

Sept. 7, 1943.

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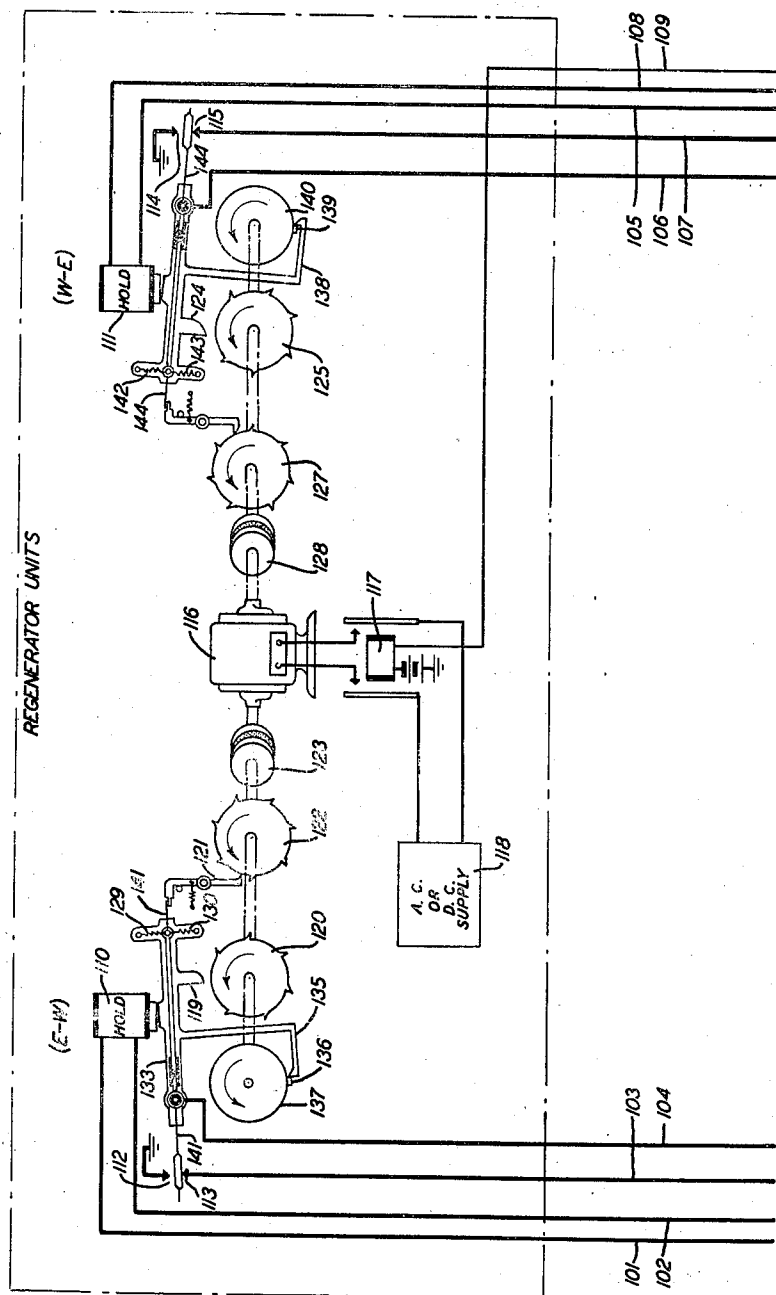
2,328,674

REGENERATIVE REPEATER FOR INVERSE NEUTRAL TELEGRAPH SYSTEMS

Filed June 28, 1941

2 Sheets-Sheet 1.

FIG. 1



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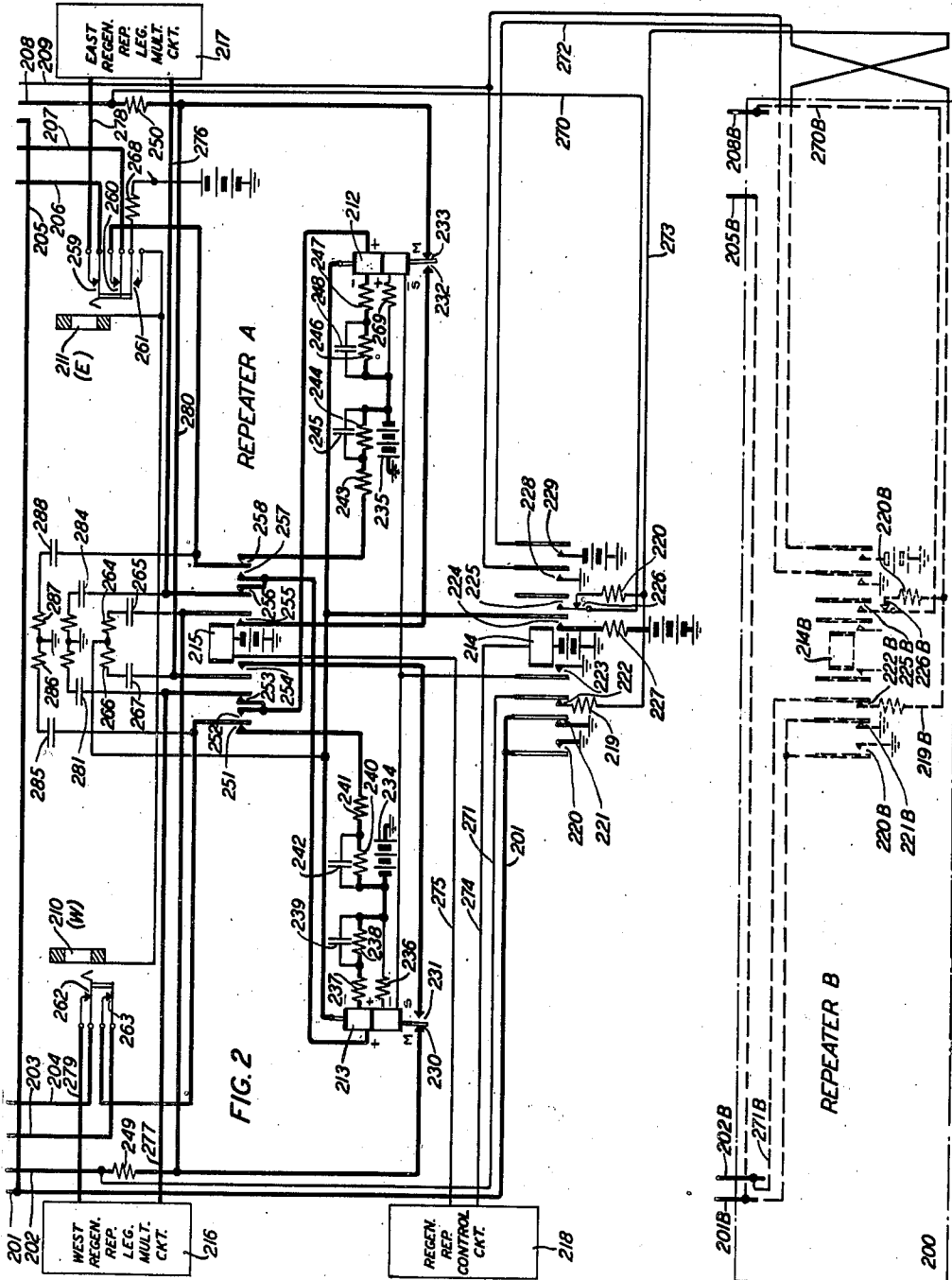
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REGENERATIVE REPEATER FOR INVERSE
NEUTRAL TELEGRAPH SYSTEMSWilton T. Rea, Bayside, N. Y., assignor to Bell
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10 Claims. (Cl. 178—71)

This invention pertains to telegraph systems of the start-stop type in which code signals are repeated from line section to line section and more particularly to an improved regenerative repeater circuit for start-stop telegraph systems.

An object of the present invention is to provide a regenerative repeater circuit arranged to function in inverse neutral repeater systems.

Another object of the present invention is to provide a regenerative repeater circuit capable of functioning in inverse neutral repeater systems which circuit includes facilities enabling it to function either on a half duplex basis or on a full duplex basis at different times.

Neutral signals are closed-circuit and open-circuit signals or current and no-current signals. Ordinarily when neutral signals are employed, the closed circuit condition or current condition is the marking condition and the open-circuit condition or no-current condition is the spacing condition. The signals herein are neutral signals in that they are current and no current signals but the marking signal is a no-current signal and the spacing signal is a current signal. They are inverted from the usual neutral signals, hence the term inverse neutral. For the marking condition, in the case of the inverse neutral repeaters described herein, the conductors interconnecting repeaters arranged for inverse neutral operation are terminated in battery of the same polarity and magnitude. Hence no current flows for the marking condition. For the spacing condition, ground is connected to one end of the conductor by the repeater which is sending and current flows in the conductor.

Inverse neutral repeater circuits are well known in the art. They are described in Patent 2,056,277 to F. S. Kinkead, et al., October 3, 1936, Patent 2,069,224 to G. C. Cummings, February 2, 1937, and Patent 2,069,251 to F. S. Kinkead, February 2, 1937.

The circuit herein includes a regenerative repeating mechanism well known in the art. It is described in detail in Patent 2,105,173 to Walter J. Zenner, et al., January 11, 1938. In the present invention Zenner's regenerative repeater mechanism is disposed in a new regenerative repeater circuit, which circuit is designed to produce regenerated inverse neutral signals and which provides new and improved protection against the mutilation of a break signal. The circuit is arranged also so that it will function on either a half duplex basis or on a full duplex basis at different times.

A feature of the present invention is a regen-

erative repeater circuit which produces regenerated inverse neutral telegraph signals.

A further feature of the invention is a regenerative repeater circuit including a switching arrangement which permits the circuit to function at one time on a half duplex basis and at another time on a full duplex basis.

A further feature of the invention is an arrangement which provides for repeating break signals or other long spacing signals while the circuit is arranged to function on a half duplex basis.

A further feature of the invention is an arrangement which prevents the mutilation of a break signal as a result of the faulty operation of one of the repeating relays.

A further feature of the invention is an arrangement for holding an idle repeater in the stop position, when an associated repeater using the same driving motor is in use.

A further feature of the invention is an arrangement which provides remote control of the repeater battery supply from the associated regenerative repeater multiple circuit.

A further feature of the invention is an arrangement which provides for remote control of the conversion between half duplex and full duplex operation.

These and other features will become apparent from the following description when read with reference to the associated drawings, in which:

Fig. 1 is a circuit schematic representation of two regenerative repeater mechanisms driven by a single motor. The regenerative repeater mechanism is described in detail in Patent 2,105,173 mentioned above. The figure shows also the manner in which these mechanisms are interconnected to the repeating relay circuit of Fig. 2; and

Fig. 2 is a regenerative repeater relay circuit arranged to cooperate with Fig. 1 to regenerate inverse neutral telegraph signals.

Numbering arrangement

The apparatus and wiring shown in Fig. 1 is numbered for purposes of identification, in the one hundred series. The apparatus and wiring per Fig. 2 is numbered in the two hundred series. The conductors shown extending to the bottom of Fig. 1 connect to conductors extending to the top of Fig. 2 in corresponding positions. A conductor, say in Fig. 1, numbered in the one hundred series, when extended into Fig. 2, will be numbered in the two hundred series, but the last

two digits of the number identifying the conductor will be the same in each figure.

Regenerative repeater mechanism

The regenerative repeater mechanism employed in the inverse neutral regenerative repeater circuit of this invention is, as mentioned above, described in detail in Patent 2,105,173. Since it is well known in the art, the principles of its operation only will be described herein, as a detailed knowledge of the mechanism is not necessary to an understanding of the present invention.

The regenerative mechanism is of the start-stop type. It is designed to function in a teleprinter system wherein each different character or function transmitted is identified by a different combination of signal elements arranged in a train. Each train is of uniform length and comprises a start or spacing signal pulse, five pulses which may be marking or spacing signal pulses in different combinations to designate the character or the function and a stop pulse which is always a marking signal. The regenerating mechanism retimes the pulses which have become distorted by their passage over the transmission circuit and restores them to their original lengths.

The regenerative unit is motor driven by a synchronous or direct current speed controlled motor. Each motor, in a practical installation, is arranged to drive a number, such as four or more, regenerative units, only two of which are indicated in Fig. 1. The regenerators may be coupled to the countershaft of the motor in any convenient manner. The two regenerative units indicated are each shown coupled directly to the motor countershaft by means of a friction clutch, such as 123 or 128, which is part of each regenerative unit. When four or more regenerative units are driven by one motor, the driving shaft of each unit is geared directly to the countershaft of the motor. The driving shaft of each unit rotates as the motor countershaft rotates. The driven shaft of each regenerative unit is prevented from rotating by means of a stop arm such as 135 on each unit, which engages a raised surface 136 on the periphery of a stop cam 137 when the driven mechanism of the unit is in the stop position. In the stop position magnet 110 is always energized. The armature 133 is raised and the stop arm 135 is interposed in the path of raised surface 136. For the start impulse armature 110 is always deenergized. The armature and stop arm 135 are lowered. The driven shaft makes one complete revolution before the raised surface again reengages stop arm 135 to stop rotation of the shaft.

Although the motor countershaft, as shall be shown, is rotated continuously and rotates the driving shaft of each unit associated with the motor, when any of the units is operated, the driven mechanisms of the regenerative units are operated individually. The arrangement herein includes means in the relay circuit, as shall be shown, which insures that, when any one of the regenerative units is to be operated and other units associated with the same motor are not to be operated, the units which are not to be operated are conditioned, by the relay circuit associated with the operated unit, so that their driven mechanisms are prevented from rotating.

The cam assembly of the regenerative unit, say the left-hand unit, comprises a cam 120 and follower 119. The follower 119 is integral with

the armature 133. Each time the cam 120 is rotated, it actuates the follower 119 six times, presenting the armature 133 to the magnet 110 six times, namely once at the middle of the interval for each of the five selecting pulses and once during the stop pulse. Whenever the magnet 110 is energized when armature 133 is presented to it, the armature will be retained in its attracted or upper position. Whenever the magnet 110 is deenergized when armature 133 is presented to it, the armature will not be retained in its upper position after the projection on cam 120, which has raised it, has moved forward, but the armature will be withdrawn into its lower position, under the influence of a spring, not shown.

The cam assembly comprises also a locking cam 122, which momentarily actuates a follower 121 to unlock the sending reed 141 an instant after the middle of each pulse. The sending reed is pivoted on the same shaft as the armature and is flexibly connected to the right-hand bifurcated end of the armature by a pair of centralizing springs 129 and 130. The sending reed tends to follow the motion of the armature, due to the tensioning of spring 129 if the armature has moved up or of spring 130 if the armature has moved down. The sending reed is locked, however, by a latching arrangement on the end of follower 121 for an interval until the armature has assumed its proper position, either raised or lowered, for a particular pulse. The cam 122 thereupon actuates the follower 121 to unlatch the sending reed for an instant to permit the sending reed to follow the armature, if the final position of the armature for the particular pulse is different from its final position for the previous pulse. Then the follower is instantly restored locking the reed in either the raised or lowered position, where it is maintained for an interval equal to the length of a pulse. Contacts 112 or 113 are closed dependent upon the position assumed by the reed.

From the above it should be apparent that each pulse is, in effect, stored for approximately one-half pulse length and is then transmitted either as a marking pulse or as a spacing pulse depending upon whether or not the holding magnet 110 was energized or deenergized. The timing of the retransmitted pulses is determined exclusively by the locking cam 122 whose projections are so spaced as to operate the locking latch 121 at intervals a unit pulse length apart. Hence the transmission times of the retransmitted signals are correct.

Repeater circuit

The repeater relay circuit per Fig. 2 employs two polar relays 212 and 213, one for each direction of transmission. Each relay receives signals from an inverse neutral transmission circuit through a leg multiple circuit, indicated by rectangles 216 and 217. Each of the polar relays in turn operates its associated regenerative unit holding magnet such as 111 or 110. The regenerative unit in turn transmits regenerated signals to a distant inverse neutral circuit through its corresponding leg multiple circuit.

Conditioning the circuit for operation

In order to condition the regenerative repeater circuit herein for operation, current is supplied from the regenerative repeater control circuit 218 to conductor 274, closing a circuit through the winding of relay 214 to battery, oper-

ating relay 214. The operation of relay 214 applies positive 130-volt telegraph battery and negative 24-volt signal battery as well as signal and telegraph grounds to the repeater. The circuits for this will now be traced.

The operation of relay 214 closes a circuit which may be traced from ground through contacts 223, conductor 209, conductor 109 and the winding of relay 117 to battery, operating relay 117. The operation of relay 117 closes a circuit from a source of potential through the left and right-hand contacts of relay 117 to the motor 116, starting the motor.

The operation of relay 214 also establishes a circuit, which may be traced from ground, through contact 223 to two parallel branches. One branch extends through the bottom winding of relay 212, resistance 239 and battery 235 to ground. The other branch extends through the bottom winding of relay 213, resistance 235, and battery 234 to ground. The effect of current flowing through the bottom winding of relay 212 and through the bottom winding of relay 213 tends to actuate the armature of relay 212 and the armature of relay 213 to engage with their respective marking contacts 233 and 230. During the marking conditions for relays 212 and 213, as will be shown below, negative batteries of equal potentials are connected to the opposite ends of the circuits which extend through their top windings, so that no current flows through the top winding of either of these relays for the marking condition. For the marking condition, therefore, the armature of relay 212 is held in engagement with its marking contact 233 and the armature of relay 213 is held in engagement with its marking contact 230.

The operation of relay 214 establishes also a circuit from telegraph battery, through resistance 227 and contacts 224 to two parallel branches. One of said branches extends through contacts 233 of relay 212, resistance 250, conductor 208, conductor 109, winding of holding magnet 111, conductor 105, conductor 205, conductor 201 and contacts 220 to telegraph ground, energizing the winding of the holding magnet 111. The second branch extends through contacts 230 of relay 213, resistance 249, conductor 202, conductor 102, winding of holding magnet 110 of the left-hand regenerative unit, conductor 101, conductor 201 and contacts 220 to telegraph ground.

For this condition, when holding magnet 110 is energized its associated armature 133 will be retained in the elevated position. Stop latch 135 will engage the raised surface 136 on the periphery of cam 137. This will prevent the rotation of the driven shaft of the regenerator unit and of the cams mounted thereon. It will be understood from the above, that the energizing of holding magnet 111 will similarly prevent the rotation of the driven shaft of the right-hand regenerative unit under this condition.

As described above motor 116 drives a number of regenerative units such as four or more. It is desirable that the driven shaft of regenerative units, which are not at the moment in use, be prevented from rotation, even though the motor such as 116 be started when any of the regenerative units to which the motor 116 is coupled is put into service, through the operation of a relay such as 214 on a particular repeater relay panel. This prevents unnecessary wear of the regenerative unit parts. The circuit herein is arranged so as to include this feature. The man-

ner in which this is performed will now be described.

When relay 214 is operated a circuit is established which may be traced from battery through contacts 229 and conductor 272 into repeater B where it connects to two parallel branches. It should be pointed out that repeater A and repeater B are identical in every respect. For this reason only a portion of repeater B is shown. This portion is adequate to disclose the manner in which the rotation of the driven mechanism of repeater B is prevented when repeater A is in use and repeater B is not in use. Apparatus in repeater B corresponding to apparatus in repeater A bears the same number as the corresponding apparatus in repeater A and bears also the letter B, which is added to the number. From conductor 272 one branch of the parallel circuit extends through resistance 220B, contacts 226B and conductor 270B to conductor 208B. From this point the circuit continues through a path in repeater B corresponding to that traced through holding magnet 111 in repeater A and returns to signal ground through contacts 221B. The other branch of the parallel circuit extends from conductor 272 through resistance 219B, contacts 222B, and conductor 271B to conductor 202B. From this point the path extends in repeater B through a path which corresponds to the path heretofore traced in repeater A through the holding magnet 110 and returns through contacts 221B to signal ground. Thus the holding magnets in repeater B corresponding to holding magnets 111 and 110 in repeater A are energized, whenever repeater A is conditioned for service and repeater B is to remain idle, to prevent the rotation of the driven mechanism in the regenerative units of repeater B.

Attention is especially called to the fact that the holding path, which maintains the holding magnets of a regenerative repeater energized to prevent motion of the associated cam mechanism when the repeater is idle, extends through contacts of relay 114 of the same repeater, which contacts are closed only when the relay 114 is released. Relay 114 for any regenerator is always operated when the regenerator is in use. Thus the holding path is always open for such condition and there can be no interference at any time.

Duplex control

As stated above the regenerative repeater circuit herein is arranged so that it may be conditioned to function either on a full duplex basis or on a half duplex basis. In the normal condition, with relay 215 released, as shown, the circuit is conditioned to function on a full duplex basis. By energizing relay 215 the circuit is conditioned to function on a half duplex basis. Relay 215 is arranged to function under control of the regenerative repeater control circuit 218 indicated by a rectangle. When it is desired to condition the circuit for half duplex operation, the operator at the switchboard, to which control circuit 218 is connected, will perform a switching operation which results in the connection of ground to conductor number 275 and the circuit is closed through the winding of relay 215 to battery, operating relay 215.

Half duplex operation

The manner in which the regenerative circuit herein functions on half duplex operation will now be described in detail.

It will be assumed that transmission is from east to west, that is to say, an inverse neutral circuit (not shown) connected through the east regenerative repeater leg multiple circuit 217 is transmitting toward an inverse neutral circuit (not shown) connected through the west regenerative repeater leg multiple circuit 216. Under this condition, with relay 215 operated, conductor 276 is disconnected from the regenerative repeater circuit at contacts 256 of relay 215 and conductor 277 is also disconnected from the regenerative repeater circuit at contacts 253 of relay 215, as these conductors play no part in the operation of the circuit when it is conditioned for half duplex operation. Conductor 278 extends through the east regenerative leg multiple circuit 217 to a circuit (not shown) arranged to transmit inverse neutral signals. For the marking condition, negative battery is connected to conductor 278 and a circuit may be traced through contacts 259 of jack 211, conductor 206, conductor 106, sending reed 144, contacts 115, conductor 107, conductor 207, contacts 260 of jack 211, contacts 257 of relay 215, top winding of relay 213, resistance 237 and resistance 233 to negative battery 234. The potential of negative battery 234 is equal to the potential of the negative battery connected to the distant end of conductor 278. Under these conditions no current flows through the top winding of relay 213. The current flowing through the bottom winding of relay 213 is therefore effective to actuate the armature of relay 213 so that it engages with its marking contact 230. With the armature of relay 213 in engagement with contact 230, the winding of holding magnet 110 of the left-hand regenerative unit is energized as described above. The first or start signal in any train received from the distant circuit connected to conductor 278 will result in ground being connected at the distant station to conductor 278. As a consequence, current of a magnitude sufficient so that its effect preponderates over the effect of current flowing through the bottom winding of relay 213, will flow through the top winding of relay 213. Its effect opposes the effect of current through the bottom winding and the armature of relay 213 is actuated so as to engage with its right-hand or spacing contact 231. This opens the path through the winding of the holding magnet 110.

When the holding magnet 110 is energized, the transmission path extending from the repeater circuit herein through the west regenerative repeater leg multiple circuit 216 toward the west is closed. This circuit may be traced from negative battery 235 through resistance 246, resistance 247, top winding of relay 212, contacts 252 of relay 215, contacts 263 of jack 210, conductor 203, conductor 103, marking contacts 113 of the left-hand regenerative unit, sending reed 141, conductor 104, conductor 204, contacts 262 of jack 210, conductor 279, and through the west regenerative repeater leg multiple circuit 216 toward the west, where it is terminated in negative battery of the same potential as the potential of battery 235. This results in a marking signal being received at the distant station. When contacts 112 of the left-hand regenerative unit are closed, in response to a spacing signal from the east, a circuit is established from ground through contacts 112, sending reed 141, conductor 104, conductor 204, contacts 262 of jack 210, and conductor 279 toward the west, resulting in a spacing signal being sent to the distant station. At

this time the opening of contacts 113 disassociates the upper winding of relay 212 from lead 279 and thus the spacing signal transmitted to the west does not reflect back into relay 212.

From the above it may be seen that, in transmitting from east to west, relay 213 follows the signals received from the east. Relay 213 in turn controls holding magnet 110 of the left-hand regenerative unit. As the left-hand regenerative unit is operated, the circuit to the west is either connected to negative battery 235, when contacts 113 are closed, or is connected to ground when contacts 112 are closed. Thus inverse neutral signals are transmitted, through the repeater herein from the east towards the west.

In transmitting from west to east, the signals are received by relay 212, which in turn controls the holding magnet 111 of the right-hand regenerative unit. When contacts 115 of the unit are closed, negative battery 234 is connected to the transmission conductor extending toward the east. When contacts 114 are closed ground is connected to the transmission conductor extending to the east.

Transmitting a break signal

The circuit herein is arranged in such manner that, while it is conditioned for half duplex operation, a break signal may be transmitted from the end of the circuit which is momentarily receiving, in order to stop transmission from the opposite end. The manner in which this is performed is as follows:

It will be assumed that the western circuit is transmitting toward the eastern circuit and that the eastern circuit breaks. In order to do this a long spacing signal is transmitted from the east. Ground is thereupon connected to conductor 278. If holding magnet 111 is energized and contacts 115 are closed as a result of a marking signal transmitted from the west, when the distant end of conductor 278 is grounded, contacts 231 of relay 213 will be closed immediately. If not, contacts 231 will be closed when contacts 115 are closed in response to the next marking signal. Under this condition contacts 233 of relay 212 which receives signals from the west are short-circuited, to maintain holding magnet 111 energized, thus maintaining contacts 115 closed, to prevent further transmission from the west toward the east. The short-circuiting path around contacts 233 may be traced from the right-hand or marking contact of relay 212, through conductor 280, contacts 254 of relay 215 and contacts 231 of relay 213 to the junction of the connection with the armature of relay 212 and the path which extends through contacts 224 of relay 214 and resistance 227 to battery. While the circuit to the east remains in the spacing condition, ground will remain connected to conductor 278. Contacts 231 of relay 213 will remain closed and the marking contacts 233 of relay 212 will remain short-circuited. Holding magnet 111 of the right-hand regenerative unit will remain energized. Holding magnet 110 of the left-hand regenerative unit will remain deenergized. Ground will remain connected to sending reed 141 and a continuous spacing signal will be transmitted toward the circuit to the west as a break signal.

The circuit is arranged correspondingly so that a break signal may be transmitted from the west toward the east. This operation will not be described in detail as it should be obvious from

reference to the drawings and the foregoing description.

Full duplex operation

In order to transmit in both directions simultaneously the operator at the switchboard, where the regenerative repeater control circuit 218 is located, will open conductor 275 releasing relay 215. In full duplex operation conductors 276 and 278 extending toward the east are both required and the corresponding conductors 277 and 279 extending toward the west are both required.

It is pointed out that by full duplex operation of inverse neutral circuits is meant, not simultaneously two-way operation over a single conductor, as such operation is not possible in inverse neutral circuits. In order to transmit in two directions simultaneously, an independent circuit in each direction is required. It is to be understood therefore that the term, full duplex, as applied to inverse neutral circuits, means simultaneous two-way transmission over two independent transmission paths and not simultaneous two-way transmission over a single path.

The manner in which signals are transmitted from the east to the west will first be described.

For the marking condition negative battery is connected to conductor 276 and a circuit may be traced through contacts 256 of relay 215, top winding of relay 213, resistance 237 and resistance 238 to negative battery 234. The batteries are of equal potential. The armature of relay 213 is actuated under the influence of current through the bottom winding of relay 213 so as to close contacts 230. This energizes holding magnet 110 closing contacts 113 and results in the transmission of a marking signal toward the west over conductor 279. The circuit for this may be traced from negative battery 234 through resistances 240 and 241, contacts 251 of relay 215, contacts 263 of jack 210, conductor 283, conductor 103, contacts 113, sending reed 141, conductor 104, conductor 204, contacts 262 of jack 210 and conductor 279 toward the distant western station, where the circuit is terminated in negative battery of the same potential as battery 234.

Ground is connected to conductor 276 for the spacing condition. The armature of relay 213 is actuated so as to engage with contacts 231. The winding of holding magnet 110 is deenergized and contacts 112 are closed. This grounds conductor 279 and a spacing signal is transmitted to the distant western station.

In transmitting from the west toward the east for the marking condition negative battery is connected to conductor 277 and the circuit may be traced through contacts 253 of relay 215, top winding of relay 212, resistance 247 and resistance 246 to negative battery 235. The armature of relay 212 engages contacts 233 for this condition. Holding magnet 111 is energized. For the spacing condition ground is connected to conductor 277. The armature of relay 212 is actuated so as to engage its contacts 232. This deenergizes holding magnet 111. Contacts 115 and 114 are closed and opened alternately to transmit marking and spacing signals toward the east over conductor 278.

Miscellaneous apparatus

Condensers 239, 242, 245 and 248 are wave-shaping condensers. The resistance-condenser networks 264, 265, 266 and 267 connected across the contacts of the polar relays serve, not only to protect the contacts, but also to shape the

wave form of the operating current for the regenerative unit holding magnets.

The resistance-condenser networks 281, 282, 283, 284, 285, 286, 287 and 288 bridged from leads 276, 277, 278 and 279 to ground serve to so shape the signal wave on these leads as to compensate for the travel time of the contacts which transmit signals over these leads.

Jacks 210 and 211 are used for connecting an ionic tube orientation testing indicator circuit to the regenerative repeater circuit. This circuit is described in Patent 2,242,324 to W. T. Rea, May 20, 1941.

What is claimed is:

1. In a telegraph system, a regenerative repeater circuit, a polar receiving relay in said circuit, a biasing winding, a transmission line winding, an armature and a pair of opposed marking and spacing contacts all on said relay, local circuit means in said repeater circuit for applying a constant and continuous force through said biasing winding on said armature to direct said armature toward said marking contact, means for connecting batteries of equal magnitudes and of the same potentials to opposite ends of said line winding at a first time, means for connecting ground to the distant end of said line winding to actuate said armature to engage with said spacing contact at a second time, a motor-driven cam mechanism in said circuit, means also in said circuit responsive to said relay for controlling said mechanism, and means responsive to the operation of said mechanism for regenerating and retransmitting improved inverse neutral signals as impaired signals are received by said relay.

2. In a telegraph system in combination, an electromechanical telegraph signal receiving and retransmitting mechanism, means in said mechanism for storing a telegraph signal for an interval substantially equal to the length of one-half of said signal, circuit means connected to said mechanism for receiving inverse neutral telegraph signals and circuit means also connected to said mechanism for retransmitting regenerated inverse neutral telegraph signals.

3. A telegraph system in accordance with claim 2 including remote control switching means for arranging said system to transmit in either of two directions alternately during a first period and including also remote control switching means for arranging said system to transmit in each of two directions simultaneously during a second period.

4. A system in accordance with claim 2 including remote control means for energizing said mechanism.

5. A system in accordance with claim 2 including remote control means for energizing both of said circuit means.

6. A system in accordance with claim 2 including remote control means for energizing said mechanism and remote control means for energizing both of said circuit means.

7. A system in accordance with claim 2 including remote control switching means for conditioning said system for alternate one-way or simultaneous two-way transmission and including also other remote control means for energizing said mechanism.

8. In a telegraph system, a regenerative repeater mechanism of the start-stop type, a relay circuit cooperating with said mechanism, a first and a second polar telegraph signal receiving relay in said circuit, an armature and a pair of opposed contacts on each of said relays, means in

said circuit for permitting a distant connected station which is receiving to break a distant connected station which is sending, and means for short-circuiting the armature and one of said contacts on the relay which has been receiving to insure a positive break.

9. In a telegraph system, a regenerative repeater, a telegraph line connected to said repeater, a telegraph signal receiving relay in said repeater, an armature and a contact on said relay, 10 and means for short-circuiting said armature and

said contact in response to a change in the direction of transmission of telegraph signals through said line.

10. In a telegraph repeater, a telegraph receiving relay, an armature and a contact thereon, a telegraph line connected to said relay, and means for short-circuiting said armature and said contact in response to a change in the direction of the transmission of telegraph signals through said line.

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