line influences the relay 2E in the repeater U2 at the incoming end of the trunk and the relay 2E energizes an auxiliary relay 2A by means of its contact *2e*. The relay 2A, by means of its contact *2a3*, energizes a slow-to-release relay 2V and, by means of its contact *2a2*, closes the circuit for the seizing relay 2C which, by means of the contact *2c1*, closes a holding circuit for itself. The short circuit for a relay H is removed by means of the contact *2c2* and the relay H responds and, by means of its contact *h1*, prepares a short circuit for the relay 2C. By means of the contact *2c3* of the relay 2C, the seizing relay 3C for the next selector (in the present case, the final selector) is energized. By means of the contact *2c4*, the energizing circuit for a relay 2U is also closed, which relay prepares, at its contact *2u1*, the retransmission of the current impulses.

The current impulses sent out by the calling station are received through the *a*-wire by the relay 1A. The transmitting relay 1S is energized

for the duration of each current impulse by means of the contact 1*a*1 and connects the trunk line to the source of alternating current 1Q. At the incoming end of the trunk, these alternating current impulses are received by the relay 2E and are retransmitted over the *a*-wire by the auxiliary relay 2A through the agency of the contact 2*a*1. The relay 3A of the final selector receives these current impulses and sets the final selector in the usual manner.

When the called subscriber removes his receiver, the relay 3Y responds and closes its contact 3*y*. In this way, the *b*-wire of the speech line remains connected to the source of current for the length of time during which the receiver is removed and the relay K in the repeater U2 is energized by its winding I. By means of its contact *k*1, the relay K closes a circuit through its own holding winding II. This circuit runs through a slow-to-attract and slow-to-release relay L. The circuit for the transmitting relay 2S which, by means of its contacts 2*s*1 and 2*s*2, connects the source of alternating current 2Q to the line, is closed by the contact *k*2 for the duration of the delay in the response of the relay L. When the relay L responds, the circuit for the relay 2S is interrupted by means of the contact *l*1 and thus stops the transmission of alternating current. The contact *l*2 short circuits the holding winding KII of the relay K. The energization of the relay K is, however, maintained by its winding KI which, when the contact *l*3 is opened, is connected through its contact *k*3 to the *b*-line and thus remains under the influence of the contact 3*y*.

In the repeater U1, the relay 1E is energized by the received alternating current impulse which, by means of its contact 1*e*, closes the following circuit for a relay 1Y:

—, resistance, contacts 1*e*, 1*x*1, relay 1Y, contact 1*s*3, +

The relay 1Y is energized in this circuit and by means of its contact 1*y*2, prepares the energization of the relay 1X. When the relay 1E drops at the end of the alternating current impulse sent through the line, the following circuit is closed:

—, resistance, contacts 1*e* (normal position), 1*x*2, 1*y*2, relay 1X, contact 1*s*3, +

The relay 1X is energized in this circuit. The make-before-break contact 1*x*3 switches the holding circuit for the relay 1Y over appropriately so that it depends upon the normal position of the contact 1*e*. The contact 1*x*2 closes a holding circuit for the relay 1X. The relay 1Y thus remains energized and by means of its contact 1*y*3, connects the *b*-wire leading to the preceding selector to the source of current. The current flowing through the *b*-wire may influence a metering device or any devices which indicate that the called subscriber has removed his receiver.

When the called subscriber restores his hand set, the relay 3Y releases and the *b*-wire of the final selector becomes devoid of current. Also, the relay K in the repeater U2 releases and by means of the contact *k*2, closes the circuit for the transmitting relay 2S. At the same time, the contact *k*1 interrupts the circuit for the relay L so that, after a lapse of time, the latter releases and by means of its contact *l*1, re-opens the circuit for the relay 2S. An alternating current impulse will again be sent to the line as long as the relay 2S remains energized, and will energize the relay 1E. When the contact 1*e* is reversed, the holding circuit for the relay 1Y is interrupted and the following holding circuit is closed for the relay 1X:

—, resistance, contacts 1*e* (thrown position) 1*x*1 (thrown position), relay 1X, contact 1*s*3, +

At the end of the alternating current impulse, the relay 1E drops as does the relay 1X. By the release of the relay 1Y, the *b*-wire running to the preceding selector is again devoid of current. On release of the relay 1X, the switch device formed by the relays 1X and 1Y is again returned into the normal position.

When the calling subscriber replaces his receiver, the relay 1C becomes devoid of current. The circuit for the relay 1U is interrupted at the contact 1*c*1 and the circuit for the transmitting relay 1S is closed at the contact 1*c*2 for the time during which the relay 1U is released. The relay 1S sends a longer alternating current impulse through the line which is received in the repeater U2 by the relay 2E. The auxiliary relay 2A which is dependent upon the relay 2E short circuits the relay 2C by means of its contact 2*a*2 so that the latter releases. The relay H, during this time, remains attracted and prevents an immediate re-energization of the relay 2C.

When the relay 2C has released, the contact 2*c*3 interrupts the circuit for the relay 3C so that the final selector is released. On release of the relay 3C, the contact 3*c* connects the *b*-wire of the final selector to the source of current through an off-normal contact *ko* of the final selector. The relay K in the repeater U2 again responds and switches in the relay L so that the transmitting relay 2S sends out an alternating current impulse. The relay 1Y in the repeater U1 is acted upon by this alternating current impulse in the manner already described and by means of its contact 1*y*4, interrupts the seizing circuit for the relay 1C and thus prevents the repeater U1 from being seized.

When the final selector reaches its normal position, the off-normal contact *ko* opens and makes the *b*-wire devoid of current. In the repeater U2, the relays K and L release in succession as described so that the transmitting relay 2S sends out an alternating current impulse. The relays 1X and 1Y in the repeater U1 release on reception of this alternating current impulse so that this repeater can again be seized.

If the calling subscriber replaces his receiver before the called subscriber does so, the release impulse is immediately sent by the repeater U1 to the repeater U2. This takes place while the relay 3Y of the final selector and, therefore, the relays K and L of the repeater U2 and the relays 1Y and 1X of the repeater U1 are still energized to indicate that the called subscriber's receiver is removed. In order to ensure the transmission of the indication that backward signals cannot be transmitted which requires the switching devices K, L and 1X, 1Y to co-operate with certainty in phase with each other, both switching devices are positively returned into the normal position. The contact 1*s*3 interrupts the circuits of the relays 1X and 1Y in the repeater U1. In the repeater U2, the *b*-wire is interrupted by the contact 2*v* of the relay 2V, the energization of which is dependent upon the condition of the auxiliary relay A and thus the relays K and L are disconnected.

This positive simultaneous setting of the devices K, L and 1X, 1Y on repetition of an alternating current impulse from the repeater at the outgoing end to that at the incoming end is of

particular importance when alternating current impulses are accidentally simultaneously transmitted in both directions over the trunk line. It ensures that after transmission of the alternating current impulse in the direction in which the connection is being made, the backward signal takes place in the right form.

When the line is seized by a particular service station such as a toll exchange, the transmission of the various switching impulses can be effected as has been described. The change-over for the different working of the line selector can be effected in a known but not illustrated manner by transmission of a seizing impulse differing from the usual seizing impulse. The switching measures carried out by the toll operator during a connection are then transmitted, as is the numerical current impulse emission, through the *a*-wire and are retransmitted in the repeater U2 through the *a*-wire. For repetition of the ringing or for switching through to a seized line and like measures, it is thus only necessary to transmit an alternating current impulse through the trunk line. Likewise, the backward signals effected through the final selector are all repeated through the *b*-wire to the repeater U2 and are converted by the switching device K, L. The switching device IX, IY of the repeater UI then retransmits this switching criterion according to its signification through the *b*-wire to the particular service station.

It is clear that the switching device K, L is so constructed that on its actuation it always causes an alternating current impulse of a particular length to be sent out. In this way, the correct response of the switching device is ensured even if it is influenced only for a short period. Energization of the relay L is also ensured, even when the periods during which current flows in the *b*-wire are short, by switching in the winding KII. The connection of the winding KI of the relay K to a normal contact of the relay L and to one of its own working contacts prevents a further energization of the released relay K before the release of the relay L so that the time sequence of the two relays is always guaranteed.

Figure 2 shows a modified form of the switching device IX, IY which differs from that shown in Figure 1 only by the introduction of an additional slow-to-respond relay IW which, on its response, positively interrupts the circuits for the relays IX and IY. When using such an arrangement, the relay L of the repeater U2 is so designed that its delay in releasing is greater than its delay in responding. On release of the relays K and L, that is to say, at the end of a switching step transmitted through the *b*-wire, a longer alternating current impulse is thus always sent through the line which, by the energization of the relay IW, resets the relays IX and IY positively and accurately into the normal position. Also with the use of the switching device for suppressing backward calls, a longer and a shorter impulse are transmitted by the relays K and L, the longer impulse for initiating the suppression and the shorter one for removing it so that the impulse which initiates the suppression can be differentiated by its time constant from a seizing impulse in the opposite direction when the arrangement is arranged to cope with traffic in both directions.

It is clear from the described example that the switching steps transmitted separately according to their direction through the various speech wires in the local circuits of the various exchanges, can be effected by currents in the same direction. No switch means are, therefore, necessary to make it possible for the speech lines to be connected to different sources of current.

I claim:

1. A telephone system comprising two exchanges with speech lines, a trunk line between said exchanges, repeaters at the two ends of said trunk line connecting said trunk line inductively to said exchanges, means associated with said repeater at the incoming end of said trunk line for receiving a backward impulse over a speech wire and retransmitting said impulse in the form of two impulses through said trunk line, means associated with said repeater at the outgoing end of said trunk line for converting two impulses received over said trunk line to one impulse and for retransmitting said impulse over a speech wire, means associated with said repeater at the outgoing end of said trunk line for transmitting impulses through said trunk line, and means associated with both repeaters for positively actuating in phase said impulse doubling and halving means on transmission of impulses from the outgoing to the incoming repeater.

2. A telephone system comprising two exchanges with speech lines, a trunk line between said exchanges, repeaters at the two ends of said trunk line connecting said trunk line inductively to said exchanges, means associated with said repeater at the incoming end of said trunk line for receiving a backward impulse over a speech wire and retransmitting said impulse in the form of two impulses through said trunk line, means associated with said repeater at the outgoing end of said trunk line for converting two impulses received over said trunk line to one impulse and for retransmitting said impulse over a speech wire, means associated with said repeater at the outgoing end of said trunk line for transmitting impulses through said trunk line and means associated with both repeaters for positively setting into the normal position said impulse doubling and halving means on transmission of impulses from the outgoing to the incoming repeater.

3. A telephone system comprising two exchanges with speech lines, a trunk line between said exchanges, repeaters at the two ends of said trunk line connecting said trunk line inductively to said exchanges, means associated with said repeater at the incoming end of said trunk line for receiving a backward impulse over a speech wire and retransmitting said impulse in the form of two impulses through said trunk line, means associated with said repeater at the outgoing end of said trunk line for converting two impulses received over said trunk line to one impulse and for retransmitting said impulse over a speech wire, means associated with said repeater at the outgoing end of said trunk line for transmitting impulses through said trunk line and means associated with both repeaters for positively setting in phase with each other said impulse doubling and halving means on each transmission of a switching step through said trunk line from the incoming repeater to the outgoing repeater.

4. A telephone installation comprising two exchanges with speech lines, a trunk line between said exchanges, repeaters at the two ends of said trunk line connecting said trunk line inductively to the speech lines of said exchanges, said incoming repeater being provided with a

relay connected to one wire of said speech line of said exchange, a marginal relay controlled by said first named relay, a device for transmitting alternating current impulses through said trunk line at each actuation, said device being controlled by contacts of said relay and said marginal relay in such a manner that an alternating current impulse is transmitted with current flows over said speech wire and a further alternating current impulse is transmitted when current ceases to flow over said speech wire, said outgoing repeater comprising means for receiving alternating current impulses transmitted through said trunk line, a relay controlled by said means and actuated at the beginning of the first received impulse, an auxiliary relay controlled by said means and actuated at the end of the first received impulse, said auxiliary relay being adapted to guard the energization of said first named relay, both relays being de-energized on the reception of a second alternating current impulse, said first named relay being adapted on its actuation to transmit current through a wire of the speech line of said exchange at the outgoing end of said trunk line corresponding to said wire of the speech line of the exchange at the incoming end over which the current actuating said means at the incoming end flows.

5. A telephone system comprising two exchanges with two-wire speech lines, a trunk line between said exchanges, a repeater at each end of said trunk line connecting said trunk line to one of said exchanges, means associated with said repeater at the outgoing end of said trunk line, connected to only one of the two wires of a speech line and adapted to receive impulses over said wire and to retransmit said impulses over said trunk line, means associated with said repeater at the incoming end of said trunk line adapted to receive impulses over said trunk line and to retransmit said impulses over that of the two wires of a speech line corresponding to the wire to which said impulse receiving means at the outgoing end of said trunk line is connected, means associated with the repeater at the incoming end of said trunk line and connected to the other wire of said speech line for receiving backward signals over said wire and transmitting said signals over said trunk line and means associated with said repeater at the outgoing end of said trunk line for receiving said backward signals over said trunk line and transmitting said signals over that of the two wires of a speech line corresponding to the wire to which said backward signal repeating means at the incoming end of the trunk line is connected.

6. A telephone system as claimed in claim 5, in which the repeater at the incoming end of the trunk line comprises an auxiliary relay cooperating with said backward signal repeating means for transmitting an impulse over said trunk line both at the beginning and at the end of a backward signal received over the wire of said speech line.

7. A telephone system comprising two exchanges with two-wire speech lines, a trunk line between said exchanges, a repeater at each end of said trunk line connecting said trunk line to said exchanges, means associated with said repeater at the incoming end of said trunk line and connected to one of the two wires of a speech line at that end for receiving a backward signal over said wire and for retransmitting said signal over said trunk line in the form of two impulses, and means associated with said repeater at the outgoing end of said trunk line for receiving said impulses and for starting the transmission of a backward signal on the reception of the first of said impulses and stopping the transmission of said signal on the reception of the second of said impulses, said last mentioned signal being transmitted over that of the two wires of a speech line corresponding to the wire to which said backward signal receiving means at the incoming end of the trunk line is connected.

8. A telephone system as claimed in claim 7, in which said repeaters connect the two ends of said trunk line inductively to the speech lines of said exchanges and in which said impulse transmitting means are adapted to transmit alternating current impulses.

9. A telephone system as claimed in claim 7 comprising also a slow acting relay at the incoming end of said trunk line and in which said backward signal transmitting means at the incoming end of said trunk line are provided with two windings, one connected to one of said speech line wires and the other connected in series with said slow acting relay and adapted to be energized upon actuation of said transmitting means by a backward signal over said last mentioned wire.

10. A telephone system comprising a pair of exchanges, a speech line in each of said exchanges, a trunk line connecting said exchanges to each other, a repeater at the end of said trunk line in each of said exchanges, a backward signal receiving relay in the repeater at the incoming end of said trunk line having two windings and a working contact through which one of said windings is connected to one wire of the speech line in the exchange at the incoming end of said trunk line, a slow acting relay in the repeater at the incoming end connected in series with the other winding of said backward signal receiving relay, actuated through a further working contact of said backward signal receiving relay, having a normal contact connected in parallel with said first mentioned working contact and having a contact adapted to short circuit said last mentioned winding, a transmitting relay in the repeater at the incoming end adapted to be actuated by said backward signal receiving relay for the transmission of an impulse at the beginning and an impulse at the end of a backward signal received over the trunk line and means associated with the repeater at the outgoing end adapted to receive said impulses and to start the transmission of a backward signal on reception of the first of said impulses and to stop the transmission thereof on reception of the second, said transmission being effected over that wire of a speech line corresponding to the wire to which said backward signal receiving relay at the incoming end is connected.

11. A telephone system comprising a pair of exchanges, a speech line in each of said exchanges, a trunk line connecting said exchanges to each other, a repeater at the end of said trunk line in each of said exchanges, a backward signal receiving relay in the repeater at the incoming end of said trunk line having two windings and a working contact through which one of said windings is connected to only one wire of the speech line in the exchange at the incoming end of said trunk line, a slow acting relay in the repeater at the incoming end connected in series with the other winding of said backward signal receiving relay, actuated through a further working contact of said backward signal receiving relay, having a normal contact connected in par-

allel with said first mentioned working contact and a contact adapted to short circuit said last mentioned winding, a transmitting relay in the repeater at the incoming end adapted to transmit an alternating current impulse through said trunk line at each actuation, an energizing circuit for said transmitting relay comprising a make and break contact of said backward signal receiving relay and a make and break contact of said slow acting relay adapted to close said circuit at each actuation of said backward signal receiving relay until the following actuation of the said slow acting relay, and means associated with the repeater at the outgoing end adapted to receive said impulses and to start the transmission of a backward signal on reception of the first of said impulses and to stop the transmission thereof on reception of the second, said transmission being effected over that wire of a speech line corresponding to the wire to which said backward signal receiving relay at the incoming end is connected.

12. A telephone system comprising two exchanges with speech lines, a trunk line, a repeater at each end of said trunk line connecting said line inductively to said exchanges, switch means in the exchange at the incoming end of said trunk line, means controlled by said switch means for transmitting a calling back signal through a wire of the speech line at the incoming end, means associated with the repeater at the incoming end connected to said wire adapted to cause said repeater on reception of said calling back signal to transmit two impulses through said trunk line and means associated with the repeater at the outgoing end adapted on reception of the first of said impulses to preclude seizure of said repeater from the outgoing exchange and to reallow such seizure on reception of the second of said impulses.

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