June 14, 1949. K. W. RICHARDS 2,473,346

TELETYPEWRITER EXCHANGE SYSTEM

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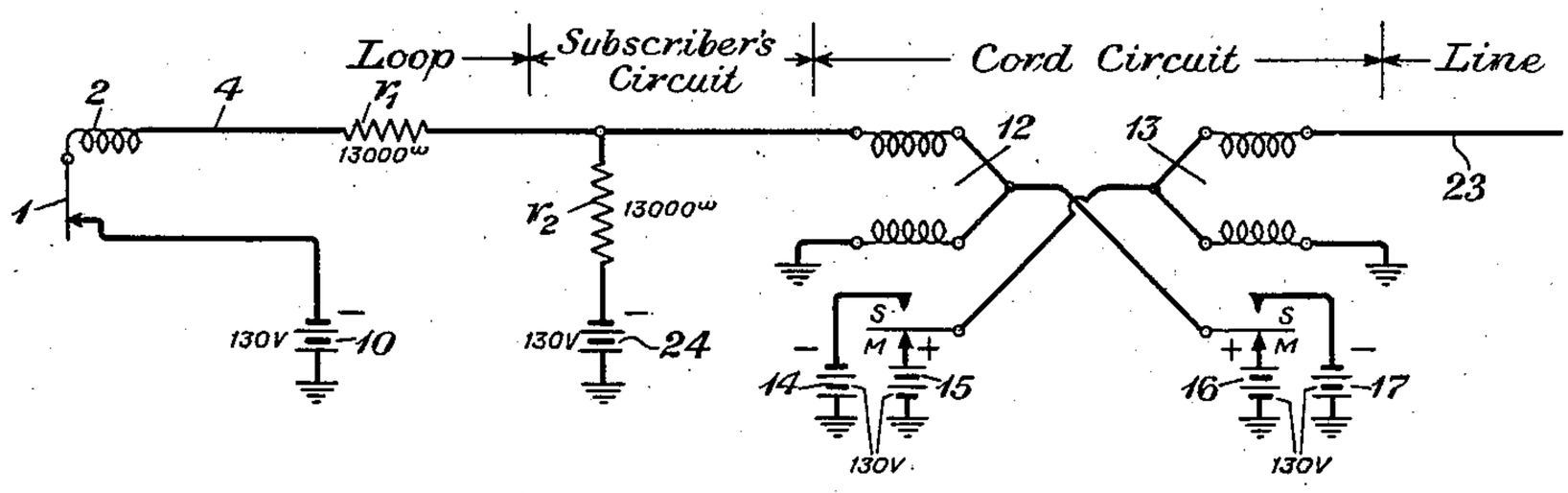

Fig. 1

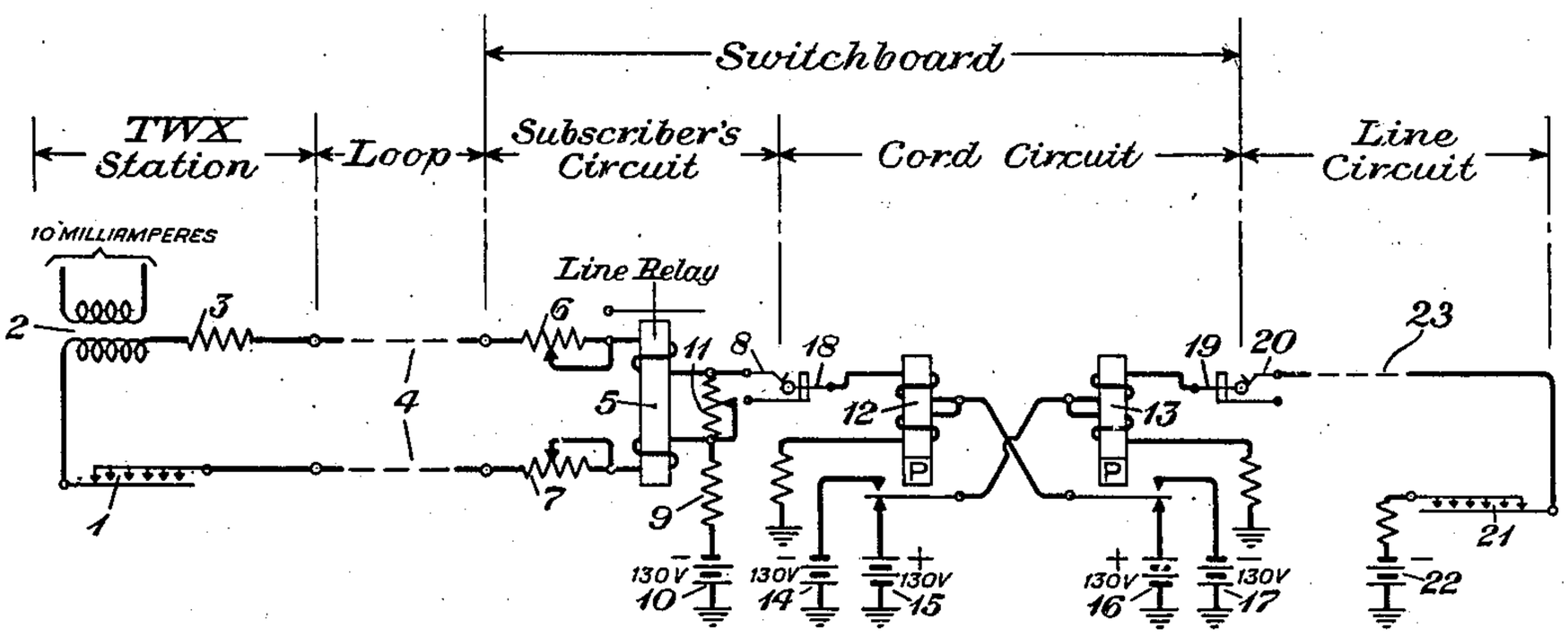

Fig. 2

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TELETYPEWRITER EXCHANGE SYSTEM

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This invention relates to telegraph systems and particularly to a method and means for transmitting telegraph signals from a circuit having a certain normal operating current into another circuit having a different operating current without employing a current converting repeater.

In the operation of a telegraph system, and particularly of an exchange teletypewriter system, the switchboards in certain offices are arranged to supply 60 milliamperes of current to the teletypewriter subscriber's loop at 130 volts whereas in other offices the subscriber's loops operate upon 20 milliamperes at 48 volts supplied by the switchboard in the latter offices. It may be desirable, or even necessary in an emergency, to operate the 20 milliampere subscriber's loop circuits from a switchboard arranged for 60 milliampere operation at 130 volts. Heretofore such a mode of operation has required the use of a telegraph repeater arranged for 130 volt, 60 milliampere operation on one side and 48 volt, 20 milliampere operation on the other side for each loop requiring such adjustment unless, of course, the station equipment were modified for the different voltage and current values, or special cord circuits were provided in the switchboard to connect the 20 milliampere circuits through the 60 milliampere switchboard.

The present invention resides in a method and means by which the 20 milliampere loops may be operated by a 60 milliampere switchboard without making any change in the station equipment, and which does not require a special cord circuit or the use of telegraph repeaters in each loop specially arranged to provide the different voltages and currents on opposite sides thereof.

This invention will be clearly understood from the following description, when read in connection with the attached drawing in which Figure 1 is a simplified diagram that serves to make clear the fundamental principle involved in the present invention and Fig. 2 shows in greater detail a circuit in which the invention is embodied.

In Fig. 1, 1 represents a transmitting device, such as a tape or keyboard transmitter at a teletypewriter station, hereinafter referred to as a TWX station, having also therein an inductance 2, such as a receiving relay, which elements are intended to represent symbolically, such a station. A battery 10, of 130 volts is also connected to the station. The station is connected by the loop 4 to the subscriber's circuit at the switchboard, the loop being represented by the resistance r_1. To the subscriber's circuit there

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is connected, in shunt to ground, a resistance r_2 in series with the battery 24, of 130 volts and poled as shown in the figure. The subscriber's circuit is connected to a cord circuit equipped with relays adapted to respond either to 60 mils or 20 mils to provide connection for TWX stations operating either upon 60 milliamperes of current or on 20 milliamperes. The cord circuit is represented by the polar relays 12 and 13 constituting a repeater, which is equipped with 130 volt batteries poled as shown in the drawing, relay 12 being adapted to respond either to 20 milliamperes or to 60 milliamperes.

Assuming that the tongue of relay 13 is on its marking contact, and the contact 1 is closed to transmit a marking impulse, and that the resistance of the line winding of relay 12 is negligible, the current i_1 in the loop is proportional to the voltage of the batteries 10 and 16, and to resistance r_1. By making that resistance 13000 ohms,

$$i_1=\frac{130+130}{13000}=20$$ milliamperes in the loop during transmission of a marking impulse from the TWX station.

During the transmission from the station of a spacing impulse, the contact 1 is open and the current in the loop is zero.

The current that flows through the shunt path that contains the resistance r_2 when the tongue of relay 13 is on its marking contact is

$$i_2=\frac{130+130}{r_2}$$

By making r_2 equal to 13000 ohms

$$l_2=20 \text{ milliamperes}$$

So that the current through the line winding of relay 12 during the transmission of a marking impulse from the TWX station equals

$$i_1+i_2=20+20=40 \text{ milliamperes}$$

For spacing, the current in the line winding $=i_2=20$ milliamperes.

The biasing current, flowing through the biasing winding, viz., the lower winding of relay 12, will equal the average of the currents for marking and spacing, viz., 30 milliamperes which is the same biasing current employed when the cord circuits are used with a loop operating upon 60 milliamperes marking and zero spacing currents.

When a spacing signaling impulse is received from the line 23, relay 13 will be operated to its spacing contact thereby connecting the negative pole of battery 17 to the apex of the windings of

relay 12. Since battery 17 is of 130 volts and since batteries 10 and 24, connected respectively to the loop and to the shunt resistance are likewise of 130 volts and poled similar to battery 17, zero current will flow through the winding of the receiving relay 2 and also the upper winding of the relay 12. Current will flow, however, through the lower winding of relay 12 in such direction as to hold the armature of that relay on its marking contact.

When the signaling impulse from the line 23 changes to marking, relay 13 will operate to its marking contact and the positive pole of the 130 volt battery 16 will be connected to the apex of relay 12 thereby restoring the system to the condition that prevailed prior to the receipt of the spacing impulse from the line 23 as heretofore described.

It will accordingly be seen that by employing the shunt resistance r_2 and by properly proportioning it, the current values may be made such that the cord circuit will operate satisfactorily in connection either with 20 milliampere loops or 60 milliampere loops.

The utilization of the shunt resistance r_2 serves also to eliminate the use of inductive loop wave shaping means at a subscriber's office by reducing the bias of the signals received from a subscriber. Owing to the presence of capacity in the loop circuits the signals may be distorted, that is, marking impulses may be unduly lengthened and spaces correspondingly shortened, which effect heretofore has been overcome by the use of inductive wave shaping means to neutralize the capacity in loops of undue length. By varying the value of the shunt resistance r_2 the maximum and minimum values of current in the line winding of relay 12, resulting from transmission from the TWX station may be adjusted to overcome the effect of distortion. Thus, if it were desired to set the value of the current in the line winding at 30 milliamperes, for a marking impulse sent from the TWX station; in order to overcome the effect upon that relay of a distorted marking impulse, this could be accomplished by adjusting the resistance r_2 so that the current in the shunt path would equal 18 milliamperes. The marking and spacing values of current in the said line winding would then be 38 and 18 milliamperes, respectively.

In Fig. 2, which shows, in greater detail, a circuit embodying this invention the TWX station is represented symbolically by the transmitter 1, the receiving relay 2 and a resistance 3. This station is connected by the subscriber's loop 4 to the subscriber's circuit at the switchboard. That circuit includes the windings of the line relay 5, and also the variable resistances 6 and 7 in each side of the said circuit. One of the windings of the said relay is connected to the tip contact of the jack 8 and the other winding is connected to a resistance 9 and the negative pole of the 130 volt battery 10. Across the right-hand terminals of the windings of the relay 5, as shown in the drawing, is a variable resistance 11 which together with the variable resistances 6 and 7, the resistance 9 and the battery 10 effects the adjustment necessary to enable the loop circuit, operating on 20 milliamperes at 48 volts to be effectively connected into a 60 milliampere TWX switchboard.

The subscriber's circuit is connected to a cord circuit having therein a repeater comprising the polar relays 12 and 13 each of which has associated with it suitable sources of potential

such as the batteries 14, 15, 16 and 17 by which positive and negative impulses representing marks and spaces, respectively, may be applied to the subscriber's circuit and also to the line circuit. The connection to the subscriber's circuit is effected by the insertion of the plug 18 into the jack 8, and, similarly, the connection to the line circuit is effected by inserting the plug 19 into the jack 20. The line circuit may be any circuit with which the subscriber at the distant TWX station desires to be connected. Such a line would have associated therewith a teletypewriter receiver and transmitter of the usual type which is indicated symbolically by the transmitting device 21 and the battery 22, the polarity of the battery connection being as shown on the drawing.

The manner in which the aforedescribed circuit works, in order to perform the function which is the object of the present invention, is similar to the operation of the circuit shown in Fig. 1, and, it is believed that repetition is unnecessary. It is desired to point out that the resistance r_1 of Fig. 1, is divided in Fig. 2 to provide better balancing of the line, and likewise the resistance 11 of Fig. 2, which, in effect corresponds to the resistance r_2 of Fig. 1, is a variable resistance connected not only to the battery 10, but also across the two sides of the subscriber's circuit.

While this invention has been disclosed as embodied in a particular form, it is capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a teletypewriter exchange system, the combination with a subscriber's loop having a teletypewriter transmitter connected therewith the said transmitter having a source of potential connected thereto adapted to transmit impulses of a certain value, of a cord circuit having sources of potential designed for operation with subscriber loops using a greater current value than is employed in the first mentioned loop, the said cord circuit including a repeater comprising a pair of polarized relays, and means to adjust the first mentioned loop for operation with the said cord circuit, the said adjusting means including a resistance a portion of which is connected across the said loop and the remainder in series with a source of voltage connected between the said loop and ground, the said resistance being so proportioned with respect to the resistance of the loop that the average current for marks and spaces passing through the line winding of the polar relay connected to the said loop shall equal the biasing current of that relay.

2. In a teletypewriter exchange system, the combination with a subscriber's loop having a teletypewriter transmitter connected therewith the said transmitter having a source of potential connection thereto adapted to transmit 20 milliampere marking impulses over the said loop, of a cord circuit having sources of potential normally intended for use with 60 milliampere loops, the said cord circuit including a repeater comprising a pair of polarized relays, and means to adjust the said 20 milliampere loop for operation with the said cord circuit, the said adjusting means including a resistance a portion of which is connected across the said loop and the remainder in series with a source of voltage connected between the said loop and ground, the said resistance being so proportioned with respect to the resistance

of the loop that the value of the average current for marks and spaces passing through the line winding of the polar relay when connected to the 20 milliampere loop shall be the same as that passing through the line winding when connected to a 60 milliampere loop.

3. In a teletypewriter exchange system, an arrangement to adapt a subscriber's loop, operating upon a given value of current, to be operatively connected to a switchboard having cord circuits designed to normally operate with subscribers' loops operating at higher values of current than the loops first mentioned, the said cord circuits including a plurality of polar relays, the said arrangement comprising a resistance a portion of which is connected across said loop and the remainder in series with a source of potential, connected between the said loop and ground, the resistance of said path being so proportioned with respect to the resistance in the said loop that the average of the currents for marks and spaces shall equal the biasing current of the polar relay of the cord circuit connected to the said subscriber's loop.

4. In a teletypewriter-exchange system, the combination with a teletypewriter-exchange station designed to operate upon 20 milliamperes of current, of a loop circuit connected therewith, a teletypewriter-exchange switchboard including a cord circuit and a subscriber circuit connected to

the said loop, the said cord circuit including a repeater having sources of potential normally adapted for use with teletypewriter-exchange stations operating upon 60 milliamperes and also those operating upon 20 milliamperes, and means connected to the said subscriber circuit to enable the station operating upon 20 milliamperes to operate the relay of the said repeater whose winding is connected to the said loop, the said means including a resistance a portion of which is connected across the said loop and the remainder is connected to ground through a source of potential and so proportioned as to resistance of the loop that the total current through the line winding of the repeater relay will be the same as that when the repeater is connected to a 60 milliampere station.

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