Nov. 16, 1943. F. H. HANLEY 2,334,551

TELEGRAPH SYSTEM

Filed Nov. 12, 1941

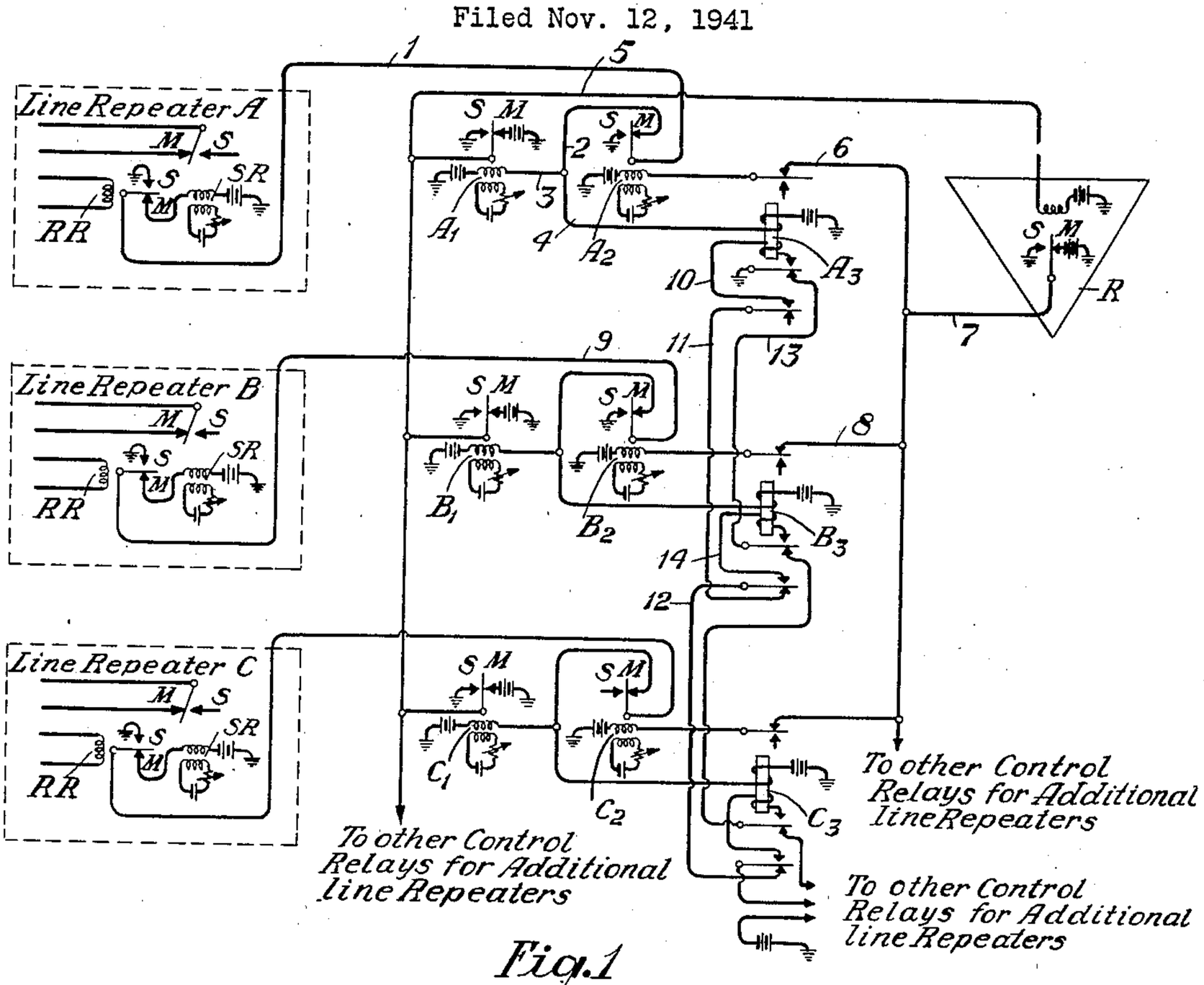

Fig. 1

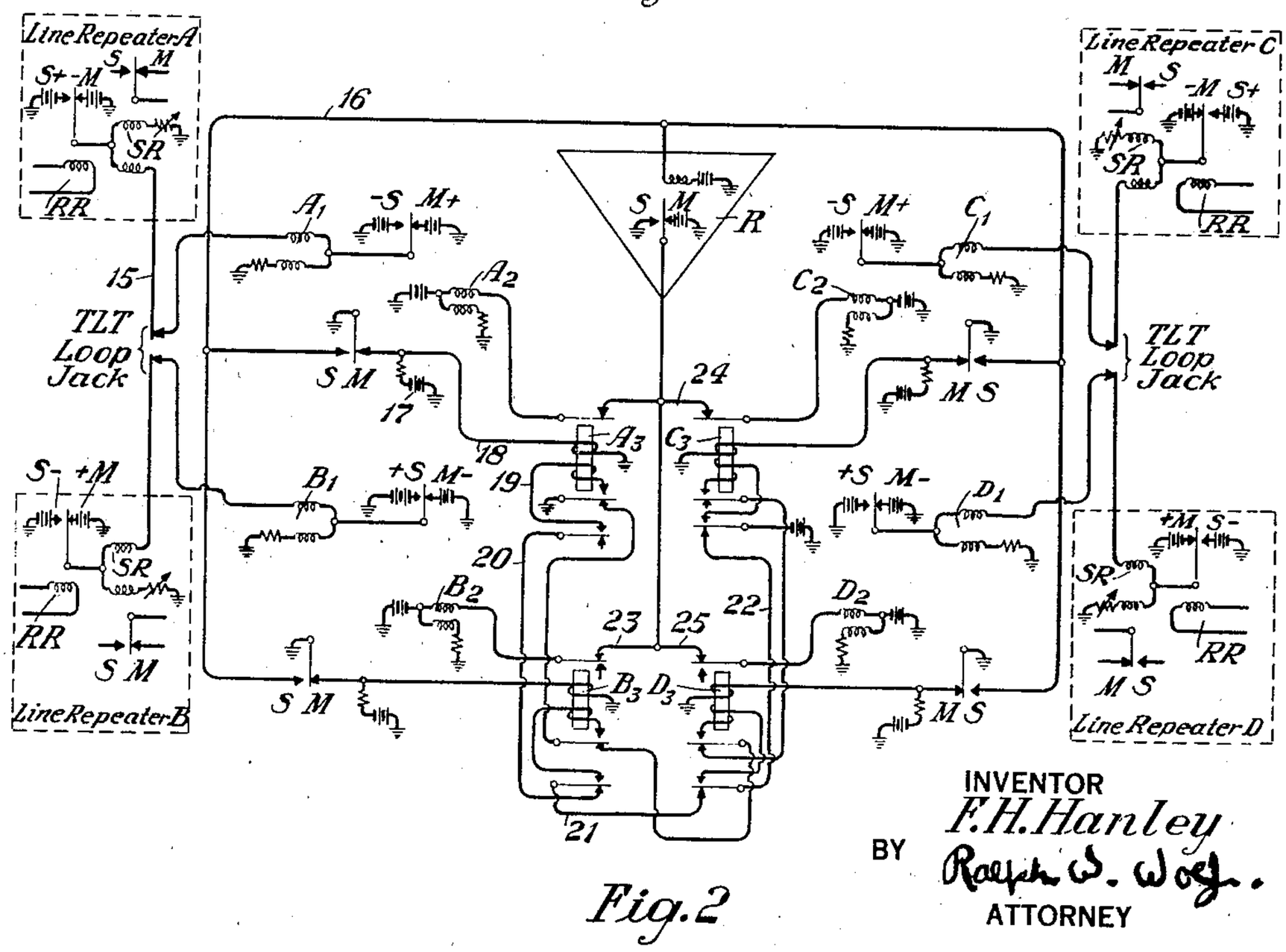

Fig. 2

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Patented Nov. 16, 1943 2,334,551

UNITED STATES PATENT OFFICE

2,334,551

TELEGRAPH SYSTEM

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Application November 12, 1941, Serial No. 418,694

8 Claims. (Cl. 178—73)

This invention relates to signaling systems and more particularly to means for providing regenerative telegraph transmission from any one of a number of telegraph lines connected to a system to all of the other telegraph lines connected thereto.

In certain types of telegraph systems, such, for example, as private line telegraph or teletypewriter systems, it has been the practice, when regenerative transmission was desired between certain legs of a multi-leg circuit, to connect a two-way regenerative repeater to the legs between which regeneration was desired. Such an arrangement might result in non-regenerative transmission between certain of the legs on the circuit, and this would be undesirable. It is one of the objects of this invention to provide an arrangement whereby regenerative transmission may be provided between any and all legs of a multi-leg telegraph circuit. It is another object of this invention to provide such regenerative transmission by the use of only a single one-way regenerative repeater. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1 and 2 of which the invention is illustrated. Fig. 1 is a circuit diagram showing one form of the invention in which a single one-way regenerative repeater interconnects all of the telegraph lines in a circuit employing inverse neutral operation. Fig. 2 is a circuit diagram showing a modification of Fig. 1 in which a single one-way regenerative repeater interconnects all of the telegraph lines in a circuit employing neutral operation. Like reference characters have been utilized to denote like parts in both of the figures.

In Fig. 1 are shown three telegraph line repeaters A, B and C. Each of these line repeaters would be provided with receiving relays RR and sending relays SR. Associated with these line repeaters are circuit arrangements whereby any one of the line repeaters may be connected to all the other line repeaters through the one-way regenerative repeater R. This is accomplished by providing each line repeater with a series of relays. For example, associated with line repeater A will be the control relays A_1, A_2 and A_3. Associated with line repeater B will be the control relays B_1, B_2 and B_3. Associated with line repeater C will be the control relays C_1, C_2 and C_3. While only three line repeaters have been illustrated, it is understood that additional line repeaters, each provided with its series of control relays, could be added to the circuit as indicated in the drawing, and interconnected through the regenerative repeater R. As indicated in the drawing, when all of the line repeaters are idle, regenerative repeater R will have its input and output circuits connected to all of the line repeaters. When one of the line repeaters, such as A, starts to send signals, the control relays associated with line repeater A will disconnect the output circuit of the repeater R from the line repeater A, but will allow it to be connected to all of the other repeaters. Similarly when any of the other repeaters starts to send signals, the output circuit of the repeater R will be disconnected from the line repeater, which is sending, but will remain connected to all of the other repeaters.

The invention may be more fully understood from the following detailed description of its operation. Let it be assumed that all of the line repeaters A, B and C are in an idle condition, and that line repeater A now begins to send signals. The signal coming in to line repeater A will cause the armature of its receiving relay RR to move to its spacing contact. This will close the following circuit: From ground, spacing contact of relay RR, conductor **1**, marking contact of relay A_2, conductors **2** and **3**, winding of relay A_1 to battery and ground. This will operate relay A_1 and cause it to move its armature to its spacing contact thereby completing the following circuit: from ground, spacing contact of relay A_1, conductor **5**, relay winding of repeater R, to battery and ground: Thus the spacing signal will be repeated from line repeater A to the regenerative repeater R. At the same time the spacing signal at line repeater A will complete the following circuit: from ground, spacing contact of relay RR, conductor **1**, marking contact of relay A_2, conductors **2** and **4**, winding of relay A_3, to battery and ground. This will operate relay A_3 and thereby disconnect the conductor **6** which is connected to the output circuit of repeater R from relay A_2, so that the spacing signal repeated by the repeater R will not operate relay A_2 and repeat the spacing signal back to the line repeater A. It is pointed out that there is approximately a 12 millisecond delay in the signals being transmitted through the regenerative repeater R, and hence relay A_3 has time to operate and break the circuit for relay A_2 before the spacing signal is repeated through the repeater R. When the repeater R repeats the spacing signal, it moves its armature to spacing and closes the following circuit: from ground, spacing contact of relay R, conductors **7**

and 8, contact and armature of relay B_3, winding of relay B_2 to battery and ground. This will operate relay B_2 and cause it to move its armature to its spacing contact thereby completing the following circuit: from ground, the spacing contact and armature of relay B_2, conductor 9, armature and marking contact of relay RR of line repeater B, winding of sending relay SR of line repeater B, to battery and ground. This will operate the sending relay SR of line repeater B and cause it to move its armature to its spacing contact and thus repeat the spacing signal to the telegraph line connected to line repeater B. In a similar manner the moving of the armature of the regenerative repeater R to its spacing contact will cause the operation of relay C_2 and result in the spacing signal being transferred to the sending relay SR of the line repeater C to repeat the spacing signal to the telegraph line connected with the line repeater C. When the relay A_3 operates, a locking circuit therefor is completed over the following path: from ground to lower middle armature of relay A_3, lower winding of relay A_3, conductor 10, lower contact and armature of relay A_3, conductor 11, lower break contact and armature of relay B_3, conductor 12, lower break contact and armature of relay C_3, to battery and ground. This will hold relay A_3 operated and keep the output of the regenerative repeater R disconnected from the line repeater A while it is sending.

From the foregoing it will be clear that transmission may thus continue from line repeater A to the line repeaters B and C until either of the line repeaters B or C send a spacing signal to break in on the line repeater A. Assume that the line repeater D desires to break and moves the armature of its receiving relay RR to its spacing contact. When a marking signal is transmitted by the output of the regenerative repeater R, relay B_2 has its armature positioned to its marking contact. This provides a path for the break signal from line repeater B to operate relay B_1 and cause it to move its armature to its spacing contact, thus transmitting a space signal into the regenerative repeater R, and to operate the relay B_3. The operation of relay B_3 at its upper contact armature opens the circuit for the operating winding of relay B_2 and prevents the output signals from the regenerative repeater R from interfering with a continuous break signal being transmitted into the repeater by the relay B_1. The operation of relay B_3 also opens the previously traced locking circuit for relay A_3, thereby allowing it to release when a marking signal is received from line repeater A. When line repeater A in response to the break signal stops sending, relay A_3 remains released and relay B_3 locks up over the following circuit: from ground lower middle contact of relay A_3, conductor 13, lower middle armature and make contact of relay B_3, conductor 14, lower armature and make contact of relay B_3, conductor 12, lower armature and break contact of relay C_3 to battery and ground. By this process the output circuit of the regenerative repeater R is disconnected from the line repeater B and is connected to the line repeaters A and C. Thus transmission may now take place from the line repeater B through the regenerative repeater R to the line repeaters A and C. The break operation with respect to other line repeaters, such as C, will be similar to the foregoing.

In Fig. 2 there is a modification of the arrangements of the invention adapted for a circuit employing neutral operation rather than inverse neutral operation as in Fig. 1. In Fig. 2 four line telegraph repeaters A, B, C and D are shown interconnected by the regenerative repeater R. Each of the line repeaters is provided with a receiving relay, such as RR, and a sending relay, such as SR. Each of the line repeaters will be provided with a series of control relays, such as A_1, A_2, A_3 and B_1, B_2, B_3, etc. Assume that all of the line repeaters A, B, C and D are idle, and line repeater A starts to transmit signals by moving the armature of its receiving relay RR to its spacing contact. This will close the following circuit: from ground and positive battery, spacing contact and armature of relay RR, conductor 15, windings of relay A_1 to ground. This will cause the relay A_1 to operate and move its armature to its spacing contact to close the following circuit: from ground, armature and spacing contact of relay A_1, conductor 16, relay winding of the regenerative repeater R to battery and ground. The operation of relay A_1 will remove a short-circuit from the battery 17 and allow current from the battery 17 to be transmitted over conductor 18 and through the winding of relay A_3 to ground, thereby operating relay A_3. The operation of relay A_3 will break at its upper armature and contact a circuit from the output of the regenerative repeater R through the operating winding of relay A_2 and thus prevent signals from the output of the regenerative repeater R from being repeated by relay A_2 back into the line repeater A. As heretofore pointed out, there is approximately a 12 millisecond delay in the signals being transmitted through the regenerative repeater R, and hence relay A_3 has a chance to operate and disable relay A_2 before the spacing signal is repeated through the regenerative repeater R. The relay A_3 will lock up over the following circuit: from ground, lower middle armature and make contact of relay A_3, conductor 19, lower armature and make contact of relay A_3, conductor 20, lower armature and break contact of relay B_3, conductor 21, lower armature and break contact of relay D_3, conductor 22, lower armature and break contact of relay C_3, to battery and ground. The space signal transmitted to the regenerative repeater R will cause it to move its armature to its spacing contact and apply ground to its output circuit, and thence over conductors 23, 24 and 25 to the operating windings of relays B_2, C_2 and D_2, thereby causing said relays to move their armatures to their spacing contacts. This will repeat the spacing signal to the line repeaters B, C and D, respectively. If all of the line repeaters were idle, and any one of the line repeaters other than A should start to send signals, the operation would be substantially the same as heretofore described.

From the foregoing it will be seen how transmission may take place from line repeater A through the regenerative repeater R to all of the other line repeaters such as B, C and D. If one of the other line repeaters, such, for example, as B, should now desire to break in on the line repeater A while it is sending, the operation is as follows: When the line repeater A is sending, relay A_3 is locked up, through the back contacts of relays B_3, D_3 and C_3, as heretofore pointed out. When the line repeater B wishes to break, it operates the armature of its receiving relay to its spacing contact, causing a spacing signal to be sent into the regenerative repeater through relay B_1 (even though line repeater A is sending a marking signal into the regenerative repeater R) and also operates relay B_3. The operation of relay B_3 breaks the previ-

ously traced locking circuit for relay A_3 and disconnects relay B_2 from the output of the regenerative repeater R. The breaking of the locking circuit of relay A_3 causes it to release when a marking signal is received from line repeater A, thus connecting relay A_2 to the output of the repeater for the duration of that marking signal. During this time the spacing signal from line repeater B through the regenerative repeater will position relay A_2 to its spacing contact causing a space signal to be sent to the line repeater A which will interrupt the transmission of signals from that line and cause the subscriber thereat to stop sending. Relay B_3 will lock up through the back contacts of the other B relays and transmission may now take place from the line repeater B to all of the other line repeaters, such as A, C and D in a manner similar to that heretofore pointed out.

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. A telegraph system comprising more than two lines and means to provide two-way transmission between any one of said lines and all of the others through a single one-way regenerative repeater.

2. A telegraph system comprising a plurality of lines, a single regenerative repeater and means whereby two-way transmission may be provided through said repeater between any one of said lines and more than one of the others.

3. A telegraph system comprising a plurality of lines, a single regenerative repeater and means whereby two-way transmission may be provided interchangeably through said repeater between any one of said lines and more than one of the others.

4. A telegraph system comprising a plurality of lines, a single regenerative repeater, means responsive to signals coming in over any one line to establish a connection through said repeater with all of the other lines, and means responsive to signals coming in over any one of said last mentioned lines for breaking said first connection and establishing a connection through said repeater from said last mentioned line with all of the other lines.

5. A telegraph system comprising a plurality of lines, a single regenerative repeater having its input and output circuits connected to all of said lines when said system is idle, and means controlled by the initial signals coming in over any one of said lines for disconnecting the output of said repeater from said line.

6. A telegraph system comprising a plurality of lines, a single regenerative repeater having its input and output circuits connected to all of said lines when said system is idle, means controlled by the initial signals coming in over a first one of said lines for disconnecting the output of said repeater from said line, and means controlled by subsequent signals coming in over a second one of said lines for reconnecting the output of said repeater to said first line and disconnecting the output of said repeater from said second line.

7. A telegraph system comprising a plurality of lines, a single regenerative repeater, a series of relays individual to each of said lines, each of said series having a first, a second and a third relay, each of said first relays being adapted to repeat signals from its line into said repeater, each of said second relays being adapted to repeat signals from said repeater into its line, each of said third relay being operative on the initial signals coming in from its line and being adapted when operative for disabling its associated second relay.

8. A telegraph system comprising a plurality of lines, a single regenerative repeater, a series of relays individual to each of said lines, each of said series having a first, a second and a third relay, each of said first relays being adapted to repeat signals from its line into said repeater, each of said second relays being adapted to repeat signals from said repeater into its line, each of said third relays being operative on the initial signals coming in from its line and being adapted when operative for disabling its associated second relay and a locking circuit for each of said third relays completed over contacts of the other third relays when unoperated.

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