May 11, 1926. 1,583,854

D. B. PERRY

VOLUME CONTROL APPARATUS

Filed Sept. 16, 1925

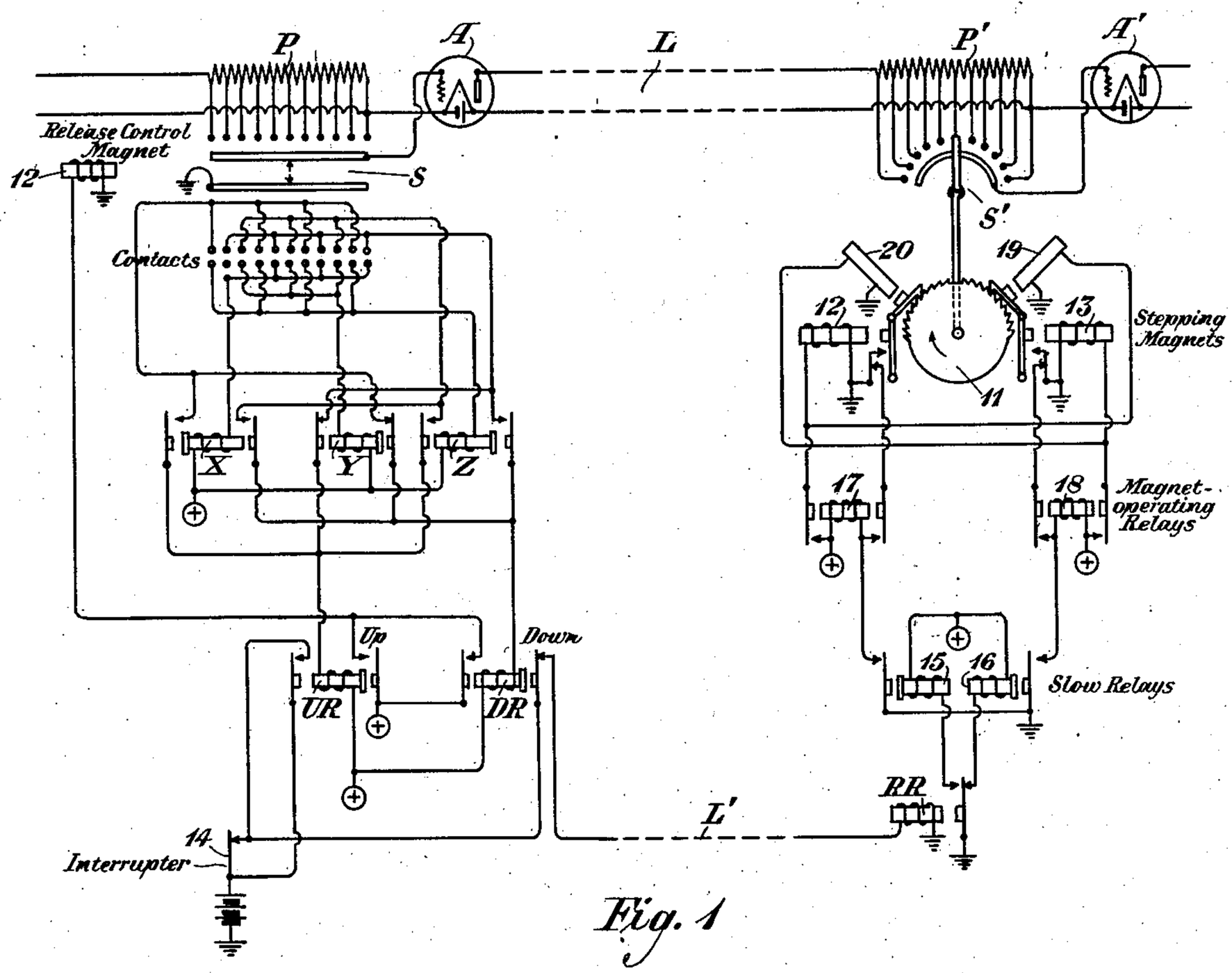

Fig. 1

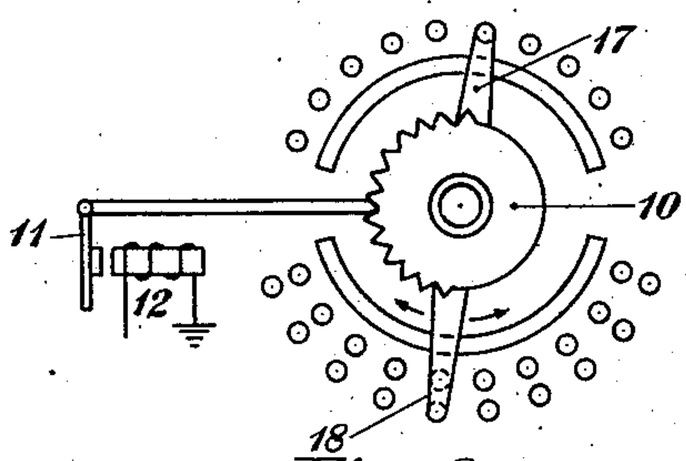

Fig. 2

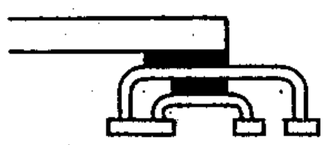

Fig. 3

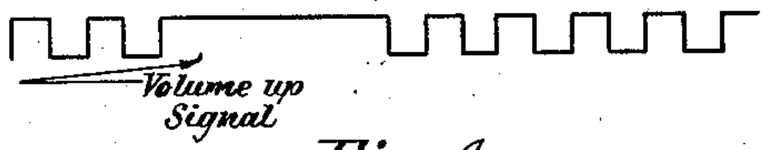

Fig. 4

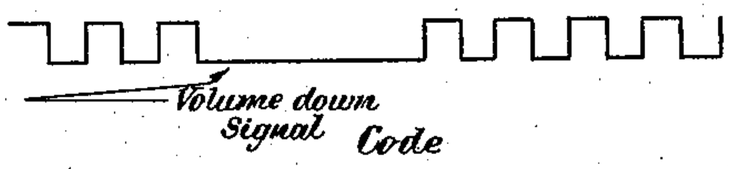

Fig. 5

INVENTOR
D. B. Perry
BY
ATTORNEY

Patented May 11, 1926. 1,583,854

UNITED STATES PATENT OFFICE.

DONALD B. PERRY, OF YONKERS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

VOLUME-CONTROL APPARATUS.

Application filed September 16, 1925. Serial No. 56,763.

This invention relates to arrangements for controlling the volume of energy transmitted over a signal transmitting circuit, and more particularly to arrangements for effecting a remote control of the volume.

Where programs are to be transmitted either by wire or radio, particularly where a program consists of musical numbers, the range of volume variation which may be transmitted is limited. The volume must not fall below a minimum level because of noise on the circuit, and it may not exceed a maximum level for the reason that it might overload vacuum tube apparatus, such as repeaters, included in the circuit. If the range of variation of the volume of the signal is greater than that for which the medium is suitable, it has been proposed to regulate the volume at the transmitting end by means of a potentiometer or the like, to bring it within the volume range of the circuit and to make a compensatory adjustment of a similar potentiometer at the receiving end of the system in order to bring the volume as received back to normal. By such an arrangement the overall gain of the system may be maintained constant and yet the volume actually transmitted may be varied to bring it within the limits of the system without affecting the range of volume received.

The purpose of the present invention is to provide an arrangement whereby when the transmitting potentiometer is adjusted, signals may be transmitted to the receiving end to cause a compensating adjustment of the receiving potentiometer. Specifically, the invention comprises an arrangement by which the adjustment of the controlling potentiometer is made one step at a time. A signal is transmitted for each step, and produces a similar step-by-step adjustment of the distant potentiometer. Preferably, the signal for each step will be the same.

The invention may now be more fully understood from the following description when read in connection with the accompanying drawing, Figure 1 of which is a circuit diagram showing the preferred form of the invention, Figs. 2 and 3 of which are the views showing details of the switch for controlling the potentiometer, in conventional form, and Figs. 4 and 5 of which are curves showing the form of the signal transmitted to control the receiving potentiometer.

Referring to Fig. 1, the sending control arrangement is shown on the left half of the diagram, and the receiving arrangement, on the right half of the diagram. The controlling potentiometer P is located at the transmitting station, and determines the gain of the amplifier A. A similar potentiometer P′ is arranged at the receiving station of the line L, and likewise controls the gain of the amplifier A′. The circuit is so arranged that when the potentiometer P is adjusted to increase the gain the potentiometer P′ is adjusted to decrease the gain, and vice versa. A telegraph or signal line L′ is provided, and the circuit is so organized that a signal is sent over the line L′ every time the control potentiometer P is changed one step.

Under normal conditions, steady dots or reversals are sent over the line L′. A signal for stepping the control potentiometer p' consists of steady battery for a time equivalent to several cycles. To increase the volume by one step, a steady marking signal is sent out, and to decrease the volume by one step, a steady spacing signal is used. These signals are shown graphically in Figs. 4 and 5, respectively.

The potentiometer control for the potentiometer P consists of a switch S, shown somewhat in detail in Fig. 2. The switch consists of two arms, each wiping over an arc-shaped busbar and over a plurality of individual contacts. The upper arm of the switch connects the upper busbar to any one of a plurality of contacts to determine the setting of the potentiometer. The lower arm connects the lower busbar independently to each of a pair of contacts to determine the stepping signal to be sent to the distant station. As the switch S must be held in position after being moved one step until the signal is transmitted to the distant station, it is provided with a notched disk 10, adapted to be locked by the armature 11 of the release control magnet 12 during the time that a signal is sent.

The switch S′ controlling the potentiometer P′ is similar to the switch S, except that the lower arm and corresponding con-

tacts are omitted. This switch is stepped automatically by a toothed disk 11 under the control of stepping magnets 12 and 13.

At the transmitting station the lower contacts are wired, as shown, so that normally one of the relays X, Y and Z is always operated, depending upon the position of the lever arm. The relay Y is shown operated in the diagram. The up and down relays UR and DR are normally released, so that the interrupter contact 14 shown in the lower left-hand corner interrupts the telegraph circuit L′ extending dots or reversals to the receiving control arrangement. The armature of the receiving relay RR will vibrate in response to these signals, holding operated the slow release relays 15 and 16.

Further details of the invention will be clear from a description of the operation, which is as follows:

Assume that the control levers 17 and 18 are in the positions shown by the arrows in the diagram of Fig. 1, where the busbars and contacts are shown extended horizontally instead of being shown in their normal condition. In this diagram, it is also assumed that the brushes making contact between each busbar and its associated individual contacts are moved both in the same direction. When the volume control lever is moved in the direction which increases volume, that is, to the left, the contacts on the lower busbar will move one step to the left. Relay X will now be operated over a circuit from the lower grounded busbar to the fifth contact from the left in the lower row and through the winding of the relay X to battery. At the same time, and before relay Y releases, (relay Y being slow to release), a circuit is closed from the grounded busbar to the fifth contact in the second row, and thence over the left-hand front contact of the armature of relay Y and winding of the up relay UR to battery. The right-hand contact of the relay UR closes a circuit which operates the release control magnet to lock the switch S and prevent further motion of the volume control lever until the signal has been sent. The left-hand contact of the up relay UR short-circuits the interrupter contact 14, closing the loop and sending a closed circuit signal as indicated in Fig. 4. The up relay UR, being slow to release, will release shortly after the relay Y releases, whereupon the steady signal will cease and the dots will be continued. The release control magnet is now deenergized so that the switch may be given an additional step, if desired.

At the receiving end, when this closed circuit signal is received, the receiving relay RR will be held operated for a longer period than occurs during the normal transmission of dots. The slow release relays 15 and 16 are both held energized during the transmission of dot signals, but when a long closed circuit impulse is received, the slow release relay 16 will permit its armature to drop back for an instant, thereby causing the relay 18 to become energized and locked up through the break contact of the stepping magnet 13. At the same time, the relay 18 closes a circuit through the stepping magnet 13 and the release magnet 20. The magnet 20 lifts the pawl of the armature of the stepping magnet 12 from the toothed disk, thereby enabling the magnet 13, through its pawl, to shift the disk one step in a clockwise direction. The controlling armature S is thus moved one step in a direction to reduce the gain of the amplifier A′.

The circuit operation is similar when the volume control lever at the transmitting station is moved to reduce the gain. Assuming, as before, that the lever is in the position indicated by the arrows, and that the Y relay is held operated, now, if the lever is moved to the right so as to decrease the gain one stop, a circuit is closed through the seventh contact of the lower row to energize the relay Z. At the same time, a circuit is closed from the grounded busbar and the seventh contact in the second row, and thence over the right-hand armature of the relay Y, which is slow to release, and through the winding of the down relay DR to battery. The down relay DR operates and remains operated for a short time after the relay Y releases. At its left contact, it holds the release control magnet operated to lock the switch in its adjusted position, and at its right-hand contact, it opens the circuit of the line L′ so that an open circuit impulse of longer than usual duration is transmitted. As soon as the relay DR releases, the open circuit impulse ceases and the dots are again transmitted. At the same time, the release control magnet is released, and the operator is free to move the control arm another step.

At the receiving end, the receiving relay RR is released for several cycles, allowing the slow relay 15 to release its armature and complete the momentary circuit through the winding of the relay 17. This relay is locked up over the break contacts of the stepping magnet 12. Relay 17, at its left-hand contact, completes a circuit for the stepping magnet 12 and the release magnet 19. The latter lifts the pawl of the armature of the stepping magnet 13 to free the disk 11, so that the stepping magnet 12 can step the disk in a counter-clockwise direction one step. This shifts the arm of the switch S′ to the left, and increases the gain of the potentiometer.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different

from those illustrated, without departing from the spirit of the invention, as defined in the following claims.

What is claimed is:

1. In a volume control system, a potentiometer at the transmitting station, and a potentiometer at the receiving station, a controlling switch for adjusting one of said potentiometers, means to transmit dots to the distant station when no adjustment is being made, and means to transmit a closed circuit dash to the distant station when an adjustment is made in one direction, and means at the distant station responsive to the closed circuit dash to produce a corresponding adjustment of the potentiometer at that station.

2. In a volume control system, a potentiometer at the transmitting station, and a potentiometer at the receiving station, a controlling switch for adjusting one of said potentiometers, means to transmit dots to the distant station when no adjustment is being made, and means to transmit a closed circuit dash to the distant station when an adjustment is made in one direction, means to transmit an open circuit dash in response to a circuit adjustment in the opposite direction, and means at the distant station responsive to the closed circuit dash to adjust the potentiometer thereat in one direction and responsive to the open circuit dash to adjust the potentiometer thereat in the opposite direction.

3. In a volume control system, a potentiometer at the transmitting station, and a potentiometer at the receiving station, a controlling switch for adjusting one of said potentiometers, means to transmit dots to the distant station when no adjustment is being made, and means to transmit a closed circuit dash to the distant station when an adjustment is made in one direction, means at the distant station responsive to the closed circuit dash to produce a corresponding adjustment of the potentiometer at that station, and means to hold the potentiometer at the first station in adjusted position until the signal is transmitted.

4. In a volume control system, a potentiometer at the transmitting station, and a potentiometer at the receiving station, a controlling switch for adjusting one of said potentiometers, means to transmit dots to the distant station when no adjustment is being made, and means to transmit a closed circuit dash to the distant station when an adjustment is made in one direction, means to transmit an open circuit dash in response to a circuit adjustment in the opposite direction, means at the distant station responsive to the closed circuit dash to adjust the potentiometer thereat in one direction and responsive to the open circuit dash to adjust the potentiometer thereat in the opposite direction, and means to hold the potentiometer at the first station in adjusted position until the signal is transmitted.

In testimony whereof, I have signed my name to this specification this 14th day of September, 1925.

DONALD B. PERRY.