

94 = 6

X 44

X 340
366

X 323
79

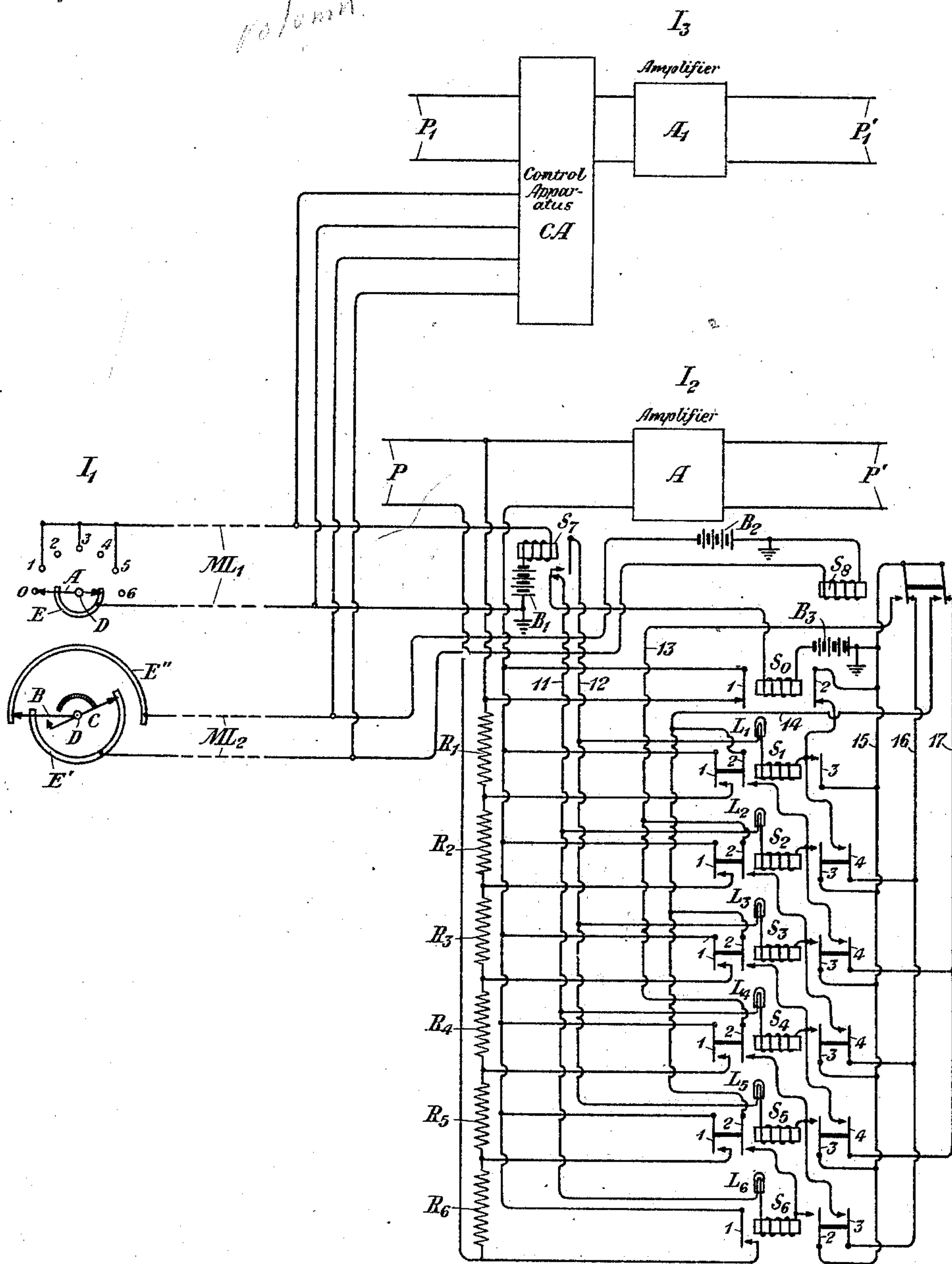
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REMOTE CONTROL OF REPEATERS

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BY

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REMOTE CONTROL OF REPEATERS

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This invention relates to remote control systems, and particularly to arrangements for remotely controlling the gain of a plurality of amplifiers each located at a repeater station.

It is often desirable to control the gain of a plurality of amplifiers from a point remote from said amplifiers. A common example of this is the cord circuit repeater system where the gain of a plurality of amplifiers must be controlled at a toll switchboard, each amplifier being often located in a repeater room which is located at a point a considerable distance from a toll switchboard. Accordingly this invention comprises means for simultaneously controlling the gain of a plurality of amplifiers by means of a control device remote from said amplifiers, the apparatus required to carry this out being comparatively inexpensive.

One embodiment of this invention is shown herein merely for the purpose of illustration. In this embodiment of the invention two transmitting media interconnect a control station and each one of a plurality of repeater stations. Means are provided for alternately closing and opening a direct current path of a signaling circuit connected to one of the transmitting media in such a manner that a "make" or a "break" occurs whenever it becomes desirable to change the gain of the amplifier. Means are also provided for closing a direct current path of another signaling circuit connected to another of the transmitting media whenever it becomes desirable to increase the gain of the amplifier. At each amplifier station a plurality of relays are provided which are operated by the currents flowing over the signaling circuits connected to the transmitting media. These relays become electrically responsive successively in one direction when direct current and pulses of current flow over the signaling circuits through the corresponding transmitting media in order to increase the gain of each amplifier, and these relays become electrically responsive successively in the other direction when pulses of current flow in one signaling circuit through its associated transmitting medium and no current flows in the

other signaling circuit, in order to decrease the gain of each amplifier. Moreover, a plurality of indicating lamps are provided at each repeater station to show at any time the state of the gain adjusting means at that station.

While the nature of the invention will be pointed out with particularity in the appended claims, the invention itself both as to its 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, which comprises a control station I_1 and two repeater stations I_2 and I_3 , the amplifiers at these repeater stations being controlled from the control station I_1 .

In the drawing there will be found a control device at the control station I_1 . This control device comprises three conductors E, E' and E'' over which pass arms A, B and C respectively. The arm A is mounted on a shaft D, one end of the arm A moving over taps 0—6 inclusive, and the other end of the arm A moving over the conductor E. Taps 1, 3 and 5 are connected to one side of a transmission path ML_1 , conductor E being connected to the other side of the transmission path ML_1 . The taps 0, 2, 4 and 6 are isolated from the transmission path ML_1 . The arm B is also mounted on the shaft D and is rigidly connected mechanically to the arm A so that these arms A and B move together but are electrically insulated from one another. The other arm C is also mounted on the shaft D and is so arranged that it drives arms A and B. When the arm C is rotated in a clockwise direction it (arm C) makes electrical contact with arm B, thereby closing the transmission path ML_2 . Yet when the arm C is rotated in a counterclockwise direction, it is insulated from the arm B thereby maintaining the transmission path ML_2 open.

For the sake of convenience, the apparatus at only one of the repeater stations I_2 will be described herein in detail, the apparatus at I_3 being the same as that at I_2 . A relay S_7 is located at the repeater station I_2 in series with a battery B_1 and the transmission path

ML₁. As the arm A of the control device at the control station I₁ moves in either direction, pulses of direct current pass through the winding of the relay S₇ causing it to become energized and deenergized alternately. A relay S₈ is also located at the repeater station and is in series with the battery B₂ and the transmission path ML₂. Inasmuch as the transmission path ML₂ becomes closed only when the arm C is rotated in a clockwise direction, the winding of the relay S₈ will therefore become energized only when the arm C is rotated in a clockwise direction. This embodiment of the invention is so arranged that when it is desired to increase the gain of the amplifier A at the repeater station, the arm C is rotated in a clockwise direction so that the relay S₈ becomes energized and the relay S₇ becomes alternately energized and deenergized. When the gain of the amplifier A is to be decreased, the arm C is rotated in a counterclockwise direction so that the relay S₈ becomes deenergized, while the relay S₇ still becomes alternately energized and deenergized.

A plurality of resistances R₁ to R₆, inclusive, are connected across the input circuit P of the amplifier A. When the gain of the amplifier A is to be increased, the input of the amplifier is connected across more of these resistances, and vice versa, when the gain of the amplifier is to be decreased, the input of the amplifier is connected across fewer of these resistances. A plurality of relays S₀ to S₆ inclusive are located at the repeater station. These relays become successively responsive in one direction when the gain of the amplifier is to be increased and become successively responsive in the opposite direction when the gain of the amplifier is to be decreased. Relays S₁ to S₆, inclusive, correspond, respectively, to resistances R₁ to R₆, inclusive. A plurality of indicating lamps L₁ to L₆, inclusive, are also located at the repeater station, these lamps corresponding, respectively, to relays S₁ to S₆, inclusive.

When arm A is on tap 0, the relay S₇ is deenergized and relay S₈ is either energized or deenergized, depending upon whether or not the arm C makes electrical contact with the arm B. The armatures 1 and 2 of the relay S₀ are normally closed, and remain closed, until current flows through the winding of the relay S₀. The input of the amplifier A is short-circuited through the armature 1 of the relay S₀. When the arm A moves in a clockwise direction and makes electrical contact with tap 1, relays S₇ and S₈ become energized, attracting their respective armatures. Accordingly, current flows from battery B₃ through the winding of a relay S₀, conductor 12, the indicating lamp L₁, the winding of the relay S₁, armature 2 of the relay S₀ and ground. Yet before armature 2 of the relay S₀ opens its contact

because of the flow of current through the winding thereof, armature 3 of the relay S₁ closes its contact, locking the winding of the relay S₁ to ground through the conductor 15. When armature 1 of relay S₁ closes its contact, the input of the amplifier A is connected across the resistance R₁, thereby increasing the gain of the amplifier as soon as the armature 1 of the relay S₀ opens its contact.

When the arm A moves in a clockwise direction toward tap 2, and opens its contact with tap 1, the winding of the relay S₇ becomes deenergized and the winding of the relay S₈ remains energized. The current now flows from the battery B₃ through the winding of the relay S₀, conductor 11, the indicating lamp L₂, the winding of the relay S₂, the armature 2 of the relay S₁, conductor 14 and ground. By virtue of the "make-before-break" feature of the armatures of relay S₇, the winding of the relay S₂ becomes locked by the armature 3 of the relay S₂ through conductor 15 before the armature 2 of the relay S₁ opens its contact. When the armature 1 of the relay S₂ closes its contact, the input of the amplifier A becomes connected across the resistances R₁ and R₂, thereby increasing the gain of the amplifier.

When the arm A moves further in a clockwise direction and makes electrical contact with the tap 3, the winding of the relay S₇ becomes energized and the winding of the relay S₈ remains energized. Current then flows from battery B₃ through the winding of the relay S₀, conductor 12, the indicating lamp L₃, the winding of the relay S₃, armature 2 of the relay S₂, conductor 13 and ground. Armature 3 of the relay S₃ connects ground to the winding of the relay S₃ through conductor 15 before armature 2 of the relay S₂ opens its contact. By the closure of the contact associated with armature 1 of the relay S₃, resistances R₁ to R₃, inclusive, are connected to the input of the amplifier A, thereby increasing the gain of the amplifier.

When the arm A moves in a clockwise direction away from tap 3 and toward tap 4, the winding of the relay S₇ becomes deenergized and the winding of the relay S₈ remains energized. Current now flows from battery B₃ through the winding of the relay S₀, the conductor 11, the indicating lamp L₄, the winding of the relay S₄, the armature 2 of the relay S₃, conductor 14 and ground. Armature 3 of the relay S₄ connects ground to the winding of the relay S₄ through conductor 15 before armature 2 of the relay S₃ opens its contact. By the closure of the contact associated with armature 1 of the relay S₄, resistances R₁ to R₄, inclusive, are connected to the input of the amplifier A.

When the arm A moves beyond tap 4 in a clockwise direction and makes electrical contact with tap 5, the winding of the relay S₇ be-

1,739,532

3

comes energized and the winding of the relay S_8 remains energized. Current flows from battery B_3 through the winding of the relay S_0 , conductor 12, the indicating lamp L_5 , the winding of the relay S_5 , armature 2 of the relay S_4 , conductor 13 and ground. Armature 3 of the relay S_5 connects ground to the winding of the relay S_5 through conductor 15 before armature 2 of the relay S_4 opens its contact. By the closure of the contact associated with armature 1 of the relay S_5 , resistances R_1 to R_5 inclusive are connected to the input of the amplifier A.

As the arm A moves away from tap 5 in a clockwise direction, the winding of the relay S_8 remains energized while the winding of the relay S_7 becomes deenergized. Consequently current flows from the battery B_3 through the winding of the relay 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. Armature 3 of the relay S_6 connects ground to the winding of the relay S_6 through conductor 15 before the armature 2 of the relay S_5 opens its contact. By the closure of the contact associated with the armature 1 of the relay S_6 , all of the resistances R_1 to R_6 , inclusive, are connected to the input of the amplifier A, so that the amplifier A may operate at its maximum gain.

Thus, it has been seen that as the arm A of the control device at the control station I_1 moves in a clockwise direction, the winding of the relay S_8 is energized, while the winding of the relay S_7 becomes energized and deenergized alternately. The relays S_1 to S_6 are progressively responsive in a downward direction connecting one or more of the resistances R_1 to R_6 , inclusive, to the input of the amplifier A, thereby increasing the gain of the amplifier.

When the arm A moves in a counterclockwise direction, the arms B and C at the control station I_1 are insulated from each other so that the circuit which includes the battery B_2 , the winding of the relay S_8 and the transmission path ML_2 is opened, the winding of the relay S_8 becoming deenergized. When the arm A is at or near tap 6, the winding of the relay S_7 is deenergized, so that current flows from the battery B_3 through the winding of the relay S_0 , conductor 11, the indicating lamp L_6 , the winding of the relay S_6 , armature 3 of the relay S_6 , conductor 15 and ground. The input of the amplifier A is then connected across all of the resistances R_1 to R_6 , inclusive, as has already been shown.

When the arm A moves in a counterclockwise direction and makes electrical contact with tap 5, the winding of the relay S_7 becomes energized, while the winding of the relay S_8 remains deenergized. Current now flows from Battery B_3 through the winding of the relay S_0 , conductor 12, the indicating lamp L_5 , the winding of the relay S_5 , armature 3 of the

relay S_6 , conductor 16 and ground. Armature 3 of the relay S_5 connects ground to the winding of the relay S_5 through conductor 15 before armature 3 of the relay S_6 opens its contact. The armature 1 of the relay S_6 opens its contact, just after the armature 1 of relay S_5 closes its contact. Consequently the input of the amplifier A is connected across the resistances R_1 to R_5 , inclusive.

When the arm A moves in a counterclockwise direction away from tap 5 and toward tap 4, the winding of the relay S_7 becomes deenergized and current flows from the battery B_3 through the winding of the relay S_0 , conductor 11, the indicating lamp L_4 , the winding of the relay S_4 , armature 4 of the relay S_5 , conductor 17 and ground. Armature 3 of the relay S_4 connects ground to the winding of the relay S_4 , through conductor 15 before armature 4 of the relay S_5 opens its contact. The armature 1 of the relay S_4 closes its contact shortly before the armature 1 of the relay S_5 opens its contact. Thereafter the input of the amplifier A is connected across the resistances R_1 to R_4 inclusive.

As the arm A continues in a counterclockwise direction and makes contact with tap 3, the winding of the relay S_7 becomes energized so that current flows from the battery B_3 through the winding of the relay S_0 , conductor 12, the 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 connects ground to the winding of the relay S_3 through conductor 15 before armature 4 of the relay S_4 opens its contact. The armature 1 of the relay S_3 closes its contact shortly before the armature 1 of the relay S_4 opens its contact and the input of the amplifier A is connected across resistances R_1 to R_3 , inclusive.

When arm A moves in a counterclockwise direction away from tap 3 and toward tap 2, the winding of the relay S_7 becomes deenergized so that current flows from the battery B_3 through the winding of the relay S_0 , conductor 11, the indicating lamp L_2 , the winding of the relay S_2 , the armature 4 of the relay S_3 , conductor 17 and ground. The armature 3 of the relay S_2 connects ground to the winding of the relay S_2 through conductor 15 before armature 4 of the relay S_3 opens its contact. The armature 1 of the relay S_2 closes its contact shortly before the armature of the relay S_3 opens its contact and the input of the amplifier A is connected across the resistances R_1 and R_2 .

As the arm A moves in a counterclockwise direction away from tap 1, the windings of the relays S_7 and S_8 are both deenergized, and the winding of the relay S_7 becomes deenergized because no current flows through the winding of that relay from the battery B_3 . Consequently the armature 1 of the relay S_0 closes its contact, putting a short circuit on

the input of the amplifier A. Thus, it is seen that the relays S_1 to S_6 , inclusive, are progressively responsive in the opposite direction as pulses of direct current are transmitted over the transmission path ML_1 . As these relays become successively energized, one or more of the resistances R_1 to R_6 , inclusive, are disconnected from the input of the amplifier A so that the gain of this amplifier is decreased.

It is to be specially noted that the control of the gain of a plurality of amplifiers each at a repeater station takes place by means of a control device located at a remote station, the control being effected by the transmission of direct current over one transmission path and pulses of direct current over another transmission path, to operate a plurality of relays at each repeater station, the apparatus at one of these stations being shown herein in detail merely for the sake of illustration. When the gain of the amplifiers at the repeater stations are to be simultaneously increased, the control device at the control station is moved in one direction, and when the gain of the amplifiers at the repeater stations is to be decreased, the control device is moved in the opposite direction. Moreover, indicating devices provide means for quickly determining the state of the gain adjusting means at each repeater station.

It is to be understood that while in the embodiment of the invention shown herein two transmission paths are provided between the control station and each repeater station, over which are transmitted direct current and pulses of direct current, respectively, to effect simultaneous changes in the gain of a plurality of amplifiers, it is within the scope of this invention to provide only one transmission path in place of the two shown herein, the control of the gain adjusting means at each repeater station taking place by the transmission of alternating currents at different frequencies, or by the use of current reversals well known in the art.

While the invention has been shown and described in one particular embodiment, it is to be distinctly understood that the general principles of this invention may be embodied in 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 system for simultaneously controlling the gain of a plurality of repeaters, each of which is located at a repeater station, comprising a station remote from the repeater stations at which there is a controlling device, a transmitting medium between said remote station and said repeater stations over which two characteristic impulses may be transmitted controlled by said control device, one characteristic impulse consisting of pulsa-

tions of direct current, the other characteristic impulse consisting of pulsations of direct current and steady direct current, and means at each repeater station responsive to said impulses to change the gain of the repeater thereat.

2. A system for simultaneously controlling the gain of a plurality of amplifiers, each of which is located at a repeater station, comprising a station remote from said repeater stations, a control device at said remote station, a transmitting medium between said remote station and said repeater stations over which two characteristic impulses may be transmitted controlled by said control device, one characteristic impulse consisting of pulsations of direct current, the other characteristic impulse consisting of pulsations of direct current superimposed upon steady direct current, a plurality of relays at each repeater station electrically responsive in one direction to increase the gain of the amplifier thereat and electrically responsive in the other direction to decrease the gain of the amplifier thereat.

3. A system for simultaneously controlling the gain of a plurality of repeaters, each of which is located at a repeater station, comprising a station remote from the repeater stations at which there is a control device, a transmitting medium between said remote station and said repeater station over which two characteristic impulses may be transmitted controlled by said control device, one characteristic impulse being represented by pulsations of direct current, the other characteristic impulse being represented by a combination of pulsations of direct current and steady direct current, means at each repeater station responsive to said impulses to change the gain of the repeater thereat, and means for indicating the state of the latter gain adjusting means.

4. A system for simultaneously controlling the gain of a plurality of repeaters, each of which is located at a repeater station, comprising a station remote from the repeater station at which there is a control device, a transmitting medium between said remote station and said repeater stations over which characteristic impulses may be transmitted controlled by said control device, one of the characteristic impulses comprising pulsations of direct current, another of the characteristic impulses comprising the combination of steady direct current and pulsations of direct current, a plurality of relays at each repeater station electrically responsive in two directions to alternately increase and decrease the gain of the repeater thereat, and a plurality of indicating lamps one associated with each relay, said indicating lamps indicating the state of the gain adjusting means.

5. A system for simultaneously controlling the gain of a plurality of repeaters each

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located at a repeater station, comprising a station remote from the repeater station at which there is a control device, two transmitting media between said control station and each repeater station over which characteristic impulses may be transmitted, the characteristic impulse transmitted over one of the transmitting media consisting of pulsations of direct current, the characteristic impulse transmitted over the other of the transmitting media consisting of pulsations of direct current as well as steady direct current, a plurality of relays at each repeater station, said relays being responsive in one direction to characteristic impulses to increase the gain of the repeater thereat, said relays being responsive in the other direction to characteristic impulses to decrease the gain of the repeater thereat.

6. In a transmission system, a control station, a repeater station, two transmitting media interconnecting said control station and said repeater station, means for generating pulses of direct current for transmission over one of the transmitting media, means for generating steady direct current and pulses of direct current for transmission over the other of the transmitting media, gain adjusting means at said repeater station, a control switch at the control station controlling the transmission of pulses of direct current over one transmitting medium and steady direct current and pulses of direct current over the other transmitting medium, thereby controlling the gain of the repeater at the repeater station.

7. In a transmission system, a plurality of repeater stations, a control station, a transmitting medium interconnecting the control station and the plurality of repeater stations, gain adjusting means at each repeater station, a control switch at the control station, said control switch simultaneously controlling the gain adjusting means at each repeater station, said control switch transmitting direct current and pulses of direct current as the gain at each repeater station is to be increased, said control switch transmitting pulses of direct current as the gain adjusting means at each repeater station is to be decreased, and step-by-step means at each repeater station responsive to the transmission of said pulsations to simultaneously control the gain adjusting means at each repeater station.

8. In a transmission system, a plurality of repeater stations, a control station, a transmitting medium interconnecting said control station and said repeater stations, gain adjusting means at each repeater station, a switch at the control station for controlling the gain adjusting means at each repeater station, means responsive to the manipulation of the switch in one direction to transmit pulses of direct current over the trans-

mitting medium, means responsive to the manipulation of the switch in the other direction to transmit steady direct current and pulses of direct current over the transmitting medium, a plurality of relays at each repeater station for controlling the gain adjusting means thereat, said relays being responsive in one direction to increase the gain of the repeater thereat, said relays being responsive in the other direction to decrease the gain of the repeater thereat, and means at each repeater station for indicating the state of the gain adjusting means thereat.

In testimony whereof, I have signed my name to this specification this 10th day of June, 1926.

EDMUND R. TAYLOR.

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