Feb. 2, 1937. G. C. CUMMINGS 2,069,224

INTERCONNECTING TELEGRAPH REPEATER SYSTEM

Filed July 24, 1935

FIG. 1

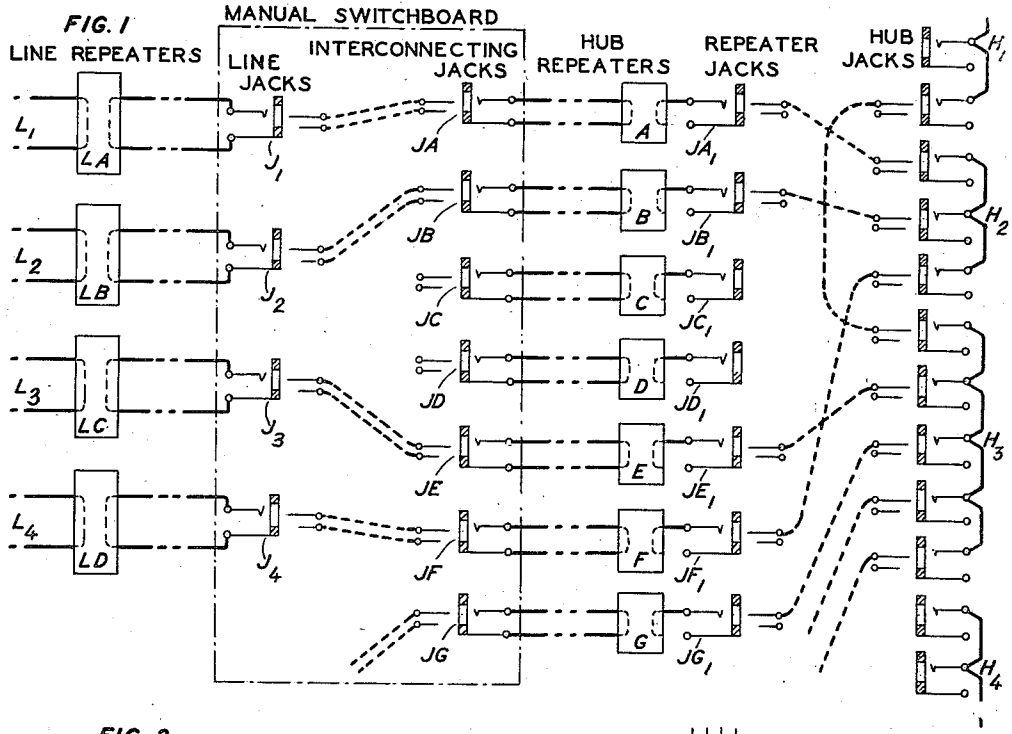
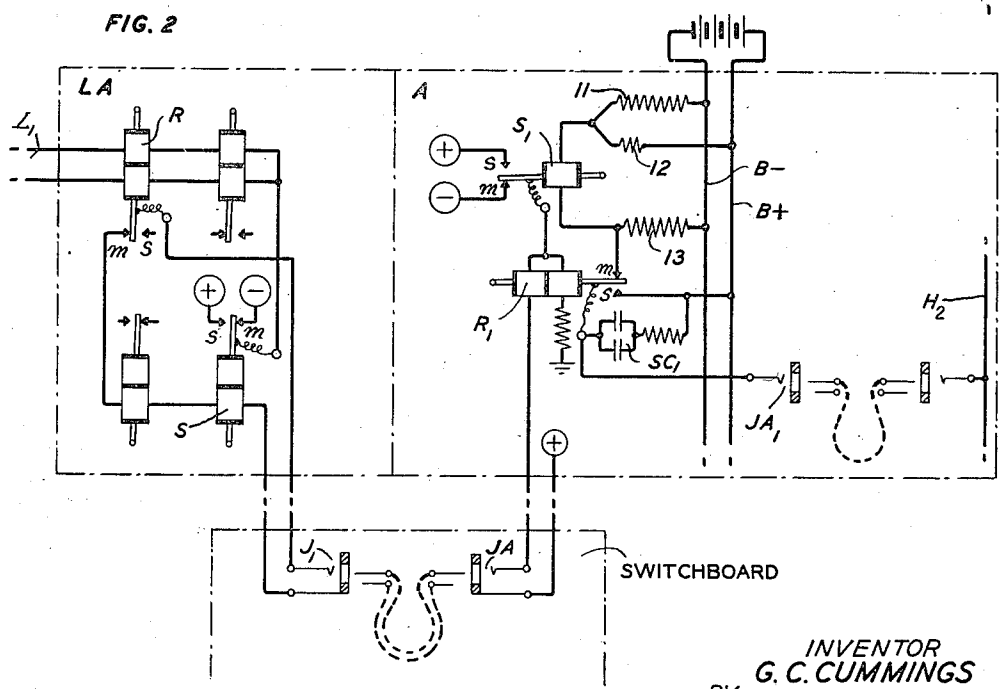


FIG. 2



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INTERCONNECTING TELEGRAPH REPEATER SYSTEM

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4 Claims. (Cl. 178—75)

This invention relates to telegraph repeating systems, and more particularly, to systems of this type which are adapted for intercommunication between a plurality of line circuits.

Main telegraph lines are usually terminated in a repeater station and the line side of the repeater is particularly designed and adjusted for the requirements of the line. The other side, usually called the loop side, is adapted for connection into a subscriber's line or loop circuit or else for connection to the loop side of another main line repeater for extension of the line circuit to another repeater station. It is frequently desirable to extend such a main line circuit into a plurality of other line circuits extending from the repeater station and this has hitherto been accomplished by insertion of additional repeaters. Thus, in one arrangement, disclosed in Patent 1,982,022 issued to E. V. Reeve, the lines would be interconnected in pairs through their line repeaters and the pairs would be interconnected by special repeaters, for example, of the type known as single line repeaters. This arrangement is complicated and has the further disadvantage that the signals are not repeated the same number of times in all the branch circuits and therefore will be subject to bias in different degrees.

It is an object of the invention to provide a more flexible arrangement for interconnection of a plurality of main telegraph lines for two-way communication between them.

It is another object of the invention to provide an interconnecting repeating system for main telegraph lines whereby the signals will pass through the same number of repeating stages from any one of the lines to the others.

It is a further object of the invention to provide an interconnecting repeater system for main telegraph lines whereby lines may be added or removed from the system without readjustment of the lines included in the system and without disturbance to messages being transmitted at the time.

In accordance with a feature of the invention, the loop side of main line repeaters are terminated in jacks on a switchboard and a plurality of interconnecting repeaters are also terminated in jacks on the same switchboard so that a line repeater may be connected to an interconnecting repeater by means of a simple two-way patching cord. Provision is furthermore made whereby the interconnecting repeaters may appear in groups each of which will serve to interconnect the lines patched to the group in accordance with each particular request.

The interconnecting repeater used for this purpose may be a single line repeater of a type recently suggested for interconnection of a large plurality of two-way circuits. Repeaters of this type may be interconnected either by a series circuit or a multiple circuit, usually termed the hub, and any one of the repeaters is adapted for transmitting signals over the hub circuit for simultaneous operation of all the other repeaters associated with the hub circuit. Thus, in accordance with this arrangement, a plurality of interconnecting or hub repeaters associated with a particular hub circuit may be patched to a plurality of line repeaters at the switchboard and each line will thereby be in two-way communication with the remaining lines associated with the hub.

In accordance with another feature of the invention, provision is made for interconnection of the hub repeaters in different numbers thereby making available at the switchboard groups of interconnecting repeaters including different numbers of interconnecting repeaters so that an interconnecting repeating set-up may be available on the switchboard which is suitable for the number of lines to be interconnected.

In accordance with a specific feature of the invention, the individual hub repeaters have their hub side terminated in a jack on the repeater panel and groups of other jacks directly interconnected are placed on the same repeater bay or in close proximity thereto; by means of patching cords between the repeater jacks and the hub jacks, any number of interconnecting repeaters may thus be grouped together for two-way intercommunication.

The invention will now be described as applied to a specific embodiment and reference will be made to the attached drawing in which:

Fig. 1 is a schematic layout showing a plurality of main telegraph lines terminating at a switchboard and interconnected by hub circuits, and

Fig. 2 is a circuit diagram showing details of a line repeater and a hub repeater interconnected as shown in Fig. 1, these repeaters being typical examples merely of arrangements suitable for interconnection as shown in Fig. 1.

Referring, now, particularly to Fig. 1, main telegraph lines L_1, L_2, L_3, etc., are connected through line repeaters LA, LB, LC, etc., to terminating jacks J_1, J_2, J_3, etc. The line repeaters are usually mounted on bays in the repeater room and a two-wire connection will be run from each

repeater to its line jack on the manual switchboard.

The line repeaters LA, LB, LC, etc., may be of different types depending upon the nature of the line and the signaling method used. However, the local or loop side of all the repeaters is unified for interconnection with any other line. Thus, whereas the line circuit may operate on a polar basis, the loop side of the repeater may operate on a neutral basis.

The diagram shown in Fig. 1, furthermore, includes a plurality of hub repeaters, A, B, C, D, etc., each terminating in a jack on a manual switchboard. The other side of each hub repeater terminates in a jack JA_1, JB_1, JC_1, etc., which is preferably mounted on the panel together with the hub repeater.

Hub repeaters of this type are described in an application of F. S. Kinkead and G. A. Locke, Serial No. 32,866, filed of even date with this application. In the application Serial No. 32,866, two types of hub repeaters are disclosed of which one type is adapted for multiple operation over the hub circuit and the other type for series operation over the hub circuit. Either of these two types of repeaters may be used for the purposes of this invention but in the preferred arrangement shown in Fig. 1, the multiple type is shown.

A plurality of hub jacks are placed in proximity to the hub repeaters and the jacks are interconnected in groups including different numbers of jacks by means of a single-wire multiple connection of each group, such as H_1, H_2, H_3, etc. By means of single-wire patching cords connected between the repeater jacks and the hub jacks, any desired set-up may be made.

Requests are frequently made for a set-up for certain lines which may be maintained for several hours or even for several days. Thus upon a request for a set-up including lines L_1, L_2, and L_4, in Fig. 1, patching cords would be inserted between jacks J_1 and JA, J_2 and JB, J_4 and JF on the manual switchboard. In the repeater room, patching cords would be inserted from a hub such as H_2 arranged for interconnection of three lines by patching cords to jacks JA_1, JB_1, and JF_1.

Signals incoming over line L_1 would be repeated by line repeater LA into hub repeater A which would repeat the signals over the hub H_2 into hub repeaters B and F in multiple and which, in turn, would repeat the signals into lines L_2 and L_4; signals incoming over line L_2 would be similarly repeated over lines L_1 and L_4 and signals incoming over L_4 would be repeated over lines L_1 and L_2.

The hub H_3 would provide for interconnection of five line circuits or if it were connected by a patching cord to another hub circuit, such as H_1, a still greater number of line circuits may be operated over the hubs H_1 and H_3.

At any time, any one of the lines, for example, line L_4 may be disconnected at the switchboard without disturbance to the communication between lines L_1 and L_2. In that case, it would also be possible to add line L_3 to the hub H_2 instead of line L_4 without disturbance to the communication between lines L_1 and L_2.

It will be noted that in the example of a set-up described above, the number of repeating stages will be the same for the signals no matter in which line they originate.

In order that a fuller understanding of the invention may be had, a more detailed description will now be given of the operation of one of the units shown in Fig. 1, such as the unit associated with line L_1 and reference will be made to Fig. 2 for this purpose.

The line L_1 terminates in the line repeater LA which may be of any desired type. The features of this repeater form no part of the invention and the circuit for this repeater is therefore, not shown complete. For a disclosure of a repeater circuit suitable for this purpose reference may be had to Patent 1,511,326 issued to J. M. Fell on October 14, 1924. The line circuit will be passed through the windings of a receiving relay R and over the contacts of a sending relay S. The loop side of this repeater should be the same as in the other line repeaters of the system to provide for freedom of interconnections. In the present arrangement, the loop circuit from the line jack J_1 on the switchboard is extended through a winding of the sending relay S and contacts on the receiving relay R.

The hub repeater A is of the general type disclosed in the Kinkead-Locke application Serial No. 32,866, already referred to, for multiple operation but is arranged in certain details in accordance with the disclosure in an application Serial No. 32,858, filed by me on even date herewith.

This repeater has a receiving relay connected to the interconnecting jack JA on the switchboard for reception of signals from the loop side of the repeater LA and has a single relay S_1 for transmission of signals into the loop side of repeater LA without operating relay R_1.

The receiving relay R_1 has its armature connected through jack JA_1 to the hub H_2; in marking position, the armature and the hub is connected to a resistance network 11, 12, 13 including the winding of relay S_1; in this manner the winding S_1 is connected from an intermediate potential supplied by battery over conductors B+ and B— through resistances 11 and 12 over the marking contact of relay R_1 to the hub H_2.

Assuming that lines L_2 and L_4 are similarly connected through repeaters B and F to the hub H_2, the windings of the sending relays in those repeaters will be similarly connected to the hub H_2 when the receiving relays in those repeaters are in marking position. The hub thus will be currentless during all-marking condition.

A spacing signal arriving over line L_1 will operate receiving relay R in repeater LA to open the loop circuit over jacks J_1 and JA and through the receiving relay R_1 in repeater A, thereby operating this relay to spacing in a well-known manner. Spacing potential from conductor B+ will thus be extended directly to the hub H_2. When a marking signal again arrives over line L_1, relay R will operate to marking and relay R_1 will return to its marking position, thus removing the spacing potential from hub conductor H_2.

Assuming, now, that a signal arrive over line L_2 to operate the receiving relay in repeater B to spacing, thereby applying a spacing potential from conductor B+ to the hub H_2, this potential would be extended over jacks JA_1 and JF_1 into the repeaters A and F; thus in repeater A, this spacing potential will be applied over the marking contact of relay R_1 to a point between resistance 13 and the winding of relay S_1 thereby reversing the direction of current in the winding of relay S_1, which consequently is operated to spacing. The spacing potential from relay S_1 is extended through the windings of relay R_1 without affecting this relay and over the jacks JA and J_1

to the loop circuit of repeater LA operating relay S to spacing for transmission of a spacing signal out over line L_1. The repeater F will be operated in the same manner to send spacing signal out over line L_4.

When relay R_1 operates to spacing, it disconnects the winding of relay S_1 and it is evident that the single circuit from conductor B+ over the spacing contact of relay R_1 and jack JA_1 and the hub H_2 would in no way be affected by the number of sending relays in other hub repeaters which may be simultaneously connected to the hub H_2. Furthermore, inasmuch as the windings of the sending relays are individually connected in circuit with their resistance networks between conductors B+ and B— and the hub H_2 and thus form independent multiple paths, each of these paths will in no way be affected by the number of such paths which may be simultaneously connected to the hub H_2. Therefore, hub repeaters may be added to or removed from the hub H_2 at will without in any way affecting the repeater A or any of the repeaters remaining in circuit.

In accordance with the disclosure of my application Serial No. 32,858, already referred to, the condenser circuit SC_1 provided for the protection of the spacing contact of relay R_1 is made of sufficient capacity to compensate for the travel time of the armature of relay R_1, thereby reducing the signal bias due to the armature travel time. The arrangement, furthermore, is such that, whereas the relay R_1, for example, may operate a number of sending relays in multiple in other repeaters and thus may carry a comparatively heavy current, the condenser network SC_1 includes a unit of capacity which is only a fraction of the total capacity required for the current load on the contact, and the unit of capacity is only of a size such as will be required for the operation of a single sending relay in another repeater. This arrangement is permissible since the condenser circuits in all the repeaters connected to a hub circuit will be connected in multiple and thus will be effective in protecting the contacts of any one of the receiving relays as well as in reducing the bias due to travel time of any one of the receiving relays.

From this it will be clear that no matter how many lines are interconnected through hub repeaters and a hub circuit, not only will the number of repeater stages be the same for signals incoming over any one of the lines, but the bias reduction will be in proportion to the number of lines interconnected and will in all cases be correct for the production of undistorted signals.

What is claimed is:

1. A telegraph repeating system comprising a plurality of at least three two-way terminal repeaters, an interconnecting repeater having one side serially connected to each of said terminal repeaters, and a circuit interconnecting the other side of said interconnecting repeaters in multiple for communication from any one of said terminal repeaters over the others of said terminal repeaters.

2. A telegraph repeating system comprising a plurality of two-way terminal repeaters, a plurality of two-way interconnecting repeaters each having one side serially connected to a corresponding one of said terminal repeaters and a multiple circuit interconnecting the other side of said interconnecting repeaters for two-way communication between any two or more of said terminal repeaters.

3. In a telegraph repeating station a plurality of at least three two-way repeaters each normally adapted for termination of a line section, a plurality of interconnecting repeaters, a local loop circuit from each interconnecting repeater to a corresponding one of said two-way repeaters, a plurality of connecting jacks permanently multiplied together, each of said interconnecting repeaters comprising a receiving relay having contacts for operating other interconnecting repeaters in response to signals from its associated two-way repeater and a transmitting relay for operating its associated two-way repeater in response to operation of the said contacts of another interconnecting repeater, and a plurality of patching circuits for connecting said multipled jacks to the said contacts of a desired plurality of said interconnecting repeaters.

4. In a telegraph repeating station a plurality of two-way terminal repeaters terminating in jacks, on a test board a plurality of two-way hub repeaters terminating on one side in jacks on said test board and terminating on the other side in repeater panel jacks, a plurality of other panel jacks permanently interconnected in groups of different numbers, patching cords for connecting a group of said other panel jacks to a corresponding number of said hub repeaters for two-way intercommunication between any one of them and the others, and patching cords for connecting said intercommunicating repeater groups to a plurality of said terminal repeaters in accordance with a requested set-up.

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