June 16, 1925. **1,541,880**

E. F. WATSON

SINGLE POLAR TELEGRAPH CIRCUITS

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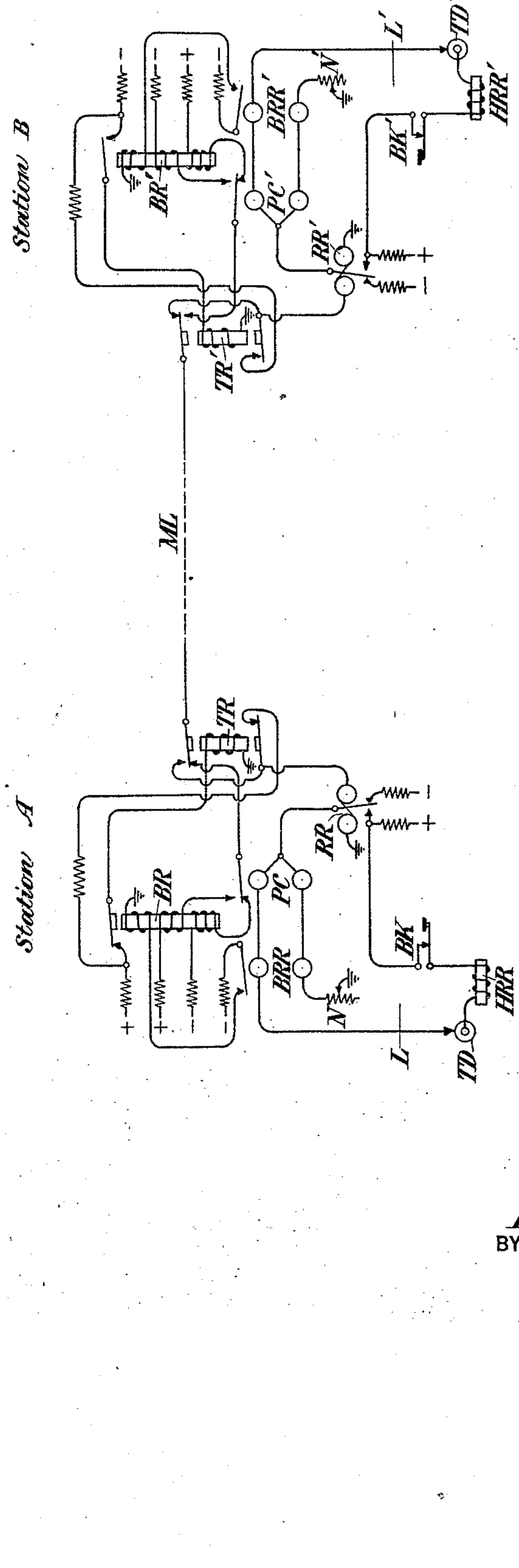

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EDWARD F. WATSON, OF YONKERS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SINGLE POLAR TELEGRAPH CIRCUITS.

Application filed November 21, 1921. Serial No. 516,870.

To all whom it may concern:

Be it known that I, EDWARD F. WATSON, residing at Yonkers, in the county of Westchester and State of New York, have invented certain Improvements in Single Polar Telegraph Circuits, of which the following is a specification.

This invention relates to telegraph circuits and more particularly to the type of telegraph circuit known as single Morse circuits in which signals are transmitted in but one direction over the same line at one time, although the system is so arranged that signals may be transmitted in either direction.

One of the objects of the invention is to produce a signaling system in which signals may be transmitted in either direction over a line wire without balancing the wire.

Another object of the invention is to produce a signaling system in which signals consisting of positive and negative impulses may be transmitted in either direction over a line wire without balancing the wire.

Another object of this invention is to produce a system in which the line will be switched into connection with the transmitting apparatus at one end and the receiving apparatus at the other end, but, under suitable conditions, may be switched into connection with the receiving apparatus at the first mentioned end and into connection with the transmitting apparatus at the other end for transmitting singnals in the reverse direction.

Another object of the invention is to provide a system in which the stations at each end of the line are provided with a transmitting and a receiving apparatus, the transmitting apparatus at one station being connected with the line and the receiving apparatus at the other station being connected with the line when signals are transmitted in one direction, the system being so arranged that, by transmitting a break signal from the station which is receiving, the connections may be interchanged to connect the transmitting apparatus with the line at the receiving station and the receiving apparatus with the line at the transmitting station, whereby signals may be transmitted in the opposite direction.

Another object of the invention is to produce a system having the characteristics above referred to and which is adapted for the transmission of printing telegraph signals.

A still further object of the invention is to provide a system having the characteristics above referred to in which the switching apparatus for determining whether the line will be connected to the transmitting or to the receiving apparatus at a given station will be under the control of a relay responsive only to abnormal current conditions in the line.

The above objects as well as other objects of the invention will be clear from the following description thereof when read in connection with the accompanying drawing, Figure 1 of which represents a telegraph system embodying the principles of the invention.

Referring to the diagram, ML designates a main transmission line for a telegraph circuit terminating at opposite ends at two stations indicated as A and B respectively. At station A a local loop L extends to a subscriber's station at which suitable transmitting and receiving apparatus may be provided,—for example, the loop L is illustrated as including a schematically indicated transmitting distributor TD of a printing telegraph set and a home recording relay HRR of such a set.

The loop L at station A is balanced by means of a balancing circuit or resistance N, and windings of a polar pole changing relay PC and a polar break release relay BRR are included in the loop L and balancing circuit N. At the junction point between the loop L and the balancing circuit N a connection extends to the armature of a polar receiving relay RR, which relay may, under certain conditions, be associated with the main line ML for transmitting signals to the loop.

A transfer relay TR is arranged, so that it may switch the main line ML either into connection with the receiving relay RR or into connection with the transmitting apparatus controlled by the armature of the pole changer PC. A break relay BR is provided, said relay having three windings, all connected so that their effects will be in the same direction magnetically. Two of these windings are controlled through the back and front contacts of the pole changer PC, so that the marking and spacing currents are transmitted through these windings.

The third winding is under the control of the armature of the break release relay BRR. The break relay is so arranged that its armature controls the circuit of the transfer relay TR, and the break relay when once energized remains energized until a break signal is transmitted from the receiving station as will be described later. The transfer relay TR will therefore remain energized or be deenergized, depending upon the condition of the break relay, so that when the transmitter at one station is connected to the line and the receiver at the other station is also connected to the line this condition will remain until a break signal is transmitted from the station which is receiving.

The apparatus at station B is identical with that at station A, and corresponding elements are represented by the same reference characters primed. Further details of the apparatus will be clear from a description of the operation, which is as follows:

As illustrated, the apparatus at stations A and B is in condition for transmitting from the former to the latter. Under these conditions, the break relay BR at station A is energized and maintains the transfer relay TR energized, so that the main line ML is connected to the armature of the pole changer PC. The transfer relay TR at its lower front contact completes a locking circuit to positive battery for the winding of the receiving relay RR, so that its armature is held against its negative contact. At station B both the break relay BR′ and the transfer relay TR′ are deenergized, so that the winding of the receiving relay RR′ is connected to the line ML over the upper back contact of the transfer relay.

Under these conditions above described, when the loop L is closed current flows from the positive battery through the winding of the home recording relay HRR, through the transmitting distributor TD, through the loop winding of the break release relay BRR and pole changer PC and over the contact of the receiving relay RR to negative battery. Current also flows from ground through the balancing resistance N, balancing windings of the break release relay BRR and pole changer PC and over the contact of the receiving relay RR to negative battery. Obviously the current flowing through the loop windings of the pole changer and the break release relay is substantially twice as great as that flowing through the balancing windings owing to the fact that the positive and negative batteries are connected in series with respect to the loop circuit. The tendency of the current flowing through the balancing windings is to shift the armatures of the pole changer PC and the break release relay BRR to their upper contacts, but owing to the greater pull in the opposite direction produced by the loop windings of said relays, the armatures are held to their lower contacts, so that negative battery is connected through the lower winding of the break relay BR, over the lower contact of the pole changer PC and over the upper front contact of the transfer relay TR to the main line ML. The resultant line current flows over the upper back contact of the transfer relay TR′ at station B and through the windings of the receiving relay RR′ to ground. The armature of the receiving relay RR′ is therefore held against its negative contact, and the current conditions in the loop circuit L′ are the same as described at station A, so that the contact of the break release relay BRR′ is held open. The contact of the pole changer PC′ controlling the circuit through the lower winding of the break relay BR′ is also closed, but as this circuit is opened at the contact of the transfer relay TR′, the break relay BR′ is not affected.

The conditions just described obtain during the transmission of marking signals. When a spacing signal is to be transmitted, the loop L will be opened by means of the transmitting distributor TD at station A, so that no current flows through the loop windings of the pole changer PC and the break release relay BRR. The balancing windings of these relays now become effective, thus shifting their armatures. The shifting of the armature of the break release relay closes a circuit through the upper winding of the break relay BR, and the shifting of the armature of the pole changer PC closes a circuit from positive battery, through the middle winding of the break relay, over the upper contact of the pole changer PC and over the upper front contact of the transfer relay TR to the main line ML, so that the receiving relay RR′ shifts its armature to its positive contact. Positive battery is now connected to both ends of the loop L′, so that no current flows through the loop windings of the pole changer PC′, the break release relay BRR′ and the winding of the home recording relay HRR′. Current flows through the balancing windings of the relays PC′ and BRR′ in the opposite direction, so that these windings are now energized in such a manner as to tend to hold their armatures against their lower contacts. Consequently, the shifting of the battery connections by means of the relay RR′ is without effect upon the armatures of the pole changer PC′ and the break release relay BRR′.

The home recording relay HRR′ may function as a sounder where the circuit is used for the transmission of ordinary Morse signals. If a printer is to be controlled by

the loop L′, however, the first space signal of a group will be used to release the receiving distributor (not shown) of the printer. Consequently, when the relay HRR′ is deenergized by reason of the fact that positive battery is connected to both ends of the loop during the first space signal of the group, the release of its armature will control the release of the receiving distributor in a well-known manner.

It will be noted that during the operations above described the relay BR is maintained energized by current through some one of its windings during the transmission of marking and spacing signals. If, now, while signals are being transmitted from station A, it is desired to transmit signals from station B, the loop circuit L′ may be opened, as, for example, by means of the break key BK′. As soon as a negative or marking signal is received from station A, negative battery will be connected to the loop over the left-hand contact of the receiving relay RR′. As the loop windings of the pole changer PC′ and the break release relay BRR′ are deenergized, the balancing windings become effective to shift their armatures to their upper contacts. The shifting of the armature of the break release relay BRR′ closes the circuit through the upper winding of the break relay BR′ thereby energizing said relay, which, at its upper front contact, completes the circuit for the transfer relay TR′. The transfer relay TR′ at its lower front contact completes a holding circuit for the receiving relay RR′ to maintain its armature against its negative contact. At its upper front contact the relay TR′ connects the main line ML over the upper contact of the pole changer PC′ and through the middle winding of the break relay BR′ to negative battery. Negative battery is now connected to both ends of the main line ML at station A through the lower winding of the break relay BR and at station B through the middle winding of the break relay BR. As a consequence, no current flows through these two windings, and as the break relay BR depends at this moment for its energization upon its lower winding, said relay will be deenergized and release the transfer relay TR. The break relay BR′ at station B, however, will be maintained energized through its upper winding under the control of the break release relay BRR′ as long as the break key BK′ is held open. The transfer relay TR at station A, upon being released, disconnects the line ML from the contact of the pole changer PC and connects it to the winding of the receiving relay RR. As negative spacing current is being transmitted over the line ML from the station B during the breaking condition, the receiving relay RR shifts its armature to its positive contact, so that the pole changer PC and the break release relay BRR will hold their armatures in their lower positions regardless of whether the loop L is open or closed. No current can flow in the loop L under these conditions, and in the case of a printing apparatus this condition results in stopping the transmitter at the end of its cycle. The break key BK′ may then be restored, whereupon the armatures of the pole changer PC′ and BRR′ will be shifted to their lower positions. The break relay BR′ will now be energized through its lower winding, and positive current will be transmitted through this winding to the main line ML. The positive current in this instance constitutes the marking signal, and it will therefore be noted that the direction of current flow with respect to the line is the same for the transmission of the marking signal whether the signal originates at station A or station B.

Signals may now be transmitted from station B to station A, and it will be obvious that the switching conditions will be maintained so long as the break key BK at station A is not actuated. If it is desired to restore the conditions to those originally described for transmission from station A to station B, this may be done by actuating the key BK to open the loop L, which will result in energizing the break relay BR and deenergizing the break relay BR′ in a manner similar to that already described. The details of this operation will be clear without further consideration.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a signaling system, a line circuit, terminal stations at each end of said line circuit, each terminal station having transmitting apparatus and receiving apparatus thereat, switching devices at each station for connecting the transmitting apparatus to the line at one station and the receiving apparatus to the line at the second station during non-signaling condition, so that signaling current may be transmitted over the line to one station, means for normally maintaining said connections during times that no signals are being transmitted in either direction, means controlling said switching devices to connect the transmitting apparatus to the line at the second station and the receiving apparatus to the line at the first station in response to the actuation of said transmitting apparatus at said second station to transmit signaling currents to the other station, said means comprising break relays at each station for con-

trolling such switching devices, the break relay at one station being maintained energized by ordinary signaling currents, and the break relay at the other station being deenergized during the transmission of signaling currents.

2. In a signaling system, a line circuit, terminal stations at each end of said line circuit, each terminal station having transmitting apparatus and receiving apparatus thereat, switching devices at each station for connecting the transmitting apparatus to the line at one station and the receiving apparatus to the line at the second station during non-signaling condition, so that signaling current may be transmitted over the line to one station, means for normally maintaining said connections during times that no signals are being transmitted in either direction, means controlling said switching devices to connect the transmitting apparatus to the line at the second station and the receiving apparatus to the line at the first station in response to the actuation of said transmitting apparatus at said second station to transmit signaling currents to the other station, said means comprising break relays at each station for controlling such switching devices, the break relay at one station being maintained energized by ordinary signaling currents, and the break relay at the other station being deenergized during the transmission of signaling currents, and means for energizing the latter break relay and deenergizing the former break relay at will, in order to shift the connections of said switching devices.

3. In a signaling system, a line circuit, terminal stations at each end of said line circuit, each terminal station having transmitting apparatus and receiving apparatus thereat, switching devices at each station for connecting the transmitting apparatus to the line at one station and the receiving apparatus to the line at the second station during nonsignaling condition, so that signaling current may be transmitted over the line to one station, means for normally maintaining said connections during times that no signals are being transmitted in either direction, means controlling said switching devices to connect the transmitting apparatus to the line at the second station and the receiving apparatus to the line at the first station in response to the actuation of said transmitting apparatus at said second station to transmit signaling currents to the other station, said means comprising break relays at each station for controlling said switching devices, each break relay having a plurality of windings, and means for transmitting signaling currents through the windings of one break relay to maintain it energized during the transmission of signals, the windings of the other break relay being deenergized.

4. In a signaling system, a line circuit, terminal stations at each end of said line circuit, each terminal station having transmitting apparatus and receiving apparatus thereat, switching devices at each station for connecting the transmitting apparatus to the line at one station and the receiving apparatus to the line at the second station during non-signaling condition, so that signaling current may be transmitted from the line to one station, means for normally maintaining said connections during times that no signals are being transmitted in either direction, means controlling said switching devices to connect the transmitting apparatus to the line at the second station and the receiving apparatus to the line at the first station in response to the actuation of said transmitting apparatus at said second station to transmit signaling currents to the other station, said means comprising break relays at each station for controlling said switching devices, each break relay having a plurality of windings, means for transmitting signaling currents through the windings of one break relay to maintain it energized during the transmission of signals, the windings of the other break relay being deenergized, and means for energizing the latter relay and deenergizing the former relay at will for changing the connections of said switching devices.

5. In a signaling system, a line circuit, terminal stations at each end of said line circuit, each terminal station having transmitting apparatus and receiving apparatus thereat, switching devices at each station for connecting the transmitting apparatus to the line at one station and the receiving apparatus to the line at the second station, so that signaling currents may be transmitted over the line to one station, said switching devices also functioning to connect the transmitting apparatus to the line at the second station and the receiving apparatus to the line at the first station to transmit signaling currents to the other station, a break relay to each station for controlling said switching devices, each break relay having windings through which signaling currents may be transmitted and an additional winding for initially energizing said relay, and means whereby when one of said break relays has been energized through one of its windings signaling currents may be transmitted through its other windings to maintain its energization while the break relay at the other station will be deenergized.

6. In a signaling system, a line circuit, terminal stations at each end of said line circuit, each terminal station having transmitting apparatus and receiving apparatus thereat, switching devices at each station for connecting the transmitting apparatus to the line at one station and the receiving

apparatus to the line at the second station, so that signaling currents may be transmitted over the line to one station, said switching devices also functioning to connect the transmitting apparatus to the line at the second station and the receiving apparatus to the line at the first station to transmit signaling currents to the other station, a break relay at each station for controlling said switching devices, each break relay having windings through which signaling currents may be transmitted and an additional winding for initially energizing said relay, means whereby when one of said break relays has been energized through one of its windings, signaling currents may be transmitted through its other windings to maintain its energization while the break relay at the other station will be deenergized and means whereby said last mentioned break relay may be initially energized at will through one of its windings to reverse the connections of said switching devices and deenergize said first mentioned relay.

7. In a signaling system, a line circuit, terminal stations at each end of said line circuit, each terminal station having transmitting apparatus and receiving apparatus thereat, switching devices at each station for connecting the transmitting apparatus to the line at one station and the receiving apparatus to the line at the second station, so that signaling currents may be transmitted over the line to one station, said switching devices also functioning to connect the transmitting apparatus to the line at the second station and the receiving apparatus to the line at the first station to transmit signaling currents to the other station, a break relay at each station for controlling said switching devices, each break relay having windings through which signaling currents may be transmitted and an additional winding for initially energizing said relay, means whereby when one of said break relays has been energized through one of its windings signaling currents may be transmitted through its other windings to maintain its energization while the break relay at the other station will be deenergized, and means to energize said last mentioned relay at will through one of its windings to shift the connections of one of said switching devices, thereby connecting one terminal of the line through another winding of said relay to a current source opposing the signaling current transmitted through a winding of the distant break relay, thereby deenergizing the latter and shifting the connections of the other switching devices.

In testimony whereof, I have signed my name to this specification this 19th day of November 1921.

EDWARD F. WATSON.