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MULTIWAY REGENERATIVE REPEATER

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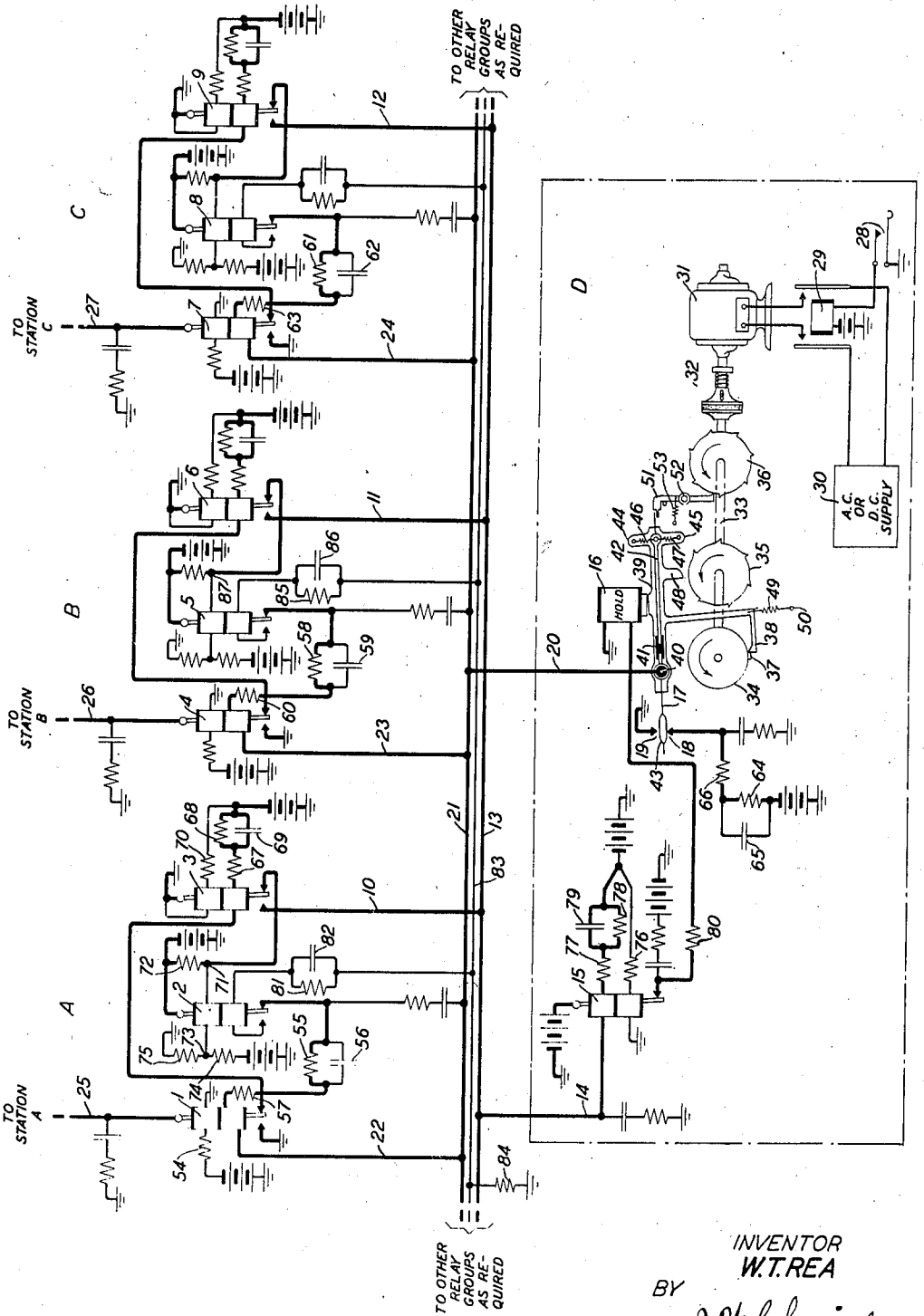

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MULTIWAY REGENERATIVE REPEATER

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This invention relates to telegraph systems and particularly to an improved multiway regenerative repeater for use in reshaping distorted signals in telegraph systems wherein a group of telegraph lines each equipped with an individual repeater are interconnected through a common neutral point and in which any one of the lines so interconnected may transmit signals which are repeated to all other lines connected to the common point or hub of the concentration, as it is known. The single regenerative repeater is arranged so that it is common to the interconnected group. It receives signals transmitted by any repeater connected to any line forming a branch of the hub and reshapes them, before they are transmitted to the other hub branches. The invention herein is an improvement in such a system. The improvement is designed to permit of faster operation of such a system without impairment of any of the signal elements.

An object of this invention is the improvement of telegraph systems which include regenerative repeaters.

A more particular object of this invention is the improvement of telegraph systems in which a group of lines is interconnected to form branches radiating from a common point and in which a regenerative repeater is employed to reshape signals transmitted through the common point.

A feature of this invention is the connection of the branches of telegraph repeater circuits, forming a hub circuit, to a regenerative repeater circuit in such a manner as to reduce the inductance in the branches of the hub, to minimize distortion due to the interconnections.

A further feature of this invention is the inclusion of means in a telegraph repeater hub circuit arrangement to prevent the possible mutilation of the first element of a signal transmitted by a regenerative repeater.

A further feature of this invention is an arrangement in which a group of circuits are interconnected into a common hub all served by a single one-way regenerative repeater and in which regenerated signals are prevented from being transmitted back over the line which is transmitting them to the regenerative repeater.

A further feature of this invention is an arrangement which prevents the mutilation of the first element of a signal train transmitted through the hub to the station which has last transmitted through the hub, when a new station starts to transmit.

A further feature of this invention is a fast operating releasing device for a holding relay.

The manner in which the invention herein operates may be understood from the following description when read with reference to the associated drawing which shows the drop side of three lines A, B, and C each incoming from individual inverse neutral repeaters to a single one-way inverse neutral regenerative repeater and associated mechanisms enclosed within the rectangle D. Although only three lines are indicated as interconnected to one regenerative repeater, it is to be understood that there is no limit to the number of lines which the single one-way regenerative unit will serve.

General Description

It will be observed that associated individually with each of the lines A, B, and C are three relays. Relays 1, 2, and 3 are associated with line A. Relays 4, 5, and 6 are associated with line B and relays 7, 8 and 9 are associated with line C. Relay 3 is the receiving relay for line A. It receives trains of signals incoming from the distant A station over the conductor 25. Each train comprises seven elements, namely a starting element which is always a spacing signal, five character determining elements, each of which may be either marking or spacing depending upon the particular character, and a stop element which is always a marking signal. Relay 3 retransmits these signals into the regenerative repeater mechanism D.

Here the signals are regenerated. That is to say, the signals are restored to their proper length, as originally transmitted, by an electromechanical timing mechanism well known in the art. The changing of the signals back to their original length as transmitted from the distant station connected to line A involves storing the received signal elements in the regenerating mechanism for a short interval, equal to about half the length of each element, while the nature of each character forming element is definitely determined. Then each element is retransmitted by what may be generally characterized as a motor-driven electromechanical interrupter which transmits signal element of proper length.

The retimed signals are then transmitted simultaneously into lines B and C where they operate a sending relay in each line, relay 4 in line B and relay 7 in line C. These relays simultaneously transmit the retimed signals to their associated lines.

Each of the three lines A, B and C must be connected into the regenerative repeater so that

signals coming in from that particular line may be retimed or regenerated. Thus lines A, B, and C are connected in parallel by means of conductors 10, 11, and 12, respectively to a common conductor 13 which is extended by means of conductor 14 to the winding of relay 15, which in turn controls hold magnet 16 of the one-way regenerative repeater unit D. The regenerative repeater unit D must be connected to the respective sending relay of each of the individual groups of relays associated with each line, so that it may transmit regenerated signals to each line. Thus the sending reed 17 of the regenerative repeater, which is operated by the interrupting mechanism between its marking and spacing contacts 18 and 19 respectively is connected by means of conductor 20 to a common conductor 21. From the common conductor 21 a sending branch, individual for each line, extends into the relay group associated with each line and through the winding of the sending relay in each group. Conductors 22, 23 and 24 are the transmitting conductors for lines A, B, and C respectively. Each controls the sending relay for the particular line, namely relay 1, 4, and 7 respectively.

One of the features incorporated into the circuit herein is an arrangement for preventing the regenerated signal from being retransmitted back over the same line from which it has been received. It was explained above that the signal elements are stored in the regenerative repeater D for an interval equal to about half the length of a pulse. Then they are retransmitted to the connected lines. The sending relay of the line which is at the moment transmitting signals into the regenerative repeater for regeneration and transmission to the other lines forming the group associated with the particular regenerator is disabled in the circuit herein, so that it cannot retransmit the same signals back to the originating line after they have been regenerated. Thus, while signals are incoming over line A, the receiving relay, relay 3, associated with line A receives the signals and transmits them into the regenerative unit D. Before the regenerated signals are retransmitted from regenerator D, the sending relay, relay 1, associated with line A is disabled so that it cannot transmit back to station A. The regenerated signals from the regenerative repeater D therefore operate only sending relay 4 associated with line B and sending relay 7 associated with line C.

In order to perform the function described in the foregoing paragraph, a relay, called a holding relay, is included in each line group. These are relays 2, 5, and 8 in line relay groups A, B, and C respectively. These relays operate to disable the associate sending relay in the group to prevent the retransmission of regenerated signals back over a line from which the original distorted signals are being received. They also function to condition the circuit so that any line in the group which has been receiving may break in and start to send. Under this condition the disabled sending relay in the relay group associated with the line which was formerly transmitting to the other lines in a group is reconditioned so that it will thereafter receive regenerated signals from the regenerative repeater and retransmit them to its associated line.

It is particularly pointed out that, as described above, when signals are incoming from a station such as station A, they are received and repeated by the receiving relay 3 into the regenerator D During the interval while this condition prevails sending relay 1 is prevented from operating to retransmit the signals back to station A after they have been regenerated by regenerator D. This is performed by means of the holding relay 2 which locks in the operated condition when the first signal is received by relay 3 and opens the transmitting path from the regenerator which extends through conductor 22 and the bottom winding of relay 1 at the right-hand contact of relay 2. Once relay 2 operates it locks and remains locked throughout at least the interval that signals are being received from station A. Relay 2 remains locked and relay 1 remains disabled until some other station in the group, such as B or C, which has been receiving from station A wishes to transmit. If station B transmits, its relay 6 will receive. Its relay 5 will lock. Its relay 4 will be disabled. There is one other function to be performed, however. The relays associated with line A must be conditioned so that signals incoming from station B will be transmitted after regeneration by regenerator D to station A. But relay 1 is disabled by relay 2 which is locked. Relay 2 is unlocked to re-enable relay 1 when relay 5 is locked in response to the first signal incoming from station B.

The time available for the performance of this function is short. The first element of the first train of signals is transmitted into the regenerator D from the contacts of relay 6 as soon as relay 6 operates. An instant later the regenerated signal is being retransmitted from regenerator D through conductors 22, 23, and 24. During the interval relay 4 must be disabled and relay 1 must be enabled. In order to enable relay 1, relay 2 must be unlocked.

The invention herein includes a novel and exceedingly fast means for accomplishing this to insure the proper transmission of the first element of the first signal train to the station which has last transmitted, when one of the stations which has been receiving starts to transmit. This feature will be explained in detail below.

The circuit of the invention is arranged also, so that in the switching apparatus employed to enable the circuit to perform the above functions, the inductive relay windings introduced into the various transmission conductors are the absolute minimum, so that distortion due to them is kept to a minimum.

Detailed Description

Regenerative unit

The one-way regenerative unit D employed in this circuit is well known in the art. It is described in detail in Patent 2,105,173, W. J. Zenner, January 11, 1938. It will be described herein only in so far as it is necessary to an understanding of the present invention.

In order to condition unit D for operation, a switch 28 is operated which energizes relay 29 over an obvious circuit, operating relay 29. Relay 29 operated supplies power from source 30 to the teletypewriter motor 31 which thereafter rotates continuously. The motor driving shaft and the regenerator unit driven shaft 33 are coupled together by means of a friction clutch 32 of the well-known type. Mounted on and rigidly secured to driven shaft 33 are the three cam discs 34, 35, and 36. The driven shaft is prevented from rotation by means of a raised surface 37 on the periphery of stop cam 34 which engages an end of the J-shaped stop arm 38, depending from and integral with armature 39, which armature

is conditioned to rotate in a limited arc about shaft 40.

If magnet 16 is energized when armature 39 is presented to it, the armature remains elevated against the tension of spring 49 secured at one end to the stop arm 38 and at the other end to a fixed pin 50. Stop arm 38 engages raised surfaces 37 in the stop position as indicated and rotation of driven shaft 33 and the cam discs 34, 35, and 36, securely mounted thereon, is prevented.

The sending reed 17 is secured by means of a sleeve to shaft 40 in such manner that it is capable of independent rotation through a small arc between its opposing contacts 18 and 19.

An extension of the sending reed to the right of the shaft 40 is separated by means of an insulating element 41 from a bar 42 in a manner to form a rigid integral structure. If bar 42 is moved upwardly, contact 43 on the sending reed will engage marking contact 18. If bar 42 is moved downwardly, contact 43 will engage spacing contact 19. The right-hand end of armature 39 is formed into two arms 44 and 45 extending one upwardly and the other downwardly. Centered near the upper and lower extremity of each arm are fixed pins each securing a spring 46 and 47, each attached at its inner end to the bar 42. When the armature 39 moves upwardly or downwardly, the centralizing springs 46 and 47 tend to move the bar 42 in the same direction to impart motion to sending reed 17.

When the regenerative repeater is in the normal stopped position, magnet 16 is energized and the driven shaft 33 is stopped. The right-hand end of bar 42 will be latched in its upper position, as shown, by the projection on the top arm of follower 51. Marking contact 18 is closed. The first signal element in any train of signal elements is always a spacing signal and the circuit herein is arranged so that magnet 16 is deenergized for this condition. Armature 39 is moved downwardly when magnet 16 is deenergized due to tension in spring 49. Stop arm 38 disengages from raised surface 37 and driven shaft 33 rotates. The speed of motor 31 is fixed so that shaft 33 will make one complete revolution in an interval equal to the proper time of transmission of one complete train of signal elements.

When released armature 39 moves downwardly under the influence of spring 49. A projection 48 on the armature will engage the periphery of cam 35. A short interval thereafter a projection on cam 36 will rotate element 51 through a small arc in a clockwise direction about its pivot 52 against the influence of spring 53 which is tensioned. The bottom arm of lever 51 operates as a follower on cam 36 and its upper end serves as a latch for bar 42. Since the armature 39 has been moved into its lower position, spring 47 was tensioned while bar 42 was retained in its upper position. Immediately upon the withdrawal of the projection of the upper arm of lever 51 from its position beneath bar 42, bar 42 will be pulled downwardly by spring 47. An instant later the first projection on cam 36 will have rotated past the projection on the bottom arm of lever 51 and the lever will be rotated in a counter-clockwise direction by spring 53. The projection on the top arm of lever 51 will engage the top surface of the right-hand end of bar 42 locking the right-hand end of the bar in its lower position. Spacing contact 19 will be closed. The bar 42 will be locked in position for an interval equal to the full length of a spacing signal which will be transmitted from contact 19 through contacting element 43 secured to sending reed 17, through sending reed 17 and out through conductor 20.

While the bar 42 is still locked to transmit its spacing signal, the pulse corresponding to the first character forming signal element will be transmitted into the regenerative repeater. It may be either marking or spacing depending upon the particular character. If it is marking, the magnet 16 will be energized. If it is spacing the magnet will be deenergized. At the middle of the pulse when the magnet doubtless will have been properly conditioned the first projection on cam 35 will urge follower 48 upwardly, raising armature 39, which is thus presented to the magnet. If the magnet is energized the armature 39 will be retained in its upper position. In any case bar 39 will remain locked in its lower position until the necessary interval for the transmission of a start pulse of proper length has elapsed. Then, once more, a raised surface on cam 36 will actuate lever 51 unlatching bar 42. If the armature 39 has remained in its upper position, spring 46 is tensioned. As soon as bar 42 is unlatched it will be moved upward. As soon as it has completed its upward movement it will be relatched. When bar 42 has moved upward contact 18 will be closed. Thus a train of signals of proper overall length and each of proper individual length will be transmitted from the regenerative repeater D. Each signal element whether marking or spacing will correspond to the received signal element.

In the event that successive signal elements are of the same nature, that is to say, in the event that successive elements are marking or successive elements are spacing, although armature 39 will move while the nature of each element is being determined, bar 42 will be locked in position while the armature is moving and the armature will have assumed a final position for the particular element corresponding to that assumed for the preceding element of the same nature before bar 42 is unlatched and bar 42 will therefore remain in the same position for successive marking signal elements or successive spacing signal elements.

The final signal element of a train is a marking signal. Magnet 16 will therefore be energized and the armature 39 will be retained in its elevated position. When lever 51 is latched the bar 42 will be secured in its elevated position.

Attention is called to the fact that the regenerative repeater mechanism operating as described above interposes a fixed delay of approximately one half the duration of a signal element between its reception by magnet 16 and its retransmission by the regenerative repeater through contacts 18 and 19. This is inevitable since the center portion of each signal element is used to determine the nature of each element as this is necessary to correctly determine the nature of greatly distorted signal elements, and after delaying until the center portion of each signal element has been received, a full length signal element is transmitted.

Overall circuit

The operation of the overall circuit will now be described in detail. The condition of the various relays when in the normal condition awaiting transmission from some line forming part of the group will be explained.

The effect of current flowing through the wind-

ings of the various relays will first be explained and the relays 1, 2, and 3 of line A will be used to illustrate this for lines A, B, and C.

Current flowing from battery through resistance 54 and the top winding of relay 1 to ground, tends to actuate the armature of relay 1 toward the right to engage with its marking contact. This effect is unopposed for the marking condition, as the circuit extending through the bottom winding is one of the branches joined into the hub, all of which branches are terminated in battery of the same polarity and magnitude. The circuit through the bottom winding of relay 1 may be traced from negative battery through the armature and right-hand contact of relay 2, resistance 55 in parallel with condenser 56, resistance 57, bottom winding of relay 1 and conductor 22 to hub 21. All other branches formed by lines connected into the hub through the bottom winding of the relay in each line corresponding to relay 1 are arranged in the same manner. For line B the circuit extends from negative battery through the armature and right-hand contact of relay 5, resistance 58, in parallel with condenser 59, resistance 60, bottom winding of relay 4, and conductor 23 to hub 21.

For line C the circuit extends from negative battery through the armature and right-hand contact of relay 8, resistance 61, in parallel with condenser 62, resistance 63, bottom winding of relay 7 and conductor 24 to hub 21.

The sending circuit of the regenerator is joined to hub 21 in the same manner. The circuit may be traced from negative battery through resistance 64, in parallel with condenser 65, resistance 66, contacts 18 and 43, sending reed 17 and conductor 20.

No current flows in any of these branches as they are all terminated in battery of the same polarity and magnitude. Therefore the armatures of all relays such as 1 are maintained in engagement with their respective right-hand contacts under the influence of the current in their respective top windings.

A circuit may be traced from ground through the top winding of relay 3 and resistance 70 to battery. The effect of this current tends to maintain the armature of relay 3 in engagement with its right-hand or marking contact. During marking this effect is unopposed as no current flows through the bottom winding of relay 3. Conductor 25 extending to the distant station A is terminated in negative battery. The circuit extends through conductor 25, armature and right-hand contact of relay 1, bottom winding of relay 3, resistance 67, resistance 68 in parallel with condenser 69 to negative battery. No current flows in this path while the marking condition prevails.

The circuit through the top winding of relay 2 during marking may be traced from ground through the armature and right-hand or marking contact of relay 3 to the junction of parallel branches at point 71. One of said branches extends through resistance 72 to negative battery. The other branch extends through the top winding of relay 2 to point 73 which is in effect a point on a potentiometer formed by resistances 74 and 75 which are terminated respectively in negative battery and ground. The values of the various impedances in this circuit are such that during the marking condition, when in effect direct ground is connected to point 71, current flows through the top winding of relay 2 in such a direction that its effect actuates the armature of relay 2 to engage with its right-hand contact. The circuit through the bottom winding of relay 2 is open at this time.

Corresponding relays in lines B and C are under corresponding influences and their armatures are in the same conditions as explained for line A. The armature of relay 15 is held in engagement with its right-hand or marking contact under the influence of current flowing in a circuit which may be traced from battery through resistance 76 and the bottom winding of relay 15 to ground. No current flows through the top winding. A circuit may be traced from battery through the armature and right-hand contact of relay 15, resistance 80 and the winding of holding magnet 16 to ground, energizing the holding magnet and holding the armature 39 of the regenerative mechanism in the elevated position. For this condition bar 39 is locked in its upper position and contacts 43 and 18 are in engagement.

It will now be assumed that ground is connected to conductor 25 so as to transmit a spacing signal. This energizes the bottom winding of relay 3. The effect tends to actuate the armature of relay 3 toward the left and the effect in the bottom winding is dominant over the effect in the top or biasing winding of relay 3, so the armature of relay 3 is actuated so as to engage with its left-hand or spacing contact. This establishes a circuit from ground through the armature and left-hand or spacing contact of relay 3, conductor 10, conductor 14, top winding of relay 15, resistance 77 and resistance 78 in parallel with condenser 79 to negative battery. The effect of current in this circuit opposes and dominates the effect of current in the bottom or biasing winding of relay 15 and the armature of relay 15 is actuated to the left so as to disengage from its marking contact. This breaks the circuit of holding magnet 16. After a delay, this results in the actuation of sending reed 17 so that contact 43 engages with spacing contact 19. This establishes a circuit from ground through contacts 19 and 43, sending reed 17 and conductor 20, which is electrically connected to the sending reed, to hub 21. From the hub a number of parallel branches extend into the various lines. For line B the circuit extends through conductor 23, bottom winding of relay 4, resistance 60, resistance 58 in parallel with condenser 59 and the right-hand contact and armature of relay 5 to negative battery. For line C the circuit extends through conductor 24, bottom winding of relay 7, resistance 63, resistance 61 in parallel with condenser 62 and the right-hand contact and armature of relay 8 to negative battery. Relays 4 and 7 are operated simultaneously to connect ground to conductors 26 and 27 respectively and transmit a spacing signal to stations B and C.

In order to prevent the transmission of a regenerated spacing signal back to station A, from which the original distorted spacing signal was received, it is necessary to open the path through conductor 22 and the bottom winding of relay 1 between the time that the original distorted spacing signal is transmitted into the regenerator from the spacing contact of relay 3 and the time that the regenerated signal is transmitted back from contact 19. The path through the bottom winding of relay 1 is opened in the following manner.

When the armature of relay 3 leaves its right-hand contact direct ground is in effect discon-

nected from point 71. The impedances of the resistances 72, 74, 75 and the relay winding are such that, for this condition, the direction of the flow of current through the top winding of relay 2 is reversed. The armature of relay 2 is actuated to the left to engage with its left-hand contact. A circuit may then be traced from battery through the armature and left-hand contact of relay 2, bottom winding of relay 2, resistance 81 and condenser 82 in parallel, through common holding conductor 83 and common holding resistance 84 to ground. The effect of current flowing in this path is in a direction to hold the armature of relay 2 in engagement with its left-hand contact and its effect is dominant over the effect of reversed current through the top winding of relay 2 when direct ground is connected to point 71 as the armature of relay 3 responds to marking signals. The armature of relay 2 therefore remains in engagement with its left-hand contact while signals are being received from station A. This maintains the path through the bottom winding of relay 1 open and prevents the retransmission of signals received from station A back to station A.

When station A has concluded transmitting relay 2 will remain locked up with its armature in engagement with its left-hand contact. Under this condition, when another station connected to the hub starts to transmit, it is imperative that relay 2 be unlocked in the interval between the time of reception of the first spacing signal element and the time when the regenerated first spacing signal element is transmitted from the regenerator. The circuit arrangements for achieving this in the present invention are unique.

Let it be assumed that station A has concluded transmitting. The armature of relay 2 is locked to its left-hand contact and the path from the regenerator through the bottom winding of sending relay 1 for station A is open so that relay 1 is not in condition to transmit regenerated signals. Station B now starts to transmit. When the first or spacing signal element of the first signal train is received by relay 6, the armature of relay 6 is operated to engage with its left-hand or spacing contact. This connects the grounded armature of relay 6 through conductor 11 to hub 13 and results in the regeneration of a spacing signal in regenerator D in the manner described above. The armature of relay 5 will be connected to its left-hand contact in the same manner as described for relay 2 above. A circuit may thus be traced from negative battery through the armature and left-hand or holding contact of relay 5, bottom winding of relay 5 and resistance 85 in parallel with condenser 86 through common holding conductor 83 and common holding resistance 84 to ground. This circuit is connected in parallel with the holding circuit heretofore traced through the bottom winding of relay 2. The magnitude of the current flowing in the holding winding of relay 2 is therefore reduced. The effect of the reduced current in the bottom winding of relay 2 is insufficient to maintain the armature of relay 2 in engagement with its left-hand contact against the opposing effect of current in the top winding of relay 2 as point 71 is grounded as relay 3 is in the marking condition when circuit A is idle. The armature of relay 2 therefore operates to its right-hand contact.

When the armature of relay 2 is restored to its right-hand contact, the circuit through the bottom winding of relay 1 is reestablished and it is conditioned to transmit the regenerated signals received from station B.

All other circuits connected into the hub such as C etc. will be in proper condition for transmitting the regenerated signals as the path through the bottom windings of their relays such as 7, etc., will be closed and in condition to receive signals from the regenerator.

It is imperative that the path through the bottom winding of relay 1 be reestablished between the time of reception of the first element of the first signal train by relay 6 and the time that the regenerated signal is started to be transmitted from contact 19. The interval available for this is slightly less than one-half the time of duration of the first signal pulse. Applicant's means for establishing this path is designed to be especially fast in operation. The circuit arrangement for both the top and bottom windings of relay 2 and the manner in which the parallel branches through the bottom windings of relays such as 2 and 5 operate to release the relay such as 2 which has been locked up since the start of transmission during the previous cycle are important aspects of applicant's invention.

It is pointed out that notwithstanding relay 2 releases in the manner explained when the armature of relay 5 is actuated so as to engage with its left-hand contact, the armature of relay 5 is at the same time maintained in engagement with its left-hand contact to open the path through the bottom winding of relay 4 and prevent the retransmission of the signal received from line B back to line B after regeneration.

The explanation of this is that at the time when the two holding paths through the bottom windings of relays 2 and 5 are connected in parallel, in the case of station A which is idle, relay 3 is in the marking condition and ground from the armature of relay 3 is connected to point 71, so that the effect of the current in the top winding of relay 2 is tending to actuate the armature of relay 2 towards its right-hand contact and after the current in the bottom winding, the effect of which is holding the armature of relay 2 in engagement with its left-hand contact, is reduced, the armature moves to its right-hand contact. In the case of relay 5, its armature is operated to the left when the armature of relay 6 breaks from its right-hand contact, disconnecting ground from point 87. That is to say, for the first spacing condition of relay 6, the effect of the current in the top winding of relay 5 actuates the armature of relay 5 to the left. After the armature of relay 5 engages its left-hand contact the effect of the current in the bottom or holding winding of relay 5 augments the effect of the current in the top winding and both windings are operating to hold the armature of relay 5 to the left during the reception of the first spacing signal by relay 6. It is emphasized that in the case of relay 2, because relay 3 is on marking while not transmitting, the effects of the currents in the two windings of relay 2 are opposed when the first spacing signal element is received by relay 6 and the holding effect in the bottom winding of relay 2, is reduced, by the parallel branch through the bottom winding of relay 5, sufficiently to permit the armature of relay 2 to be actuated toward the right. As soon as the armature of relay 2 leaves its left-hand contact, the current through the bottom winding of relay 5 rises to its full value as the parallel branch through the bottom winding of relay 2

is opened. Therefore, the armature of relay 5 will remain locked to its left-hand contact, notwithstanding the reversals in the direction of current flow through it stop winding, as ground is alternately connected to and disconnected from point 87 as the armature of relay 6 responds to marking and spacing signals from line B.

The purpose of the condenser such as 82 in each of the parallel holding branches is to develop a transient which forces the magnitude of the current in the bottom winding of a holding relay quickly to a value considerably below its steady state value, when two holding circuits through the bottom windings such as 2 and 5 are interconnected. This increases the speed with which the holding relay such as relay 2 will release and reestablish the transmitting path through the bottom winding of a sending relay such as relay 1 when a station such as B starts to transmit following transmission by a station such as A.

What is claimed is:

1. In a telegraph communication circuit, a plurality of telegraph lines interconnected through individual repeaters to a single one-way regenerative repeater common to all of said lines, means in said circuit for regenerating signals incoming from any one of said lines in said common regenerative repeater and transmitting them simultaneously to more than one of the others, means for conditioning the repeaters to which said signals are transmitted simultaneously so that each of their transmitting circuits is closed before the first regenerated signal element is transmitted said means including a holding circuit comprising parallel branches in a plurality of which the magnitude of the holding current is reduced simultaneously to a current of lower value to effect the closing of one of said transmitting circuits.

2. As elements in a multiway regenerative telegraph repeater circuit, individual polar relays each having an armature connected in series in individual communication branches, said branches connected to the output of a single one-way regenerative repeater arranged to serve all of said branches in common, said relays including means for holding one of said branches continuously open when signals are not to be transmitted therethrough, two independent windings on each of said relays, and means for transmitting current in reverse directions through one of said windings and current of two different magnitudes through the other of said windings.

3. In a telegraph system, at least three telegraph lines each comprising an individual repeater connected to a single one-way regenerative repeater arranged to serve all of said branches in common, means for repeating signals from any one of said lines to all of said others through said regenerative repeater, a sending relay, a receiving relay and a polar relay in each of said line repeaters, said polar relay comprising means for conditioning its associated line repeater to prevent the transmission of regenerated signals therethrough, and means comprising a locking winding on said polar relay through which currents of two different magnitudes are passed at different times to control the effective connection of one of said individual repeaters to the output of said regenerative repeater.

4. In a multiway regenerative telegraph repeater system, receiving branches from individual repeaters connected in parallel to the input of a single regenerative repeater arrangd to serve all of said repeaters in common, transmitting branches to individual repeaters connected in parallel to the output of said regenerative repeater and a repeater transmission enabling circuit having a group of parallel branches each of which is connected in parallel to a winding on a polar relay in one of said individual repeaters.

5. In a telegraph repeater, a relay, a winding thereon, means connected to said winding for transmitting a first steady state current of a first magnitude in a first direction through said winding at a first time to operate an armature of said relay to a particular position, means connected to said winding for transmitting a second steady state current of a second and lower magnitude than said first magnitude through said winding in the same direction as said first direction at a second time and means connected to said winding for developing a transient voltage to reduce the magnitude of said second current below its steady state value to permit the position of said armature to be reversed faster.

6. In a telegraph system, at least three telegraph relay repeaters interconnected through a single one-way regenerative repeater, means in said system for receiving signals from any one of said relay repeaters and repeating regenerated signals from said regenerative repeater to all others of said relay repeaters and a winding of not more than one relay in the circuit connecting the output of said regenerative repeater and the transmission conductor directly connecting each relay repeater with the distant terminal.

7. A multiway regenerative telegraph repeater system, at least three telegraph lines therein extending individually from a common regenerating station to three distant stations, an individual telegraph relay repeater connected to each line at said regenerating station, a regenerative repeater having an input and an output at said regenerating station, means in said system for impressing telegraph signals received from any of said lines through its said individual relay repeater on said input, means for impressing regenerated telegraph signals from said output on all others of said lines simultaneously through its said individual repeater in response thereto, said latter means comprising individual branches of a parallel transmitting circuit interconnecting said output and each of said lines, and a winding of not more than one relay connected between the output of said regenerator and each of the conductors connected directly to the distant station.

8. A multiway regenerative telegraph repeater system comprising a single one-way regenerative repeater interconnected by means of individual line repeaters to at least three telegraph conductors each extending to a distant station, means in said system for regenerating telegraph signals received from any one of said conductors and impressing them simultaneously on all of the others of said conductors, and a winding of one relay only interposed in the complete circuit branch connecting the output of said regenerative repeater to each of said conductors.

9. In a multiway regenerative telegraph repeater system, a group of at least three individual telegraph line repeaters connected to a single one-way regenerative repeater, means in said system for receiving signals from any one of said line repeaters and repeating regenerated signals in response thereto to all of the others of said line repeaters simultaneously, a polar control relay in each of said line repeaters for pre-

venting the transmission of regenerated signals back to the same line from which corresponding distorted signals are received, a transmitting branch connecting the output of said regenerative repeater to each of said line repeaters, said branches being connected in parallel, a winding on a transmitting relay and an armature on said polar control relay both connected in series in each of said branches, a locking circuit on each of said polar relays, and means directly connected to said locking circuit for increasing the speed of the unlocking operation.

10. In a telegraph system, a polar relay, a first winding, a second winding and an armature, all on said relay, means for passing current of a first magnitude through said first winding and for passing no current through said second winding at a first time to actuate said armature to a first position, means for changing the direction of said current in said first winding while maintaining no current in said second winding to actuate said armature to a second position at a second time, means for passing a locking current through said second winding to lock said armature in said second position at a third time, means for intermittently reversing the direction of the current in said first winding, means for maintaining said armature in said second position notwithstanding said reversal at a fourth time, and means comprising the connection of a circuit in parallel with said second winding to reduce the magnitude of said locking current in said second winding and permit the restoration of said armature to its first position in response to a reversal of the direction of current in said first winding at a fifth time.

11. In a multiway regenerative telegraph repeater system, at least three lines each extending to a distant station and each equipped with an individual repeater all connected to a single one-way regenerative repeater mechanism, means for receiving distorted signals from any one of said lines and repeating regenerated signals to all of the other simultaneously in response thereto, and not more than one relay winding interposed between the output of said regenerative repeater and any of said lines.

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