

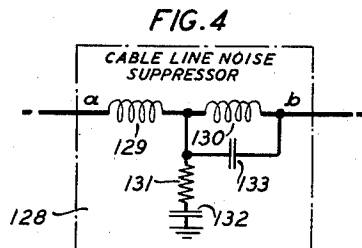
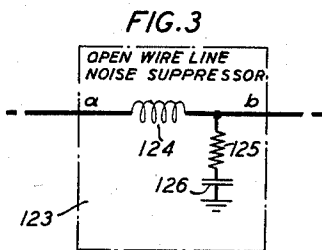
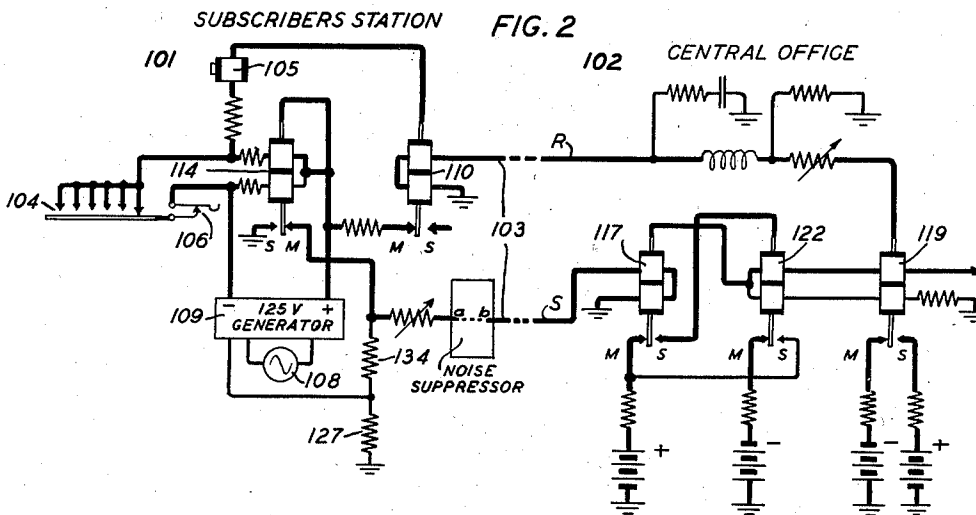
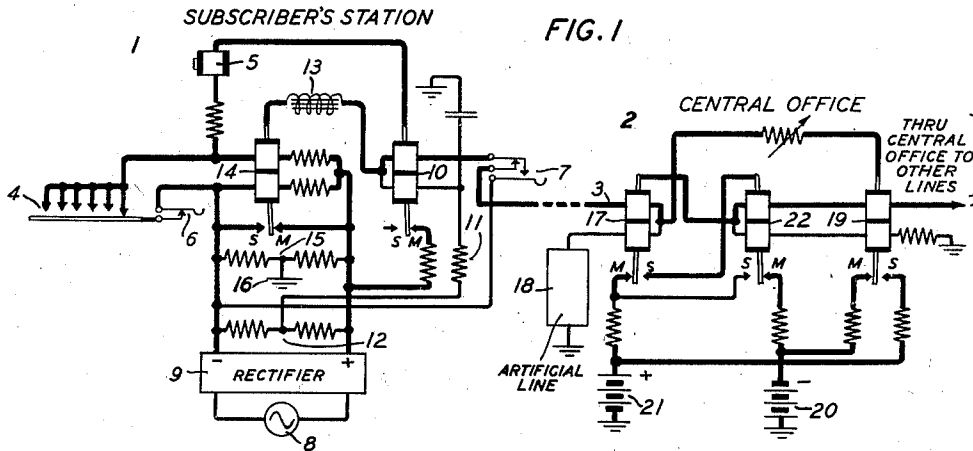
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W. W. CRAMER ET AL

2,117,705

TELETYPEWRITER SYSTEM

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INVENTORS: W. W. CRAMER
G. C. CUMMINGS
BY *g W Schumier*

ATTORNEY

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TELETYPEWRITER SYSTEM

Walter W. Cramer, Rutherford, and George C. Cummings, Orange, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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This invention relates to a teletypewriter system and, more particularly, to a teletypewriter system which includes a subscriber's station circuit for enabling operation over longer lines than would otherwise be possible without the use of a telegraph repeater, all other conditions being equal.

Heretofore, when a subscriber's teletypewriter station has been located at a considerable distance from its associated teletypewriter central office, it has ordinarily been necessary to connect a telegraph repeater into the line between the central office and the subscriber's station. In a widespread communication system, it has often been necessary to employ a considerable number of such telegraph repeaters. Since each repeater costs several hundred dollars, the total cost of all the repeaters used in a large communication system is quite high.

Accordingly, it is an object of this invention to obviate the need for using as many telegraph repeaters in a communication system as has heretofore been necessary.

It is also an object of this invention to obviate the need for a break relay at a subscriber's teletypewriter station thereby avoiding the initial cost of such a relay and the expense of its maintenance.

It is a further object of this invention to enable the subscriber's teletypewriter to print a home copy of all messages transmitted notwithstanding the elimination of the break relay usually employed at a subscriber's station.

These objects of the invention are accomplished, in a telegraph system having only a one-wire line with a ground return for connecting the subscriber's station to the central office, by providing separate sending and receiving loops at the subscriber's station connected together by the subscriber's set of sending contacts. This provision of separate sending and receiving loops eliminates the need for a break relay at the subscriber's station. To provide the subscriber with a home copy of transmitted messages, it is necessary that the sending and receiving loops be connected together through the subscriber's set of sending contacts to battery. With this arrangement, the operation of the subscriber's sending contacts will open both the sending and receiving loops thereby transmitting the signal both to the subscriber's printer magnet and also out over the line to the central office. This permits local, as well as distant, reception of messages transmitted by the subscriber's printer and, at the same time, eliminates the need for a break relay which would

ordinarily be required for a single, or common, sending and receiving loop of usual design.

In the subscriber's station circuit, two potentiometers are bridged across the local source of power supply which may include either a motor-generator or rectifier. The mid-point of the resistance of one potentiometer is connected to ground to provide the effect of two polarities; i. e., positive and negative voltage with respect to ground as will be explained hereinafter. The resistance element of the subscriber's artificial line, or balancing network, is connected to the mid-point of the resistance element of the other potentiometer instead of being connected directly to ground in the usual manner. This enables the artificial line currents to return to the local power supply source by a separate metallic path instead of through the grounded potentiometer through which the line currents pass. This increases the voltage applied to the line with respect to ground, as will be explained hereinafter, thereby permitting operation over longer lines than would otherwise be possible all other conditions being equal.

These and other features of the invention will be described more fully in connection with the following detailed description of the drawing in which:

Fig. 1 represents a subscriber's teletypewriter station connected by a one-wire telegraph line having a ground return to receiving teletypewriter apparatus at a central office;

Fig. 2 illustrates a subscriber's teletypewriter station which is somewhat similar to that shown in Fig. 1 but which is connected to receiving teletypewriter apparatus at a central office by a two-path metallic circuit;

Fig. 3 shows a noise suppressor suitable for use at the subscriber's station shown in Fig. 2 when the two-path metallic circuit includes an open-wire line; and

Fig. 4 represents a noise suppressor suitable for use at the subscriber's station shown in Fig. 1 when the two-path metallic circuit includes a cable line.

It is to be understood that the circuits shown in the drawing are presented for the purpose of illustrating principles of the invention and that the invention is not restricted to the particular circuits shown. The central office may be of any suitable construction such as that described in Patent 2,028,818; granted January 28, 1936, to R. J. Anspach et al. The disclosure of this Anspach et al. patent is incorporated herein by reference as a part of this specification.

After traveling through the receiving apparatus at the central office, the line circuits pass through other equipment at the central office and then out over other lines leading either to other teletypewriter central offices or to other subscribers' teletypewriter stations. The central office equipment and the line circuits may be of any suitable design, such as that disclosed in a copending application filed Oct. 29, 1936, by W. V. K. Large and G. A. Locke and having Serial No. 108,154.

In Fig. 1, there is represented in schematic form a subscriber's teletypewriter station 1 connected to a central office 2 by a one-wire telegraph line 3, which, as is indicated in the drawing, leads through the equipment at the central office 2 to other lines extending either to other central offices or to other subscribers' teletypewriter stations. It is to be understood that line 3 may be any suitable type of line, such as a composite line. The subscriber's station 1 is shown to be provided with the usual well-known equipment including sending contacts 4, printer magnet 5, break key 6, recall key 7, local source of power supply 8, and rectifier 9.

The receiving relay 10 at the subscriber's station 1 has one side of its lower winding connected to the balancing network or artificial line 11 which is, in turn, connected to the mid-point of the resistance element of potentiometer 12. The line circuit leads from the upper winding of receiving relay 10 through noise suppressor 13, over the armature of the subscriber's sending relay 14, and then through a portion of potentiometer 15 to ground 16. Incoming signals from line 3 will pass through receiving relay 10 and will cause it to actuate its armature to open and close the receiving loop which leads from the positive output terminal of rectifier 9 to the contact and armature of receiving relay 10, through the winding of printer magnet 5, sending contacts 4, break key 6, and then to the negative output terminal of rectifier 9.

The subscriber's sending loop leads from the positive output terminal of rectifier 9, through the upper winding of sending relay 14, sending contacts 4, break key 6, and then to the negative output terminal of rectifier 9. Opening of this sending loop by the sending contacts 4 will cause the sending relay 14 to actuate its armature thereby applying either positive or negative voltage to the line circuit.

At the central office 2, the line circuit leads from line 3 through the upper winding of receiving relay 17 and then the line current divides, one portion passing through the lower winding of receiving relay 17 and then through the balancing network, or artificial line, 18 to ground. The other portion of the line current passes over the armature of the sending relay 19 and then to grounded battery 20. Variations in the line current effected by operation of sending contacts 4 will cause receiving relay 17 to move its armature back and forth to apply either positive current from battery 21 or negative current from battery 20 (after the current has passed from battery 20 over the armature of the break relay 22) to the circuit leading from the armature of receiving relay 17 through the upper winding of break relay 22, upper winding of the sending relay 19, and then out through the rest of the central office equipment to other lines leading either to other central offices or to other subscribers' stations. The rest of the central office equipment and the other lines with their associated central offices and subscribers' stations have not been

shown in the drawing for the sake of simplicity. As was stated above, these may be of the type shown in the copending application of Large et al. identified above.

In the operation of the system, when the subscriber wishes to transmit a message, he opens and closes his sending contacts 4. The subscriber's sending relay 14 follows the opening and closing of contacts 4 and moves its armature back and forth between its contacts to apply either negative or positive voltage from rectifier 9 to the line circuit which, as is shown in the drawing, has a ground return path to ground 16 at the mid-point of potentiometer 15. Thus, by means of grounded potentiometer 15, the subscriber is able to alternately apply positive and negative voltages from his rectifier 9 to line 3. This produces a change in the current flowing in line 3 and operates the receiving relay 17 at central office 2. Due to the sending contacts 4 being also connected into the subscriber's receiving loop, the subscriber's receiving relay 10 will follow the opening and closing of contacts 4 thereby causing the subscriber's teletypewriter to make a record, or home copy, of the messages that he transmits.

The subscriber's circuit arrangement combines the functions of a subscriber's station set and a toll line terminal repeater. It requires little more apparatus than the station set alone and is designed to operate on power furnished by the rectifier 9. Although a single polarity rectifier 9 has been shown with a potentiometer 15 to secure its mid-point, equally good results may be obtained by using a two-polarity rectifier having its mid-point grounded.

The repeating function of the subscriber's station set is accomplished in part by connecting the artificial line 11 to the mid-point of a potentiometer 12 bridged across the output terminals of rectifier 9. Then, when current from rectifier 9 passes over the armature of sending relay 14 and through the noise suppressor 13, it arrives at the receiving relay 10 where it divides. Some of the current goes out over the line 3 and some goes through the artificial line 11 to potentiometer 12.

Potentiometer 12 thus provides a return path to rectifier 9 for the artificial line currents which is separate from the path followed by the line currents in the ground return path through potentiometer 15 thereby avoiding objectionable voltage drops in potentiometer 15. This increases the current in line 3 thereby permitting operation over longer lines than would otherwise be possible without using a repeater and using a given generator operating at a given speed with a given impedance drop. Thus, the subscriber's station circuit requires two less telegraph relays than would a repeater using the standard balanced loop circuit.

The currents flowing in the two windings of receiving relay 10 oppose each other. When a marking signal is transmitted by relay 14, the current in the upper winding of relay 10 will be larger than the current in the lower winding and will consequently cause the armature of relay 10 to be held on its marking contact. When a spacing signal is transmitted by relay 14, the current in the upper winding of relay 10 is decreased below the level of current in the lower winding. This will hold the armature of relay 10 on its marking contact as the current in the lower, or artificial line, winding has been reversed.

In summary, it can be seen that the subscriber's sending contacts 4 control the circuit through the printer magnet 5 as well as through

the sending relay 14 so that the subscriber's teletypewriter prints a record of whatever is transmitted. It can thus be seen that the printer magnet 5 is under the control of both the receiving relay 10 and the sending contacts 4 of the subscriber's teletypewriter and operates on open and closed signals in either case.

During the time that the subscriber is transmitting a message, an operator at the central office 2 may take control of the circuit by operating his break key (not shown) which opens the circuit leading through the upper windings of the sending relay 19 and break relay 22. The resulting operation of the armatures of these relays causes a spacing signal to be transmitted to the subscriber's station 1. The arrival of this spacing impulse at station 1 causes the receiving relay 10 to operate its armature to its spacing contact. This opens the subscriber's receiving loop through the printer magnet 5 thereby stopping the printing, by the subscriber's teletypewriter, of the home copy of the message being transmitted by him.

After the subscriber has finished transmitting messages to the central office 2, he may, at some later time, recall the operator by momentarily operating his recall key 7 which is of the make-before-break type. The operation of recall key 7 maintains the subscriber's local sending and receiving loops closed and energized, but opens line 3. This opening of line 3 effects the operation, in a well-known manner, of the usual recall lamp (not shown) at the central office 2 which serves to attract the attention of the operator.

Signals transmitted from central office 2 to subscriber's station 1 cause the sending relay 19 to actuate its armature which fluctuates between its marking and spacing contacts to transmit polar reversals of current through the apex of the central office receiving relay 17. As the artificial line 18 is adjusted to closely simulate the impedance of the actual line 3 and its terminal equipment at station 1, the current from relay 19 divides between the upper and lower windings of relay 17 which are series opposing with respect to the outgoing current.

When a marking signal is being transmitted from central office 2, the current in the upper, or line winding, of relay 17 is the larger due to the aiding polarity of voltage applied to line 3 at station 1. This holds the armature of relay 17 on its marking contact, and the armature of relay 10 will also remain on its marking contact.

When a spacing signal is transmitted, the voltage applied to the line opposes that applied at station 1 and reduces the current flowing in the upper winding of relay 17 to a lower level than that flowing in the lower, or artificial line, winding. At the same time, the current in the lower winding of relay 17 is reversed, thereby causing the armature of receiving relay 17 to be held on its marking contact. When the normal line current is reduced by the application of a spacing voltage at the central office, the armature of the receiving relay 10 at station 1 will be operated to its spacing contact by the current flowing in its artificial line winding.

During the transmission of signals from central office 2 to the subscriber's station 1, the subscriber can interrupt and take control of the communication circuit by operating his break key 6. This opens the operating circuit of his printer magnet 5 thereby preventing printing by his teletypewriter. The operation of break key 6 also opens the circuit through the upper wind-

ing of sending relay 14 thereby allowing the biasing current in the lower winding to cause relay 14 to operate its armature to its spacing contact. This applies spacing, or negative, voltage to line 3 and causes the armature of relay 17 at central office 2 to be operated to its spacing contact. Consequently, the current in the loop passing through the upper windings of the sending and break relays 19 and 22 is reduced to zero thereby interrupting transmission to station 1.

In addition to saving the expense of providing and maintaining the usual break relay at the subscriber's station 1 and saving the expense of a repeater connected in series with the line 3, the circuit described above possesses the advantage of providing high quality transmission in both directions. Furthermore, the operating voltages at the subscriber's station 1 are approximately one-half those employed at central office 2 because of the grounded potentiometer 15 bridged across the output terminals of rectifier 9. This reduces the unbalance effects at station 1, due to line leakage, sufficiently to permit the use of a fixed balance artificial line at station 1 for communication lines of moderate length. Although the use of a fixed balance artificial line at station 1 increases the unbalance effects of leakage at the central office 2, repeaters with adequate balancing facilities are provided at central office 2 for compensating for these unbalance effects.

A subscriber's station set arranged for two-path polar operation is shown in Fig. 2. The outstanding feature of this station set is that it permits transmission of positive and negative 125-volt signals from a single polarity non-grounded power supply source by means of a single relay whereas full commutation arrangements of usual design generally require two relays.

Transmission of messages from the central office 102 to the subscriber's station 101 is accomplished by opening and closing the loop circuit through the upper windings of the sending and break relays 119 and 122. The resulting operation of the armature of the sending relay 119 transmits polar reversals out over the line 103 which are received at station 101 by the receiving relay 110 connected in series with line 103. The resulting operation of the armature of relay 110 opens and closes the subscriber's receiving loop through the printer magnet 105.

When the subscriber sends messages to the central office, the operation of his sending contacts 104 will open the sending loop connected through the upper winding of the sending relay 114. The resulting operation of the armature of relay 114 alternately applies positive and negative 125 volts to the line 103 thereby operating the receiving relay 117 at central office 102. This is accomplished as follows: when the sending contacts 104 are closed, the armature of the subscriber's sending relay 114 is on its marking contact and positive current will flow from the armature of the sending relay 114 through the noise suppressor and over line 103 thereby holding the armature of receiving relay 117 at central office 102 on its marking contact. This current returns to station 101 over a ground return path and through resistance 127 to the negative terminal of the generator 109.

When the sending contacts 104 are opened, the armature of the sending relay 114 is operated to its spacing contact and negative current will flow through resistance 134 and out over line 103

to operate the armature of the receiving relay 117 at central office 102 to its spacing contact. This current returns to station 101 over the ground return path to the positive side of the generator 109 which is grounded by the spacing contact of the sending relay 114. Positive and negative voltages of full generator voltage are therefore applied alternately to the line 103 by means of a single transmitting relay 114. When the resistance 127 equals resistance 134 the terminal impedance for marking equals the terminal impedance for spacing thereby insuring unbiased transmission of signals to the central office 102.

When line 103 is an open-wire line, the noise suppressor 123, shown in Fig. 3, should be connected into the circuit, shown in Fig. 2, at the points indicated by the letters *a* and *b*. Noise suppressor 123 comprises an inductance 124, connectible in series with the line circuit, and a resistance 125, connectible in parallel with the line circuit, connected to a grounded condenser 126.

On the other hand, if line 103 is a cable line, the cable line noise suppressor 128, shown in Fig. 4, should be connected into the circuit of Fig. 2 at the points *a* and *b*. Noise suppressor 128 includes two inductances 129 and 130 connectible in series with the line circuit and having their mid-point connected to a resistance 131 and grounded condenser 132. In addition, a condenser 133 is bridged across the inductance 130. This cable line noise suppressor 128 is very effective in preventing noise in telephone circuits operating over the same line circuit and also permits a high degree of quality in the transmission of telegraph messages.

What is claimed is:

1. A teletypewriter system having in combination a telegraph line, a subscriber's teletypewriter station connected thereto, said subscriber's teletypewriter station having a receiving loop with a receiving magnet connected therein, a sending loop with a sending relay connected therein, a source of power supply, and means for simultaneously applying the source of power supply to both a winding of the receiving magnet and a winding of the sending relay, said means including an operative connection between the source of power supply and the receiving magnet and the sending relay.

2. A teletypewriter system having in combination a telegraph line, a subscriber's teletypewriter station connected thereto, said subscriber's teletypewriter station having a receiving loop with a receiving magnet connected therein, a sending loop with a sending relay connected therein, a source of power supply, and means for simultaneously applying the source of power supply to both a winding of the receiving magnet and a winding of the sending relay, said means including a set of sending contacts.

3. A teletypewriter system having in combination a telegraph line, a subscriber's teletypewriter station connected thereto, said subscriber's teletypewriter station having a receiving relay connected into the telegraph line, a receiving loop with a receiving magnet connected therein, a sending loop with a sending relay connected therein, a source of power supply, and interconnecting instrumentalities for simultaneously ap-

plying the source of power supply to both a winding of the receiving magnet and a winding of the sending relay, said interconnecting instrumentalities including sending means.

4. A teletypewriter system having in combination a telegraph line, a subscriber's teletypewriter station having a potentiometer having a negative side and a positive side, a receiving relay provided with two windings, one of said windings being connected into the telegraph line and the other of said windings being connected to the mid-point of the potentiometer, a source of power supply having a negative terminal and a positive terminal, control means for applying voltage from either terminal to the telegraph line, and means for increasing the voltage applied to the line, said means comprising two electrical conductors, one connecting the negative side of the potentiometer directly to the negative terminal of the source of power supply and the other connecting the positive side of the potentiometer directly to the positive terminal of the source of power supply.

5. A teletypewriter system having in combination a telegraph line, a subscriber's teletypewriter station having a potentiometer having a negative side and a positive side, a receiving relay provided with two windings, one of said windings being connected into the telegraph line and the other of said windings being connected to the potentiometer, a grounded potentiometer connected across the terminals of the source of power supply, control means for applying voltage from either terminal to the telegraph line, and means for increasing the voltage applied to the line, said means comprising two electrical conductors, one connecting the negative side of the potentiometer directly to the negative terminal of the source of power supply and the other connecting the positive side of the potentiometer directly to the positive terminal of the source of power supply.

6. A teletypewriter system having in combination a telegraph line, a subscriber's teletypewriter station connected thereto, said subscriber's teletypewriter station having an artificial line, a receiving relay provided with two windings, one of said windings being connected into the telegraph line, and the other of said windings being connected to the artificial line, a source of power supply having a negative terminal and a positive terminal, control means for applying voltage from either terminal to the telegraph line, and means for increasing the voltage applied to the line, said means comprising a resistance bridged across the terminals of the source of power supply and an electrical conductor for connecting the artificial line to the mid-point of said resistance.

7. A teletypewriter system including a teletypewriter central office, a subscriber's teletypewriter station, a two-path circuit connecting the subscriber's station to the central office for the transmission of polar telegraph signals, said subscriber's station having a single non-grounded power supply, and control means for applying positive and negative voltage from the power supply to the two-path metallic circuit, said control means including a single transmitting relay.

WALTER W. CRAMER.

GEORGE C. CUMMINGS.