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TELEGRAPH SYSTEM

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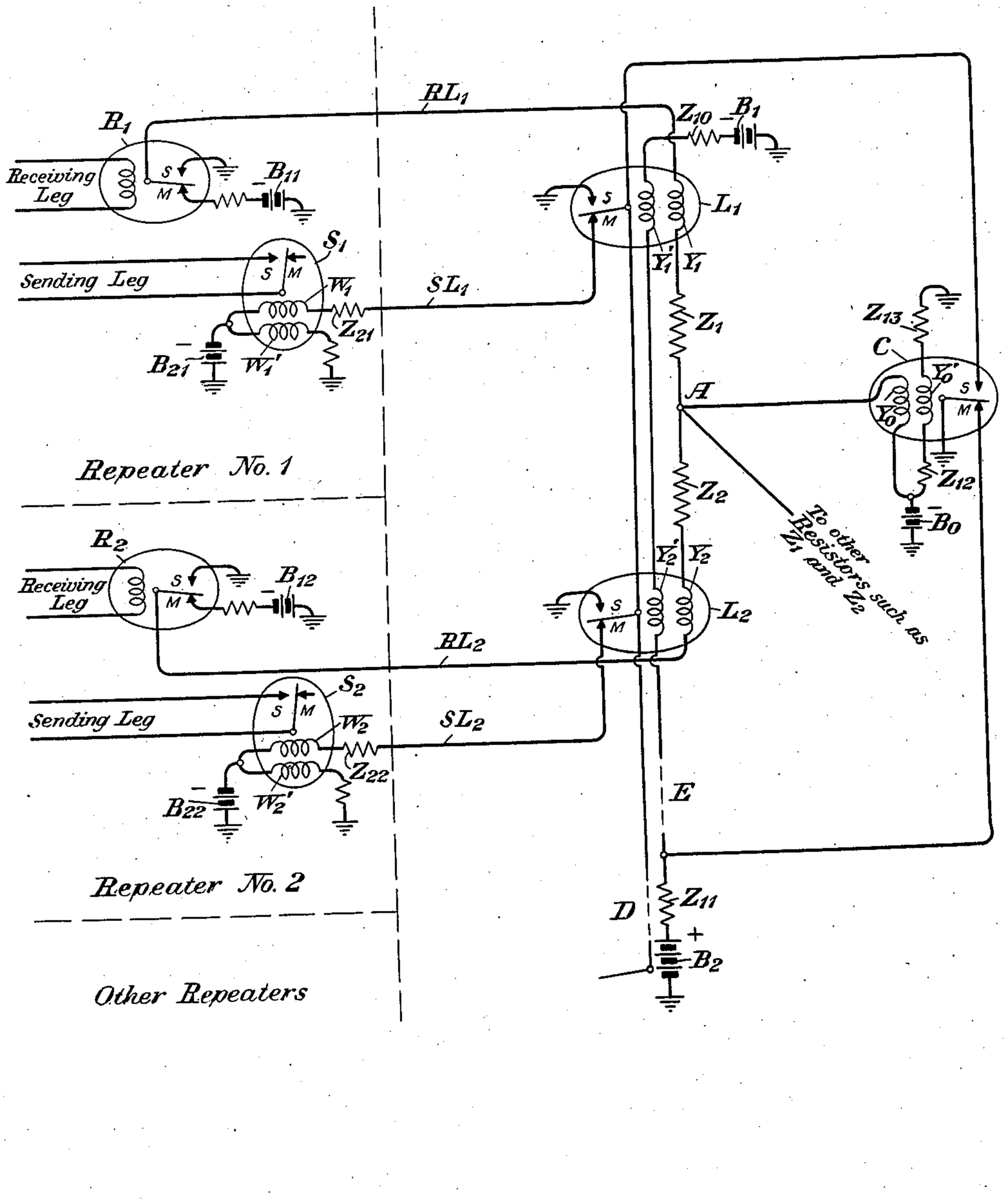

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TELEGRAPH SYSTEM

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This invention relates to telegraph systems, and more particularly to arrangements for reducing or eliminating present difficulties which occur when two or more stations attempt to send signals simultaneously over long circuits or lines. Stated more positively, this invention relates to arrangements in half-duplex telegraph systems for facilitating the simultaneous transmission of signals through a plurality of repeaters connected to a telegraph line or circuit so that each of the sending stations will be apprised that another station is also sending signals at the same time.

In present telegraph systems of the half-duplex type, the repeaters are generally arranged so that when the receiving relay of the repeater is in its spacing position, the sending relay of the repeater is held in its marking position. This arrangement on circuits composed of numerous repeater sections permits two or more subscribers to send signals simultaneously over the circuit for appreciable periods of time without any one of the sending subscribers getting any positive indication that one or more other subscribers are sending at the same time. This results in considerable confusion. The confusion arises particularly on long circuits where there are subscribers intermediate of the terminals. In these cases the subscribers sending telegraph or teletypewriter signals simultaneously may obtain a perfect copy of their own signals for appreciable periods of time, but the intermediate subscribers will receive signals from all of the sending stations simultaneously, whereupon the copy will be mutilated. The longer and the more complicated the circuits, the greater are the difficulties involved in getting the desired signals to each of the different sending subscribers to apprise each of these subscribers that another subscriber is also sending signals at the same time.

In telegraph systems of, for example, the inverse neutral type arranged for half-duplex operation, the difficulties above-mentioned may be eliminated by modification of the circuits connected to the various repeaters in accordance with the principles and apparatus of this invention. In one embodiment of this invention given for illustrative purposes the existing repeaters along the line (or lines) are left unchanged, but relay arrangements are added to permit the simultaneous transmission of spacing signals through the repeaters connected to the line.

According to this invention the arrangements to be added to the repeaters comprise a plurality of like relays, one individual to each repeater, and an additional relay common to all of the repeaters. The relay individual to each repeater is employed primarily to repeat signals from its associated repeater to all of the other repeaters connected to the circuit or circuits. The relay common to all of the repeaters is maintained in a fixed condition, as, for example, with its armature on its marking contact, during the time when signals are being transmitted from one of the repeaters to the other repeaters connected to the line. However, the common relay is operated only when two or more of the repeaters are transmitting signals at the same time, the common relay then aiding in repeating these signals from the two or more repeaters to all of the other repeaters connected to the line.

This invention will be better understood from the more detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention applied to inverse neutral telegraph circuits merely for the purpose of illustration.

Referring to the drawing, two of a plurality of similar telegraph repeaters are shown, the repeater No. 1 including a receiving relay R_1 and a sending relay S_1, the repeater No. 2 including a similar receiving relay R_2 and a similar sending relay S_2. The winding of the receiving relay R_1 may be used to receive signals coming from, for example, New York, and the sending relay S_1 may be employed to send signals to that point, namely New York. The relay R_2 may be employed to receive signals from, for example, Chicago, and the relay S_2 to send signals to the latter city. In prior half-duplex telegraph systems of, for example, the inverse neutral type, the local or leg sides of the repeaters were directly connected together in parallel relationship with each other. In accordance with this invention the arrangement of the circuits interconnecting these repeaters is modified as will now be explained.

The relays L_1 and L_2 are two of a plurality of polar relays, each of which is individual to one of the repeaters, relay L_1 being individual to the repeater No. 1 and relay L_2 individual to repeater No. 2. An additional relay C, which is also of the polar type, is added to the circuit, this relay being common to the various L relays and their associated repeaters. The relays L_1, L_2 and C each include two windings and an armature which moves between two contacts as shown. The point or apex A of the system is connected to the armature of the relay R_1 by means of the resistor Z_1, winding Y_1 of relay L_1 and the re-

ceiving conductor RL_1. Similarly the apex A is connected to the armature of the relay R_2 of repeater No. 2 by means of resistor Z_2, the winding Y_2 of relay L_2 and the receiving conductor RL_2. The remaining windings of the L relays are connected in series relationship. The series circuit includes battery B_1, resistor Z_{10}, winding Y'_1 of relay L_1, winding Y'_2 of relay L_2 (and additional windings of other similar L relays), resistor Z_{11}, battery B_2 and ground. Battery B_2 is poled in the same direction as battery B_1 so that both batteries will be in series-aiding relationship with each other. The apex A is connected through the winding Y_0 of the common relay C and battery B_0 to ground. The winding Y'_0 of relay C is the usual biasing winding and is connected in a series circuit which includes battery B_0, resistor Z_{12}, winding Y'_0 of relay C, resistor Z_{13} and ground. The upper or operating windings W_1 and W_2 of relays S_1 and S_2 are connected, respectively, through resistors Z_{21} and Z_{22} to conductors SL_1 and SL_2 and to the marking contacts M of relays L_1 and L_2, as shown. The windings W'_1 and W'_2 of relays S_1 and S_2, respectively, are the usual biasing windings for these relays, these biasing windings normally biasing their armatures to their marking contacts.

The spacing contact S of the relay C is connected to the armatures of relays L_1 and L_2 and to the armatures of other L relays (not shown) which may be added to the circuit. The marking contact M of relay C is connected to the upper terminal of resistor Z_{11}. The relay C is normally maintained with its armature on its marking contact M as shown in the drawing. The relay armature is held in this position as long as but one of the repeaters, such as R_1, is relaying signals to the repeater No. 2 and to the other repeaters (not shown). However, when relays R_1 and R_2 (or when any two or more receiving relays) are repeating space signals simultaneously, the armature of relay C will then be moved to its spacing contact S, in which case the signals received by relay R_1 will be repeated by relay S_2 over the sending leg of repeater No. 2, and the signals received by relay R_2 will be repeated by relay S_1 over the sending leg of repeater No. 1 as will now be explained.

In the idle condition of the apparatus all the relays will be in their indicated positions with their armatures on their marking contacts M. This same condition will prevail when a marking signal is received over the receiving leg of relay R_1. With the armature of relay R_1 on its marking contact M there will be no flow of current through the windings Y_1 and Y_2 of the respective relays L_1 and L_2, nor through the winding Y_0 of relay C. This is because batteries B_{11} and B_0 are connected in a series circuit which includes winding Y_1 and winding Y_0, and as these batteries produce equal and opposite potentials in the series circuit, no current will flow through the windings therein. A similar series circuit including batteries B_{12} and B_0 and including the windings Y_2 and Y_0, will likewise be devoid of current. While the armature of relay R_1 is on its marking contact M, current will flow through the windings Y'_1 and Y'_2 of relays L_1 and L_2, respectively, over a circuit which includes battery B_1, resistor Z_{10}, windings Y'_1 and Y'_2, the armature and marking contact M of relay C and ground. This current will be sufficient to cause the armatures of relays L_1 and L_2 to close their marking contacts M. Relay C will be held in its marking position by the bias current traversing its winding Y'_0.

When a spacing signal is received by the winding of relay R_1 of repeater No. 1, the armature of relay R_1 will be moved to its spacing contact S. In that case current will flow through the winding Y_1 of relay L_1 over a circuit which includes the battery B_0, the winding Y_0 of relay C, resistor Z_1, the winding Y_1 of relay L_1, conductor RL_1, the armature and spacing contacts of relay R_1 and ground. The current through the winding Y_1 of relay L_1 will overcome the effect of the current traversing winding Y'_1, and hence the armature of relay L_1 will be moved to its spacing contact S. When this happens, current will flow through the operating winding W_2 of relay S_2 over a circuit which includes battery B_{22}, the winding W_2 of relay S_2, resistor Z_{22}, conductor SL_2, the armature and marking contact M of relay L_2, the armature and spacing contact S of relay L_1 and ground. The armature of relay S_2 will, therefore, close its spacing contact S and send a spacing signal over the sending leg controlled by this relay.

Although relay L_1 responds to the spacing signal received by relay R_1, the flow of current through the winding Y_0 of relay C will be insufficient to move the armature of relay C to its spacing contact S. In other words, the armature of relay C will remain on its marking contact M. While relay R_1 is still in a spacing condition, the flow of current through the winding Y_2 of relay L_2 will be practically negligible and, therefore, the relay L_2 will also remain in its marking condition. Thus it will be observed that a spacing signal received by relay R_1 will cause relay L_1 to respond to that spacing signal to repeat the spacing signal to sending relay S_2, but relays C and L_2 will remain unaffected by such a signal.

When a marking signal is received by relay R_1, relay L_1 will then move its armature back to its marking contact M, and relay S_2 in turn will respond to this condition and send a marking signal over the sending leg controlled by relay S_2. Thus when relay R_1 receives a marking signal, the relays will be in their positions as indicated in the drawing.

When a spacing signal is received by relay R_2 of repeater No. 2, relay L_2 will respond to that spacing signal, causing its armature to close its spacing contact S. This spacing signal will be repeated by relay L_2 to the operating winding W_1 of relay S_1 over a circuit which includes battery B_{21}, winding W_1 of relay S_1, resistor Z_{21}, conductor SL_1, the armature and marking contact M of relay L_1, the armature and spacing contact S of relay L_2 and ground. Thus the relay S_1 will repeat the spacing signal over the sending leg controlled by that relay. However, relays L_1 and C will be non-responsive to the spacing signal received by relay R_2. In other words, the armatures of relays L_1 and C will remain on their marking contacts M. A marking signal received by relay R_2 will cause relay L_2 to close its marking contact M, thereby causing relay S_1 to operate to its marking position in order to repeat the marking signal over the sending leg controlled by the latter relay. Thus when signals are being repeated from relay R_2 through repeater No. 1, relays L_1 and C will remain unaffected by these signals.

When relays R_1 and R_2 are both receiving signals simultaneously a special situation will de-

velop. When the signals received by relays R_1 and R_2 are spaces, the armatures of both relays R_1 and R_2 will be moved to their spacing contacts S. Current will then traverse the winding Y_1 of relay L_1, as already explained in regard to the case in which the relay R_1 received a spacing signal. A similar current will also traverse the winding Y_2 of relay L_2, as already explained in regard to the case in which relay R_2 received a spacing signal. These currents through windings Y_1 and Y_2 will cause the armatures of the respective relays L_1 and L_2 to move (or tend to move) momentarily toward their spacing contacts S. But the current traversing the winding Y_0 of relay C will now be practically doubled because the battery B_0 is supplying current to this winding over two parallel branches, (1) the branch which includes resistor Z_1 and winding Y_1 to ground over conductor RL_1 and contact S of relay R_1, and (2) the branch which includes resistor Z_2 and winding Y_2 to ground over conductor RL_2 and contact S of relay R_2. The increased current through winding Y_0 of relay C will overcome the opposing effect traversing its other winding Y'_0, thereby moving the armature of relay C to its spacing contact S.

The removal of ground from the marking contact of relay C and, therefore, from the upper terminal of resistor Z_{11} will cause an increased current to flow through the windings Y'_1 and Y'_2 of relays L_1 and L_2, respectively. The increased current will be caused by the addition of battery B_2 to the circuit of battery B_1 in series-aiding relationship. The increased current will cause the armatures of relays L_1 and L_2 to be returned to their marking contacts M. The transient movement, if any, of the armatures of relays L_1 and L_2 toward their spacing contacts is so brief as hardly to affect these relays. In practical effect relays L_1 and L_2 do not fully respond to simultaneously received spacing signals.

The armature of relay C will connect ground to the operating windings W_1 and W_2 of relays S_1 and S_2, respectively, the grounding path including the conductor common to the armatures of relays L_1 and L_2 and the armature and spacing contacts of relay C. Hence relays S_1 and S_2 will repeat the spacing signals over the respective sending legs controlled by these relays.

It will be observed, therefore, that like signals, such as spaces received by relays R_1 and R_2, will cause relay C to move its armature to its spacing contact S in order that spacing signals may be relayed over the sending legs of relays S_1 and S_2. The subscribers connected to these sending legs will, therefore, be apprised that spacing signals are being transmitted to them. If these subscribers are sending, their copy will then be mutilated. The relays L_1 and L_2, however, will both remain in their marking positions. When either or both of the relays R_1 and R_2 receive marking signals, relay C will return its armature to its M contact.

Although the L relays, such as L_1, L_2 etc., are shown and described as separate and distinct from the associated repeaters, such as Nos. 1, 2, etc., it will be understood that these L relays may be incorporated in the repeater circuits if so desired.

In connecting other L relays to other telegraph repeaters (not shown) the armatures of the additional L relays will be conductively connected to each other as at point D. One of the windings of each such additional relay will be connected in series with a resistor, such as Z_1 or Z_2, between the apex A and the armature of the receiving relay of the corresponding repeater. The other windings of the L relay will be connected to point E, for example, in series with windings Y_1' and Y_2'. The marking contact M of each L relay will be connected to the operating winding of the sending relay of the corresponding repeater. The spacing contact M of each L relay will be connected to ground.

The arrangement of this invention may be applied to inverse neutral telegraph systems, differential or neutral systems, or to any telegraph systems employing a plurality of repeaters located at one or several points of the system. The invention is especially useful and important in situations in which the various repeaters terminate in teletypewriters which provide copy of all messages sent by any station connected to the circuit.

While this invention has been shown and described in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a telegraph system, the combination of a plurality of repeaters, a plurality of individual telegraph relays each of which is connected to one of said repeaters, a telegraph relay common to all of said repeaters, means responsive to signals received by any one of said repeaters to operate the individual relay connected thereto, means responsive to the operation of any one of said individual relays to repeat the signals through said other repeaters corresponding to the other individual relays, means responsive to predetermined signals received simultaneously by any two of said repeaters to operate said common relay, and means responsive to the operation of said common relay to repeat the received signals through all of said repeaters simultaneously.

2. In a telegraph system, the combination of a plurality of repeaters, a plurality of telegraph relays one corresponding to each repeater and individual thereto, a telegraph relay common to all of said repeaters, means responsive to signals received by any one of said repeaters to operate only the individual relay corresponding thereto in accordance with said signals to the exclusion of all other relays individual to other repeaters, said latter means including means to maintain the common relay unoperated, and means responsive to predetermined signals received simultaneously by a plurality of said repeaters to operate only the common relay in accordance with said signals, said latter means including means to maintain all of the relays individual to the various repeaters substantially unoperated.

3. In a telegraph system, the combination of a plurality of repeaters each including a receiving relay and a sending relay, a plurality of telegraph relays one corresponding to each repeater and individual thereto, sending and receiving conductors interconnecting each repeater with the relay individual thereto, a relay common to all of said individual relays, means responsive to signals received by one of said repeaters to operate the individual relay corresponding thereto in accordance with said signals and to maintain the other individual relays unoperated, the operated individual relay repeating the received signals to the other repeaters over the sending conductors

connected thereto, and means responsive to the receipt of predetermined signals by two or more of said repeaters simultaneously to operate the common relay in accordance with said signals while maintaining all of the individual relays effectively unoperated, the common relay repeating the received signals simultaneously to all of the other repeaters over the sending conductors connected thereto.

4. In a telegraph system interconnecting a plurality of repeaters, the combination of a plurality of relays one corresponding to each repeater and individually connected thereto, a relay common to all of said individual relays, means interconnecting the individual relays with the common relay so that the operation of one of said individual relays in response to signals received by said individual relay will prevent the operation of all the other individual relays and of the common relay, and means responsive to the operation of the common relay in response to predetermined signals received from two or more of the repeaters simultaneously to prevent effectively the operation of all of the individual relays.

5. In a telegraph system for a plurality of repeaters, the combination of a plurality of relays, one of which is individual to each repeater, sending and receiving lines interconnecting each individual relay with its corresponding repeater, a relay common to all of the individual relays, means responsive to signals received over the receiving line connected to one of the repeaters to operate the individual relay corresponding thereto to repeat the received signals to the other repeaters over the sending lines connected thereto, said means including means to prevent the operation of the other individual relays and of the common relay, and means responsive to the simultaneous reception of spacing signals over two or more of the receiving lines extending to two or more of the repeaters to operate the common relay in accordance with said signals to repeat said signals simultaneously to the other repeaters over the sending lines connected thereto, said latter means including means to prevent effectively the operation of all of the individual relays.

6. In a telegraph system, the combination of a plurality of repeaters, a plurality of telegraph relays each of which is individual to one of said repeaters, a plurality of receiving lines, one connecting each repeater with its individual relay, a plurality of sending lines each connecting a repeater with its individual relay, a relay common to all of said individual relays and connected to said individual relays, means responsive to signals received over only one of said receiving lines to operate the individual relay connected thereto to repeat the received signals over the sending lines connected to all of the other repeaters, and means responsive to the simultaneous reception of spacing signals over two or more of the receiving lines to operate the common relay to repeat said signals simultaneously over the sending lines connected to the other repeaters.

7. In a half-duplex telegraph system, the combination of a plurality of repeaters, means responsive to signals received by one of said repeaters to repeat the received signals simultaneously to all of the other repeaters, and means including a relay common to all of said repeaters responsive to signals received by two or more of said repeaters simultaneously to repeat the simultaneously received signals to all of the repeaters.

8. In a half-duplex telegraph system having a plurality of repeaters connected thereto, the combination of a relay connected to all of said repeaters, means responsive to signals received by but one of said repeaters to maintain said relay unoperated and to repeat said signals to all of the other repeaters, said means also including means to operate said relay when two or more of said repeaters receive like signals simultaneously, whereby said relay will repeat the received signals to all of the repeaters.

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