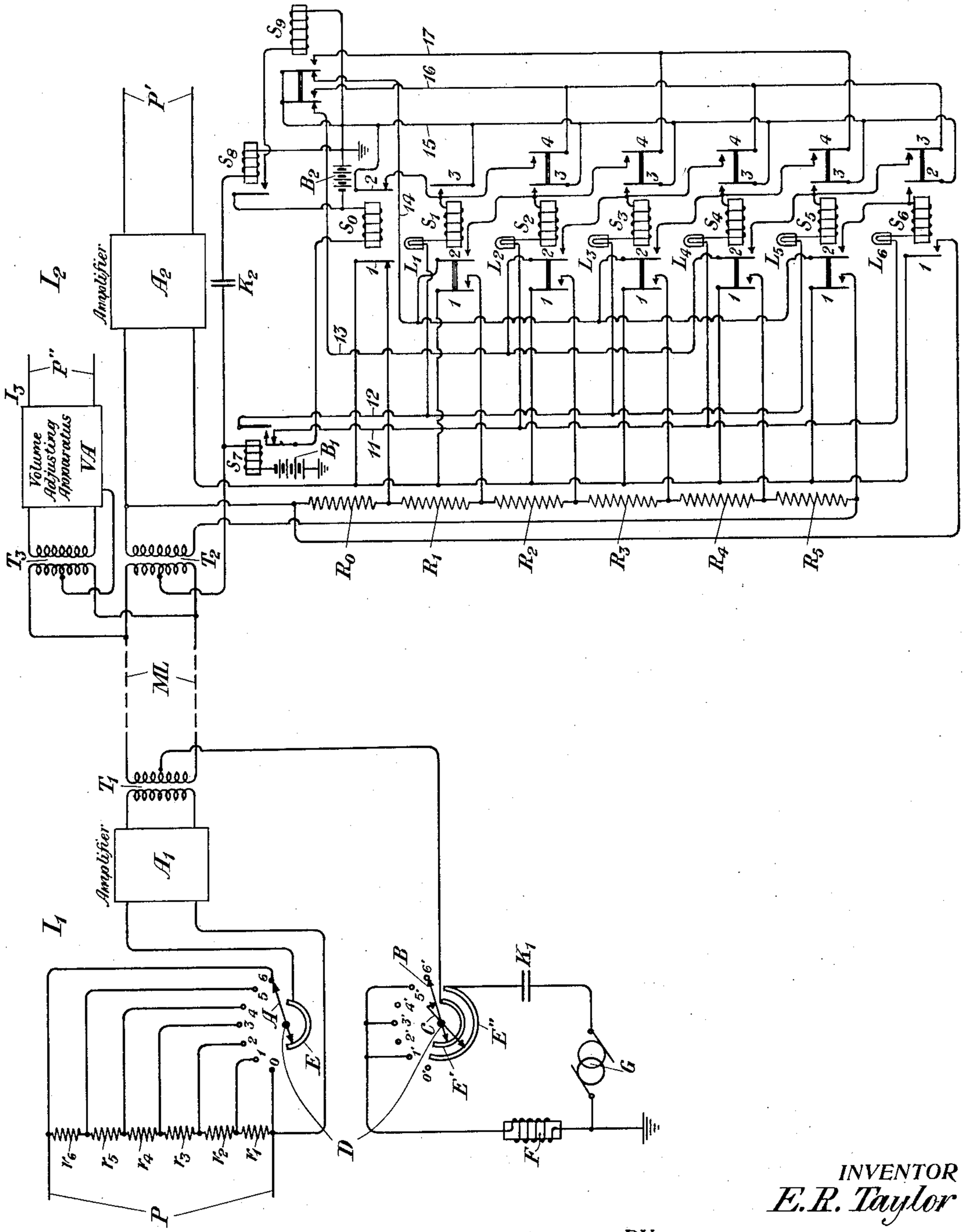
Dec. 17, 1929. E. R. TAYLOR 1,739,531

REMOTE CONTROL SYSTEM

Filed May 12, 1926



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Patented Dec. 17, 1929 1,739,531

UNITED STATES PATENT OFFICE

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REMOTE CONTROL SYSTEM

Application filed May 12, 1926. Serial No. 108,653.

This invention relates to volume control systems and particularly to arrangements in signaling systems for simultaneously controlling at a sending station the volume of transmission at a plurality of receiving stations of such systems.

The range of volume change occurring at the source of a program of news, music or the like is in many cases much greater than can conveniently be transmitted in a transmission system such as a radio broadcasting or public address system. The reasons for the limitation in the range of these systems are that if the transmitted energy rises to a great height, the system will be overloaded, causing the quality to be distorted; on the other hand, if the energy sinks to a low level it is drowned by interfering noises which are inherent to such systems. Accordingly, it is customary to regulate the gain of the amplifier at the sending station of such a system so that the transmitted energy is kept within the proper limits. This regulation becomes apparent at the receiving station in several ways, the most serious of which are perhaps as follows: (*a*) There is a sense of restrictedness or constraint as though the artist at the sending station was trying to swing into a full volume range but was continuously prevented from doing so; (*b*) the program is jerky and uneven because the average operator who controls the gain of the system cannot anticipate the extremes of the volume range and hence cannot smoothly control the volume between these extremes; (*c*) there is an inherent signal distortion due to the fact that the volume-amplification characteristic of the system is not maintained constant.

These difficulties, and numerous others of a lesser nature, can be alleviated to a large degree if the amplifier at the receiving end of the system is operated in such a manner that the over-all gain of the system is approximately constant at all times, i. e., the gain changes of the amplifier at a receiving station are equal to the gain changes of the amplifier at the sending station, and these changes are in opposite directions. Such a system can be brought about by arrangements which produce simultaneous and complementary changes in the gain of the amplifier at each receiving station when the gain of the amplifier at the sending station is changed.

In this invention there will be described the arrangements for accomplishing these ends, which employ comparatively inexpensive apparatus. It is to be understood, however, that in the particular embodiment of the invention to be described, in which the gain changes at each of a plurality of receiving stations are equal to the gain changes at the sending station, slight modifications well known to those skilled in the art may be made so that a change in the gain of the amplifier at the sending station will bear any fixed and predetermined relation to the change in the gain taking place at each of the receiving stations.

It may be said that it is one of the objects of this invention to provide a plurality of relays at each receiving station of a transmission system, one relay being associated with each of the steps of the volume adjusting means at each receiving station, so that as the volume at the sending station is changed, the relays at the receiving stations will be successively operated to bring about simultaneous and complementary changes in the volume.

It is a further object of this invention to provide a plurality of indicating devices, one indicating device associated with each step at each receiving station, so that there will be means for indicating the gain of the amplifier at each receiving station.

While the nature of the invention will be pointed out with particularity in the appended claims, the invention itself, both as to its further objects and features, will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention.

In the particular embodiment of the invention which is given merely for the purpose of illustration, there is one transmitting station I_1, and there are two receiving stations I_2 and I_3, the apparatus at the receiving station I_3 being identical with the apparatus

at the receiving station I_2 shown in detail. It may be said generally that at the sending station there are provided means for sending alternating current and pulses of direct current over a main line ML in accordance with changes in the gain of the amplifier at the sending station. Thus, there will be provided means for establishing a "make" or a "break" whenever it is desired to change the gain of the amplifier at each receiving station by one step. Alternating current and pulses of direct current are transmitted over the main line ML when it is desired to increase the gain of the amplifier at the sending station, whereas pulses of direct current are transmitted when it is desired to decrease the gain of the amplifier at the sending station. At each receiving station a plurality of relays S_0 to S_5, inclusive, are so arranged that each is associated with one of the resistances R_0 to R_5, inclusive, of the potentiometer at each receiving station, these relays being successively responsive in one direction to pulses of direct current and being similarly responsive in the opposite direction to alternating current and pulses of direct current. As stated above, it is one of the features of this invention to provide a plurality of indicating lamps L_1 to L_6, inclusive, to indicate the gain of the amplifier at each receiving station.

Two potentiometers are provided at the sending station, one of these in addition to the usual and well known gain control potentiometer. The resistances r_1 to r_6, inclusive, are connected across the source of supply P. The first potentiometer has an arm A, one end of which moves over taps 0 to 6, inclusive, to connect any number of the resistances r_1 to r_6, inclusive, to the amplifier A_1 at the sending station. The other end of the arm A moves over the conductor E. Thus the arm A is moved clockwise or counterclockwise as the gain of the amplifier at the sending station is to be increased or decreased, respectively. The other potentiometer has an arm B mounted on a shaft D which is common also to the arm A of the first potentiometer. The arms A and B are so arranged as to rotate together and to make corresponding contacts at the same time, but they are insulated electrically from each other. One end of the arm B moves over taps 0′ to 6′, inclusive, the taps 1′, 3′ and 5′ being connected to ground through a choke coil F, the other end of the arm B moving over a conductor E′. A third arm C is also mounted on the shaft D. The arm C is arranged so as to drive both arms A and B, making electrical contact with the arm B when the rotation is clockwise to increase the gain of the amplifier at the sending station, but is insulated from the arm B when the rotation is counterclockwise to decrease the gain of the amplifier at the sending station. One end of the arm C moves over a conductor E″, which is connected through a condenser K′ to a source of alternating current G. Accordingly, when the arm C is rotated clockwise to increase the gain of the amplifier at the sending station, alternating current and pulses of direct current are transmitted over the main line ML. The alternating current circuit between stations I_1 and I_2 includes the alternating current generator G, the condenser K_1, the conductor E″, the arm C, the arm B, the conductor E′, the secondary winding of the transformer T_1, the main line ML, the primary winding of the transformer T_2, a condenser K_2 and a relay S_8. The direct current circuit between these stations includes the choke coil F, the arm B, the conductor E′, the secondary winding of the transformer T_1, the main line ML, the primary winding of the transformer T_2, a relay S_7 and a battery B_1. The choke coil F prevents the alternating current of the generator G from being short-circuited through the potentiometer, and similarly the condenser K_1 prevents the arm C from being connected to ground through the generator G.

As shown in the figure arm A rests on tap 6 connecting resistances r_1 to r_6, inclusive, to the input of the amplifier A_1 at the sending station I_1 for the condition of maximum gain at that station. Arm B rests on tap 6′, and therefore the direct current circuit heretofore described is open. None of relays at the receiving station I_2 are operated, and hence the input of the amplifier A_2 is connected across the resistance R_0 through the armature 1 of the relay S_0.

When the arm B moves from tap 6′ to tap 5′ and makes electrical contact with tap 5′, the relay S_7 becomes energized so that current flows from a battery B_2 through the winding of relay S_0, conductor 12, indicating lamp L_1, the winding of the relay S_1, the armature 2 of the relay S_0 and ground. The armature 3 of the relay S_1 becomes attracted to connect ground to the winding of the relay S_1 before the armature 2 of the relay S_0 opens its contact. When the armature 1 of the relay S_1 closes its contact resistances R_0 and R_1 are connected to the input of the amplifier A_2, and shortly afterwards the armature 1 of the relay S_0 opens, disconnecting the circuit which formerly connected the input of the amplifier A_2 with the resistance R_0, and hence the gain of the amplifier A_2 is increased without its input being open-circuited. When the arm B moves counterclockwise from tap 5′ to tap 4′ and makes electrical contact with the tap 4′, the relay S_7 becomes deenergized so that current now flows from the battery B_2 through the winding of the relay S_0, conductor 11, the indicating lamp L_2, the winding of the relay S_2, the armature 2 of the relay S_1, conductor 14 and ground. The armature 3 of the relay S_2, connects ground to

the winding of said relay before the relay S_1 becomes deenergized. When the armature 1 of the relay S_2 closes its contact, resistances R_0 to R_2, inclusive, are connected to the input of the amplifier A_2.

As the arm B moves counterclockwise from tap 4′ to tap 3′ and makes electrical contact with tap 3′, the relay S_7 becomes energized by the flow of current from the battery B_1 therethrough. Current now flows from battery B_2 through the winding of the relay S_0, conductor 12, the indicating lamp L_3, the winding of the relay S_3, the armature 2 of the relay S_2, conductor 13 and ground. The armature 3 of the relay S_3 connects ground to the winding thereof before the relay S_2 becomes deenergized. When the armature 1 of the relay S_3 closes its contact, resistances R_0 to R_3, inclusive, are connected to the input of the amplifier A_2. When the arm B moving counterclockwise makes contact with the tap 2, the relay S_7 becomes deenergized so that current now flows from the battery B_2 through the winding of the relay S_0, conductor 11, the indicating lamp L_4, the winding of the relay S_4, the armature 2 of the relay S_3, conductor 14 and ground. The armature 3 of the relay S_4 connects ground to the winding thereof before the relay S_3 becomes deenergized.

As the arm B moves counterclockwise and makes electrical contact with the tap 1′, the relay S_7 becomes energized so that current flows from the battery B_2 through the winding of the relay S_0, conductor 12, the indicating lamp L_5, the winding of the relay S_5, the armature 2 of the relay S_4, conductor 13 and ground. The armature 3 of the relay S_5 puts ground on the winding of said relay, before the relay S_4 becomes deenergized. When the armature 1 closes its contact, resistances R_0 to R_5, inclusive, are connected to the input of the amplifier A_2. Finally, as the arm B moves counterclockwise away from tap 1′, the relay S_7 becomes deenergized, so that current flows from the battery B_2 through the winding S_0, conductor 11, the indicating lamp L_6, the winding of the relay S_6, the armature 2 of the relay S_5, conductor 14 and ground. The armature 2 puts ground on the winding of the relay S_6 before the relay S_5 becomes deenergized. The armature 1 of the relay S_6, by closing its contact, brings about a short-circuit for the input of the amplifier A_2 so that no signals may be transmitted through the amplifier A_2.

To increase the gain of the amplifier A_1 at the sending station I_1, the arm C drives the arm B in a clockwise direction. The arms B and C make electrical contact with each other, and alternating current is sent over the line ML, causing relay S_8 to become energized, and remain energized as long as it is desired to increase the gain of the amplifier A_1 at the sending station I_1. Consequently, the relay S_9 becomes energized by the flow of current through the winding of said relay from the battery B_2. No change is yet effected in the system. As the arm C drives the arm B clockwise to the point where the arm B makes electrical contact with the tap 1′, the relay S_7 becomes energized and the relays S_8 and S_9 remain energized. Moreover, the relays S_0 and S_6 momentarily remain energized on account of the make-before-break contacts of relay S_7, so that current now flows from the battery B_2 through the winding of the relay S_0, the conductor 12, the indicating lamp L_5 and the winding of the relay S_5, the armature 3 of the relay S_6, conductor 16 and ground. The armature 3 of the relay S_5 puts ground on the winding of said relay before the relay S_6 becomes deenergized. When the armature 1 of the relay S_5 closes its contact, resistances R_0 to R_5, inclusive, are connected to the input of the amplifier A_2. As the arm C moves the arm B clockwise to the point where it makes electrical contact with the tap 2′, the relay S_7 becomes deenergized, whereas relays S_8 and S_9 remain energized. Current now flows from battery B_2 through the winding of the relay S_0, conductor 11, the indicating lamp L_4, the winding of the relay S_4, the armature 4 of the relay S_5, conductor 17 and ground. Armature 3 of relay S_4 puts ground on the winding of said relay before the relay S_5 becomes deenergized. When the armature 1 of the relay S_4 closes its contact, resistances R_0 to R_4 are connected to the input of the amplifier A_2. When the arm B makes electrical contact with the tap 3′, the relay S_7 becomes energized so that current flows from the battery B_2 through the winding of the relay S_0, the conductor 12, indicating lamp L_3, the winding of the relay S_3, armature 4 of the relay S_4, conductor 16 and ground. Armature 3 of the relay S_3 locks the winding of said relay. Resistances R_0 to R_3, inclusive, are now connected to the input of the amplifier A_2.

When the arm B makes contact with the tap 4′, the relay S_7 becomes deenergized and current flows from the battery B_2 through the winding of relay S_0, conductor 11, indicating lamp L_2, winding of the relay S_2, the armature 4 of the relay S_3, conductor 17 and ground. Armature 3 locks the winding of said relay. Resistances R_0 to R_2, inclusive, are now connected to the input of the amplifier A_2. When the arm B makes contact with the tap 5′, relay S_7 becomes energized and current flows from the battery B_2 through the winding of the relay S_0, conductor 12, indicating lamp L_1, the winding of the relay S_1, armature 4 of the relay S_2, conductor 16 and ground. The armature 3 of the relay S_1 locks the winding of said relay. Resistances R_0 and R_1 are now connected to the input

of the amplifier A_2. When arm B makes contact with the tap 6′, relay S_7 becomes deenergized, and relays S_0 and S_1 also become deenergized. Resistance R_0 is then connected to the input of the amplifier A_2 by armature 1 of the relay S_0.

It is to be specially noted that the control of the volume takes place at one station which has a control device thereat for controlling the transmission of alternating current and pulses of direct current to operate a plurality of relays located at two or more other stations, the apparatus at one of which is shown in detail. Whenever the gain of the amplifier at the sending station increases, there will be a simultaneous and complementary change in the gain of the amplifier at each of the receiving stations. Indicating devices provide means for quickly determining the state of the volume transmitted over the main line of the system.

It is to be understood that, while in the embodiment of the invention shown herein alternating current and pulses of direct current are transmitted over the main line of the system to effect simultaneous and complementary changes in the gain of the amplifiers at the sending and receiving stations of the system, it is within the scope of this invention to provide any pair of alternating currents of different frequencies in place of the alternating current and the direct current (which obviously has zero frequency) or to use current reversals well known in the art for accomplishing these objects.

While the invention has been shown and described in one particular embodiment, it is to be distinctly understood that the invention is capable of embodiment in other and widely varied arrangements without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a transmission system, a transmitting medium interconnecting a sending station and a plurality of receiving stations, volume adjusting means at each station, a control switch at the sending station, a plurality of relays at each receiving station, means operated by a change in the setting of said switch to transmit alternating current and pulses of direct current between said stations for rendering said relays responsive to said impulses to effect simultaneous and complementary adjustments of the volume at the sending and the receiving stations.

2. In a transmission system, a transmitting medium interconnecting a sending station and a receiving station, volume adjusting means at each station, a control switch at the sending station, said control switch controlling the transmission of alternating current and successive pulsations of direct current as the volume at the sending station is increased and of successive pulsations of direct current as the volume at the sending station is decreased, and step-by-step means responsive to the transmission of said pulsations to simultaneously effect equal and complementary step-by-step adjustments of the volume at the receiving station as are taking place at the sending station.

3. In a transmission system, a transmitting medium interconnecting a sending station and a receiving station, volume adjusting means at each station, a control switch at the sending station, said control switch simultaneously controlling the volume at both the sending and receiving stations, said control switch transmitting alternating current and successive pulsations of direct current as the volume at the sending station is increased, said control switch transmitting successive pulsations of direct current as the volume at the sending station is decreased, and step-by-step means responsive to the transmission of said pulsations to simultaneously effect equal and complementary step-by-step adjustments of the volume at the receiving station as are taking place at the sending station.

4. In a transmission system, a transmitting medium interconnecting a sending station and a receiving station, volume adjusting means at each station, means at the sending station for controlling the volume at both the sending and receiving stations, means operated by said controlling means for transmitting direct current and alternating current impulses through the transmitting medium between stations, a plurality of relays at the receiving station, means for rendering said relays responsive to said impulses to effect simultaneously complementary adjustments of the volume at the sending and receiving stations, and means for indicating the state of the volume adjusting means.

5. In a transmission system, a main line interconnecting a sending station and a receiving station, volume adjusting means at each station, a switch at the sending station for controlling the volume adjusting means thereat, means responsive to the manipulation of said switch in one direction to transmit characteristic direct current impulses over the main line, means responsive to the manipulation of said switch in the opposite direction to transmit alternating current of suitable frequency and other characteristic direct current impulses over the main line, and a plurality of relays at the receiving station for controlling the volume adjusting means thereat, said relays at the receiving station being operated successively in one order in response to said alternating current and the characteristic direct current impulses transmitted over the main line to decrease the volume, said relays at the receiving station

being operated successively in reverse order in response to the other characteristic direct current impulses transmitted over the main line to increase the volume.

6. In a transmission system, a main line interconnecting a sending station and a receiving station, volume adjusting means at each station, a switch at the sending station for controlling the volume adjusting means thereat, means responsive to the manipulation of said switch in one direction to transmit alternating current of suitable frequency and characteristic direct current impulses over the main line, means responsive to the manipulation of said switch in the opposite direction to transmit other characteristic direct current impulses over the main line, a plurality of relays at the receiving station for controlling the volume adjusting means thereat, said relays at the receiving station being operated successively in one order in response to said alternating current and the characteristic direct current impulses transmitted over the main line, said relays at the receiving station being operated successively in the reverse order in response to the other characteristic direct current impulses transmitted over the main line, and means associated with said relays for indicating the state of the volume adjusting means at the receiving station.

7. In a transmission system, a main line interconnecting a sending station and a receiving station, volume adjusting means at each station, a switch at the sending station for controlling the volume adjusting means thereat, means responsive to the manipulation of the switch in one direction to transmit alternating current of suitable frequency as well as direct current pulsations over the main line, means responsive to the manipulation of the switch in the other direction to transmit other direct current pulsations over the main line, a plurality of relays at the receiving station for controlling the volume adjusting means thereat, means for successively operating the relays in one order in response to said alternating current of suitable frequency and said direct current pulsations, and means for successively operating the relays in the other order in response to the other direct current pulsations.

8. In a transmission system, a main line interconnecting a sending station and a receiving station, volume adjusting means at each station, a switch at the sending station for controlling the volume adjusting means thereat, means responsive to the manipulation of the switch in one direction to transmit current of one frequency over the main line, means responsive to the manipulation of the switch in the other direction to transmit current of another frequency over the main line, a plurality of relays at the receiving station for controlling the volume adjusting means thereat, means for successively operating the relays in one or the other order in response to current of one or the other frequency, and means for indicating the state of the volume indicating means.

9. In a transmission system, a main line interconnecting a sending station and a receiving station, volume adjusting means at each station, a switch at the sending station for controlling the volume adjusting means thereat, means responsive to the manipulation of the switch in one direction to transmit pulses of direct current over the main line, means responsive to the manipulation of the switch in the other direction to transmit alternating current and pulses of direct current over the main line, a plurality of relays at the receiving station for controlling the volume adjusting means thereat, means for successively operating the relays in one order in response to the pulses of direct current, means for successively operating the relays in the other order in response to alternating current and pulses of direct current, and volume indicating means at the receiving station.

10. A system for simultaneously controlling from a central station the gain of a plurality of amplifiers at remote stations, the amplifiers at the various remote stations being connected to the central station by a common transmitting medium suitable for the transmission of speech, including means for transmitting characteristic alternating current impulses over said transmitting medium between the central station and all of the remote stations when the gain is to be changed, and a plurality of relays at each remote station successively responsive to said characteristic alternating current impulses to produce the required change in the gain.

11. A system for simultaneously controlling from a central station the volume of transmission at a plurality of remote stations, comprising means whereby the volume changes at each remote station and the volume changes at the central station may be produced which are equal and complementary, said volume changes at each remote station being effected by means producing combinations of alternating current of suitable frequency and characteristic direct current pulsations and other means responsive to said alternating current and said characteristic direct current pulsations.

12. A signaling system comprising a central station, a plurality of distant stations, a common transmitting medium interconnecting said central station and said distant stations suitable for carrying speech, and means transmitting combinations of alternating current of suitable frequency and characteristic direct current pulsations over said transmitting medium and other means connected to said transmitting medium re-

sponsive thereto for rendering equal and complementary volume changes at each of the distant stations as are taking place at the central station.

In testimony whereof, I have signed my name to this specification this 11th day of May, 1926.

EDMUND R. TAYLOR.