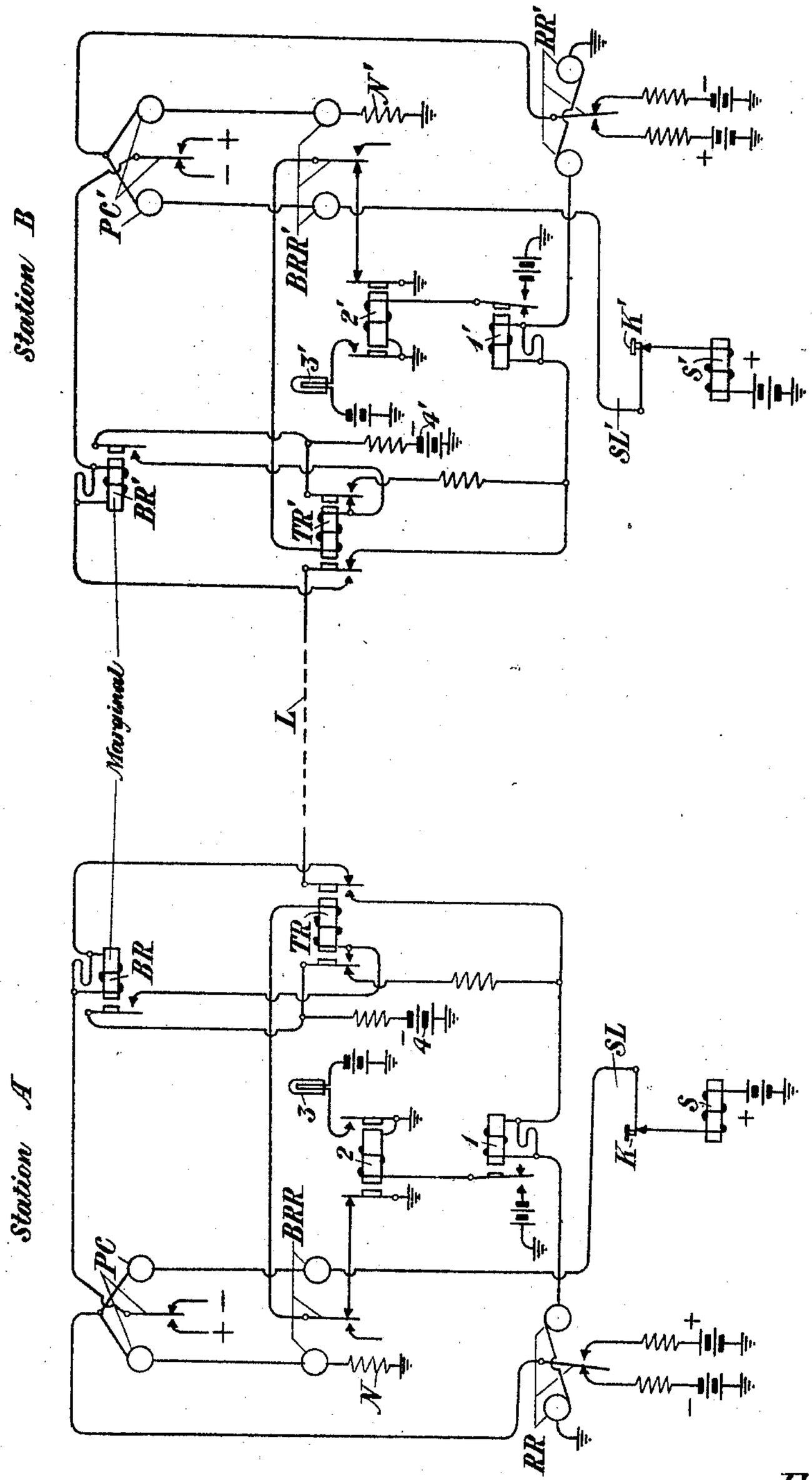
Feb. 9, 1926.

1,572,785

F. H. FOX

TELEGRAPH CIRCUIT

Filed Sept. 27, 1923



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Patented Feb. 9, 1926. 1,572,785

UNITED STATES PATENT OFFICE.

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TELEGRAPH CIRCUIT.

Application filed September 27, 1923. Serial No. 665,174.

To all whom it may concern:

Be it known that I, FRANCIS H. FOX, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain Improvements in Telegraph Circuits, of which the following is a specification.

This invention relates to telegraph circuits and more particularly to improvements in 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.

A two-way polar telegraph system of the above mentioned type is illustrated in detail in the U. S. patent application, Serial No. 516,868, filed November 21, 1921, in the name of E. F. Watson. It has been found in practice that in the repeater sets of circuits of this type that it is possible under certain conditions for the subscriber to be "tied up" and unable to send. This condition may occur when the break relay at the sending station operates falsely from any cause, such as a line swing, and thus causes the operation of the transfer relay at that station. The operation of the transfer relay at the sending station causes ground to be connected to both ends of the line and the current through the windings of the receiving relays to be approximately zero. If at this time the armature of the receiving relay is held against the spacing contact by a spacing earth current or a spacing bias in the relay, the subscriber's loop will be practically short-circuited and it will be impossible for him to send. It is in general the object of the invention to provide arrangements for the purpose of eliminating this possibility of the subscriber being "tied up" or unable to send. In the arrangements of the invention this is accomplished by providing a number of relay arrangements associated with each repeater set, which, when the above described conditions occur, will operate to restore the circuit to a normal condition again. Other objects and features of the invention will appear more fully from the detailed description hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the figure of which is illustrated a circuit diagram of a telegraph system embodying the invention.

Referring to the figure, L 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 SL extends to a subscriber's station at which suitable transmitting and receiving apparatus may be provided, for example, the loop is illustrated as including a sounder S, a key K, and a positive source of potential.

The loop SL at station A is balanced by means of a balancing circuit or resistance N, and the windings of a polar pole changing relay PC and a polar break release relay BRR are included in the loop SL and the balancing circuit N. At the junction point between the loop SL 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 L for transmitting signals to the loop.

A transfer relay TR is so arranged that it may switch the main line L either into connection with the receiving relay RR or into connection with the transmitting apparatus controlled by the armature of the pole changer PC. The connection from the main line L to the armature of the pole changer PC includes the winding of a break relay BR. The break relay BR is a marginal neutral relay so designed that it will be unresponsive to positive or negative currents transmitted over the line in connection with ordinary signaling, but will be responsive to a current of greater amplitude transmitted over the line as the result of a break signal. Associated with the transfer relay TR is a battery 4 and two circuits, one of which is controlled by the armature of the break relay BR for initially energizing the transfer relay and the other of which acts as a locking circuit for the transfer relay and is controlled over the contacts of the break release relay BRR and the contacts of relay 2. Relay 2 controls the signal means 3 and is in turn controlled by a relay 1 connected in series with the receiving relay RR as shown. Relay 1 is adjusted so that on the normal received signals it remains operated as shown. The

purpose of relays 1 and 2 will be pointed out hereinafter.

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 the following description of its operation.

As illustrated the apparatus at stations A and B is in condition for transmitting from station A to station B. Under these conditions, transfer relay TR′ at station B is locked up to connect line L to the receiving relay RR′. At station A the transfer relay TR is deenergized so that the line L is connected to the armature of the pole changer PC. When the transfer relay TR is deenergized, a negative battery 4 is connected from the back left-hand contact of the transfer relay to the winding of the receiving relay RR′ so that the armature of the latter relay is maintained against its negative contact. Under these conditions, when the loop SL is closed, current flows from the positive battery through the sounder windings over the contacts of key K through the loop windings of the break release relay BRR and the pole changer PC and over the contact of the receiving relay RR to negative battery. Current also flows from ground to the balancing resistance N, balancing windings of the break release relay BRR and the 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 left-hand contacts, but owing to the greater pull in the oppoiste direction due to the loop windings of said relays, the armatures are held to their right-hand contacts so that negative battery is connected through the windings of the break relay BR and over the right-hand back contact of the transfer relay to the main line L. The resultant line current flows through the front left-hand contact of the transfer relay TR′ at station B and through the windings of the relay 1′ and 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 SL′ are the same as described at station A so that the armature of the break release relay BRR′ is held against its left-hand contact thereby maintaining a locking circuit through the winding and over the right-hand front contact of the transfer relay TR′.

The conditions just described obtain through the transmission of marking signals. When a spacing signal is to be transmitted, the loop SL will be opened by means of the key K 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. The shifting of the armature of the break release relay is without effect but the armature of the pole changer connects positive battery to the main line L so that the receiving relay RR′ shifts its armature to the positive contact. The positive battery is now connected to both ends of the loop SL′ so that practically no current flows through the loop windings of the pole changer PC′ and the break release relay BRR′. 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 direction as to tend to hold their armatures against their left-hand contacts. Consequently, the shifting of the battery connections by means of the relay RR′ is without effect upon the armature of the pole changer PC′ and the break release relay BRR′. The incoming signal will be recorded by the sounder apparatus S′.

If, while signals are being transmitted from station A, it is desired to transmit signals from station B, the loop circuit SL′ may be opened, as for example, by means of the key K′. As soon as a negative or marking signal is received from station A, negative battery will be connected to the loop over the right-hand contact of the receiving relay RR′. As the loop windings of the pole changer PC′ and break release relay BRR′ are denergized, the balancing windings become effective to shift their armatures to their right-hand contacts. The shifting of the armature of the break release relay BRR′ opens the locking circuit of the transfer relay TR′ which is deenergized so that its right-hand back contact connects negative battery 4′ to the receiving relay RR′ to hold the armature of the latter relay against its negative contact. At its left-hand back contact, transfer relay TR′ connects the line L through the winding of the break relay BR′ to the armature of the pole changer PC′.

The armature of the pole changer is connected to positive battery at station B and it will be remembered that the changes just described occur at the time a marking signal is being transmitted from station A so that negative battery is connected to the line L at the latter station. This results in a current flow of approximately twice the normal amplitude through the windings of the break relay BR′ over the line L and through the

winding of the break relay BR at station A. Both break relays are energized but the energization of the break relay BR′ at station B is without effect to energize the transfer relay TR′ owing to the fact that the circuit of the latter relay is held open at the armature of the break release relay BRR′. Consequently, the transfer relay TR′ at station B remains deenergized. At station A, however, the armature of the break release relay will be upon its right-hand contact owing to the fact that the loop SL is closed, and upon the energization of the break relay BR a circuit is completed from ground over the contact of relay 2, contact of the break release relay BRR, winding of transfer relay TR, contact of break relay BR, to the negative battery 4. The transfer relay TR is energized and at its left-hand contact completes a locking circuit to the battery 4. By means of its right-hand armature, said relay shifts the connection of the line L from control of the pole changer PC into circuit with the receiving relay RR. Signals may now be transmitted from station B to station A in an obvious manner.

If the break relay at the sending station, such as relay BR at station A, should operate falsely from any cause such as a line swing, the transfer relay TR would, as has been seen, be operated. This operation of the transfer relay TR would cause ground to be connected to both ends of the line and the current through the windings of the receiving relays to be approximately zero. If at this time the armature of the receiving relay is held against its spacing or positive contact by a spacing earth current or a spacing bias in the relay the subscriber's loop SL will be practically short-circuited and it will be impossible for him to send. Accordingly the relays 1 and 2 are provided in addition to the usual repeater equipment heretofore described. Relay 1 is in series with the receiving relay RR and is so adjusted that on the normal received signals it remains operated as shown in the drawing. Also, when the station is sending, the relay 1 is held operated by the holding current from battery 4 for the receiving relay RR. Thus in the normal operation of the repeater set the relay 1 is always operated. However, in case the transfer relays at both ends of the line should become operated, connecting ground to both ends of the line, the relay 1 will be released. Relay 1 in releasing will close through its back contact a circuit through relay 2, operating it to open the previously described locking circuit for the transfer relay TR. Relay 2 will also light the signal lamp 3 or some other suitable alarm device. Opening the locking circuit of the transfer relay releases it and places the repeater in the sending position. With the line circuit complete between the two stations, both transfer relays will be released and the sending station will have to first "break" the circuit before continuing to send.

While the arrangements of the invention have been disclosed in certain specific arrangements which are deemed desirable it is understood that they are capable of embodiment in other and widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. In a signaling system, a line circuit, terminal stations at each end of said line circuit, transmitting apparatus and receiving apparatus at each terminal station, a transfer relay at each terminal station, said transfer relays being arranged to connect the transmitting apparatus to the line circuit at one station and the receiving apparatus to the line circuit at the other station for transmission in one direction, said transfer relays being also arranged to shift the connection so that the transmitting apparatus will be connected to the line circuit at the second station and the receiving apparatus to the line circuit at the first station to transmit signaling currents in the opposite direction, locking circuits for said transfer relays, relay means at each station connected in series with the receiving apparatus thereat and means controlled by said relays for opening said locking circuits.

2. In a signaling system, a line circuit, terminal stations at each end of said line circuit, transmitting apparatus and receiving apparatus at each terminal station, a transfer relay at each terminal station, said transfer relays being arranged to connect the transmitting apparatus to the line circuit at one station and the receiving apparatus to the line circuit at the other station for transmission in one direction, said transfer relays being also arranged to shift the connection, so that the transmitting apparatus will be connected to the line circuit at the second station and the receiving apparatus to the line circuit at the first station to transmit signaling currents in the opposite direction, relay means at each station connected in series with the receiving apparatus thereat, and locking circuits for said transfer relays completed over the contacts of said last mentioned relay means.

3. In a signaling system, a line circuit, terminal stations at each end of said line circuit, transmitting apparatus and receiving apparatus at each terminal station, a transfer relay at each terminal station, said transfer relays being arranged to connect the transmitting apparatus to the line circuit at one station and the receiving apparatus to the line circuit at the other station for transmission in one direction, said transfer relays being also arranged to shift the connection, so that the transmitting ap-

paratus will be connected to the line circuit at the second station and the receiving apparatus to the line circuit at the first station to transmit signaling currents in the opposite direction, locking circuits for said transfer relays, means at each station connected in series with the receiving apparatus thereat and responsive when a condition of no current exists through said receiving apparatus for controlling said locking circuits.

4. In a signaling system, a line circuit, terminal stations at each end of said line circuit, transmitting apparatus and receiving apparatus at each terminal station, a transfer relay at each terminal station, said transfer relays being arranged to connect the transmitting apparatus to the line circuit at one station and the receiving apparatus to the line circuit at the other station for transmission in one direction, said transfer relays being also arranged to shift the connection, so that the transmitting apparatus will be connected to the line circuit at the second station and the receiving apparatus to the line circuit at the first station to transmit signaling currents in the opposite direction, locking circuits for said transfer relays, and means at one of said stations associated with the receiving apparatus thereat and responsive to a condition of no current through said receiving apparatus and over said line circuit for controlling the locking circuit for the transfer relay at said station.

5. In a signaling system, a line circuit, terminal stations at each end of said line circuit, transmitting apparatus and receiving apparatus at each terminal station, a transfer relay at each terminal station, said transfer relays being arranged to connect the transmitting apparatus to the line circuit at one station and the receiving apparatus to the line circuit at the other station for transmission in one direction, said transfer relays being also arranged to shift the connection, so that the transmitting apparatus will be connected to the line circuit at the second station and the receiving apparatus to the line circuit at the first station to transmit signaling currents in the opposite direction, locking circuits for said transfer relays, means at one of said stations associated with the receiving apparatus thereat and responsive when a condition of no current exists through said receiving apparatus and over said line circuit for controlling the locking circuit for the transfer relay at said station, and signaling means controlled by said last mentioned means.

In testimony whereof, I have signed my name to this specification this 15th day of September, 1923.

FRANCIS H. FOX.