June 30, 1931. D. MITCHELL ET AL 1,811,955

TRANSMISSION VOLUME CONTROL

Filed Dec. 17, 1928 2 Sheets-Sheet 1

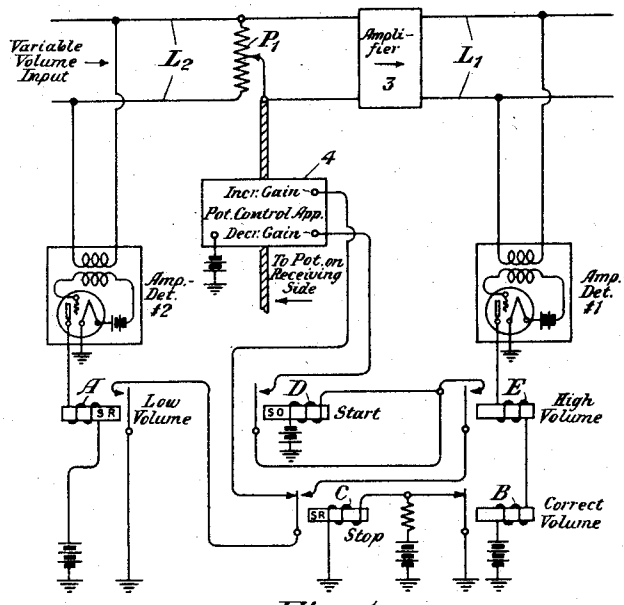


Fig. 1

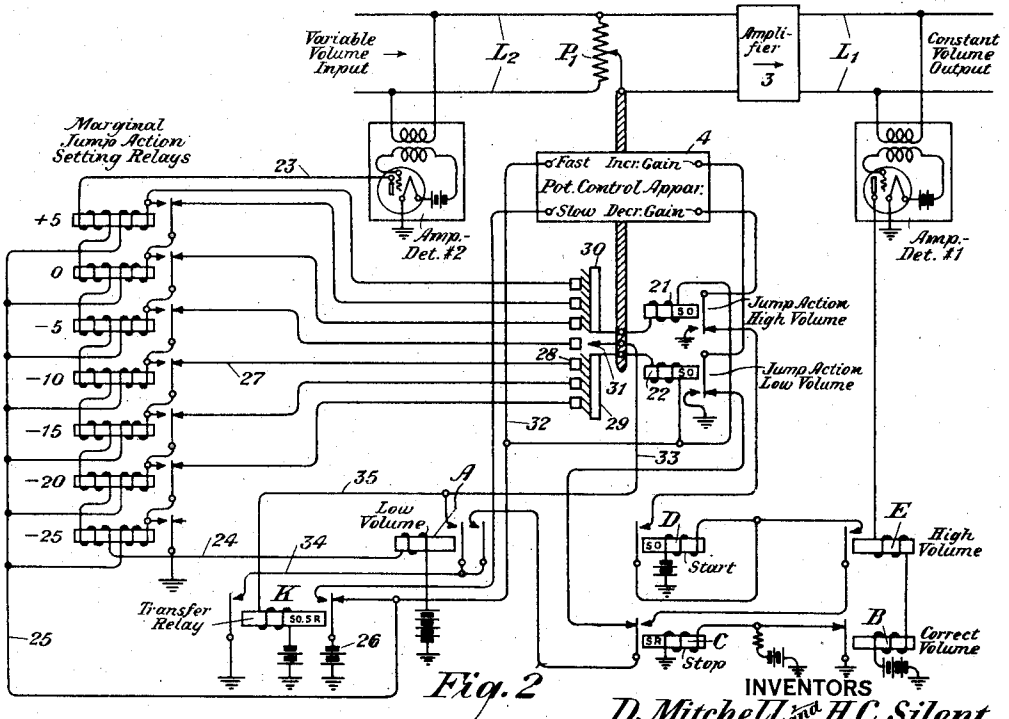


Fig. 2

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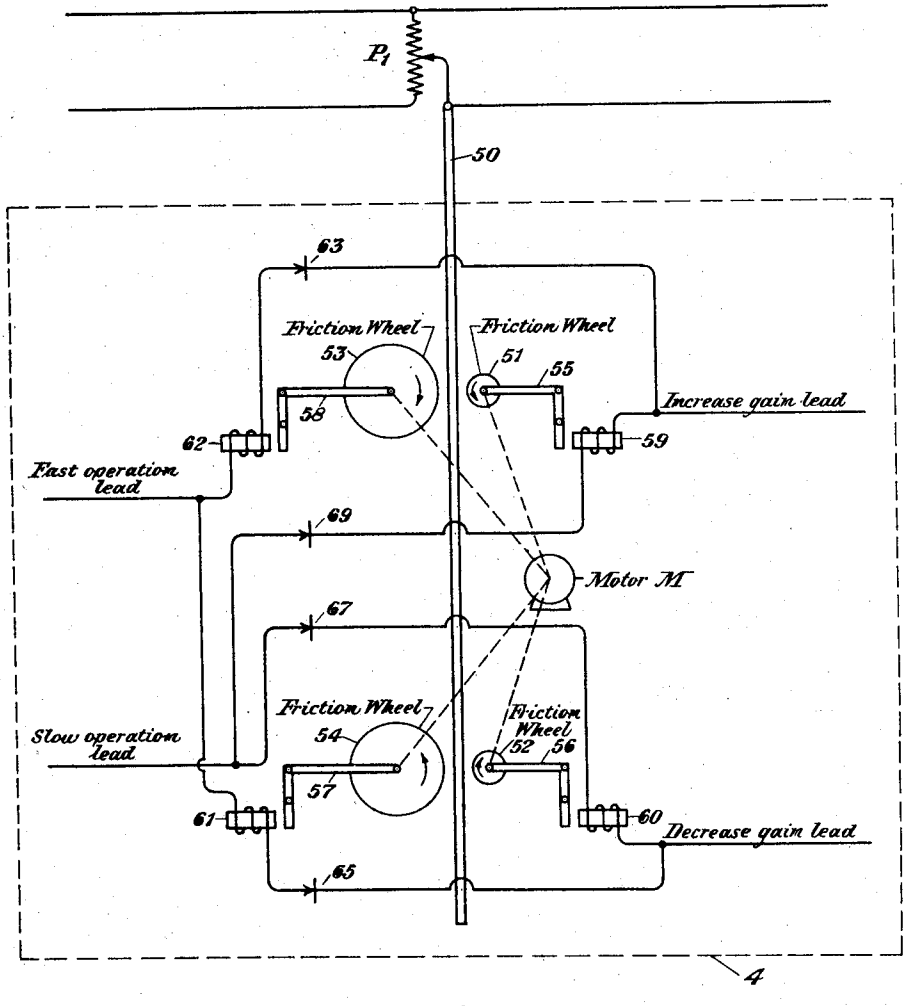


Fig. 3

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1,811,955

UNITED STATES PATENT OFFICE

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TRANSMISSION VOLUME CONTROL

Application filed December 17, 1928. Serial No. 326,598.

This invention relates to transmission systems and more particularly to arrangements for automatically controlling the volume of transmission on such systems.

The arrangements of the invention are particularly applicable to long distance lines or to circuits of the type utilized for transoceanic telephony. On the above types of systems, it has been the practice to provide at each end of the line a "technical operator" whose duty is to adjust the volume of the speech entering the line by hand under the guidance of a volume indicator. In this invention, there is utilized an arrangement of amplifier-detectors or relays, whereby the volume may automatically be controlled by the voice or other signals themselves.

In a copending application, Serial No. 326,597, filed December 17, 1928, in the names of D. Mitchell and H. C. Silent, there is disclosed an arrangement for automatically controlling the volume by means of amplifier-detectors and a basic relay chain, the relays of which are operated by the voice or other signals. In this system, the basic relay chain operates control apparatus to change the setting of gain control means, such as a potentiometer and amplifier. The arrangements of this invention constitute an improvement over the above referred to system in that they add thereto high speed adjustment of the potentiometer or gain control apparatus. This high speed adjustment of the gain control apparatus is accomplished by a series of "jump-action" relays and is effective at the start of speech after which it drops off and allows the normal action of the basic relay chain to control as soon as the approximate correct setting of the potentiometer, or gain control apparatus, has been reached. 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 drawings, in the Figures 1, 2 and 3 of which are shown, respectively, the basic relay chain arrangement for automatically controlling volume disclosed in the above referred to copending application, the "jump-action" feature, or high speed adjustment feature, added to such basic relay chain by the arrangements of the invention, and details of the potentiometer control apparatus. Similar reference characters have been utilized to denote like parts in the figures of the drawings.

In order to more fully understand the arrangements of the invention, there is illustrated in Fig. 1, the basic relay chain arrangement utilized and disclosed in the above referred to application in the names of D. Mitchell and H. C. Silent, for automatically controlling volume. In Fig. 1 is shown a portion of a one-way section of a transmission system. Of this there are illustrated two line sections L_1 and L_2, together with amplifier apparatus 3 and a potentiometer P_1 whereby the volume may be controlled. The potentiometer P_1 is under the control of the apparatus 4. This potentiometer control apparatus may be of any convenient form to permit an increase or decrease in the adjustment of the potentiometer P_1. A number of motor driven schemes have heretofore been utilized for the purpose of controlling a potentiometer and, also, relay operated devices have been used.

In the case where a weak talker begins speaking, causing too low a volume to come in over line section L_2, the operation of the system is as follows: Bridged across line secton L_2 will be an amplifier-detector 2 whose sensitivity is such that the strong peaks of the weakest volume just cause operation of the low volume relay A. Bridged across line section L_1 will be the amplifier-detector 1. The plate circuit of amplifier-detector 1 will include the high volume relay E and the correct volume relay B. Under the above mentioned conditions amplifier-detector 1 may be insufficiently sensitive to operate relays B and E. Ground is therefore fed through the contact of relay A and through the back contact of relay C to the potentiometer control apparatus 4 to cause it to increase gain through adjustment of the potentiometer P_1. It increases gain as long as relay A is operated by the incoming peaks of speech current until amplifier-detector 1 receives sufficient volume

to cause its plate current to operate the correct volume relay B. When the volume has reached the proper value relays A and B are operated in such a manner that relay C is held operated. This will remove ground from the increase gain control circuit of apparatus 4 and transfer the ground from the contact of relay A to the armature of relay E. Should the volume rise too high the high volume relay E which may be made, for example, 5 t. u. less sensitive than the correct volume relay B, becomes operated. Relay D is operated by relay E and in turn applies ground to the decrease gain circuit of the potentiometer control apparatus 4. This causes a reduction in the potentiometer setting until the volume shall have fallen to such a value as to permit the release of relay E. All gain adjustment then ceases until the volume again requires adjustment. At the conclusion of the conversation all of the relays return to their normal setting without altering the potentiometer setting, and the system waits for further impulses. It is pointed out that the relay arrangement adjusts only when the volume is not correct, remaining at rest as long as the volume is correct or no one is speaking. For this reason any tendency for the control system to hunt is reduced to the minimum or eliminated.

In order that the above actions may be properly effected certain requirements in the time relationships of the relays must be fulfilled. It appears desirable to make relay C slow release and relay D slow operate. Relay A may or may not be a slow release relay but must not remain operated longer than the combined release time of relays C and B. Otherwise, the system will be caused to hunt. It is expected that relays B and E will be fluttering under the action of the voice peaks, relay E fluttering less often than relay B, so that unless the voice reaches a fairly well sustained value relay D, being slow operate, will not be pulled up to cause reduction of the volume. Relay E will be fairly quick release in order to prevent hunting.

The arrangements of the invention are illustrated in Fig. 2. These arrangements employ the basic relay scheme of Fig. 1, to which has been added a system controlling a high speed adjustment of the potentiometer known as the "jump action". This is effective at the start of speech, after which it drops off and allows the normal action of the basic relay chain to control volume adjustment as soon as the approximate correct setting of the potentiometer has been reached.

The operation of the arrangements of Fig. 2 is as follows: Initially, all relays are in the non-operated position. When speech is received from the line section L_2, the resulting plate current in amplifier-detector 2 operates a series of the "jump action" setting relays according to its amplitude, so that a register of the amplitude of the speech wave is set up on these relays. By means of locking windings this register is held on the relays until released by the sequence of operations. The plate circuit of amplifier-detector 2 would include conductor 23, windings of the setting relays, conductor 24, winding of low volume relay A, to battery and ground. These "jump action" setting relays are made marginal so as to have varying sensitivities, as indicated by the figures +5 to −25. If the amplitude of the first impulse is, say such as to operate the −15 relay, the two relays directly beneath it will also be operated. These relays lock themselves up through their front contacts and thence over conductor 25, contact of the transfer relay K, to battery 26 and ground. The operation of these setting relays will also apply ground to one of the studs, such as stud 28, on the sliding contact system. The sliding contact system comprises a series of studs, such as 28, the slidable brush contacts 29 and 30 and a slidable central contact 31. These contacts are adapted to engage the studs similar to stud 28, and are slidably controlled by the operation of the shaft of the potentiometer P_1. Connected to the slidable brush contact 29 is the relay 22 which may be termed the "jump action low volume" relay. Connected to the slidable brush contact 30 is a relay 21 which may be termed the "jump action high volume" relay. Due to the slow-operating characteristics of the relays 21 and 22 and the transfer relay K, the speech amplitude is permitted to build up to a maximum value and register on the setting relays before any adjustment begins to take place. The register of the amplitude of the first impulse having been set up, through relay −15 having been operated (for example), ground will be applied to the following circuit: from conductor 27, stud 28, brush contact 29, winding of relay 22 to battery 26 and ground. This will operate the "jump action low volume" relay 22 which will apply ground from its make contact to the increase gain circuit of the potentiometer control apparatus 4. Battery 26 is already connected over conductor 32 to the "fast" circuit of potentiometer control apparatus 4. This causes apparatus 4 to quickly shift the potentiometer shaft until the brush contacts 29 and 30 come into such a position that ground is connected to the middle sliding brush 31, or, in other words, until brush 31 comes into contact with the stud 28. The shifting of the sliding brush contacts 29 and 30 removes the ground from the "jump action low volume" relay 22 and allows it to restore. This will cause the movement of the potentiometer control apparatus and the potentiometer to cease at a point corresponding to the volume register on the setting relays. In other words, the sliding contact system will come to rest under the assumed conditions

with the contact brush 31 at stud 28. Ground will now be applied from stud 28 over the following circuit: contact 31, conductor 33, conductor 35, winding of the transfer relay K, to battery and ground. This will cause the operation of the transfer relay K. The operation of the transfer relay K will remove battery 26 from its break contact and thereby disassociate the "jump action" system from the potentiometer control. The operation of the transfer relay will also connect ground from its left-hand contact to the armature of the low volume relay A and will thereby permit the basic relay chain, designated by relays A, B, C, D and E, to function in the same manner as heretofore described with respect to Fig. 1. Since the transfer relay K is a slow-release relay, it will be kept operated by the intermittent operation of the low-volume relay A under the action of incoming speech. This is caused by the completion of the following circuit: from ground, left-hand contact of transfer relay K, conductor 34, contact of relay A, conductor 35, winding of the transfer relay K, to battery. As long as this transfer relay is held operated, the volume control of the system is retained by the basic relay chain, as in Fig. 1. Although the "jump action" setting relays will be operated by the incoming speech, nevertheless while the transfer relay K is held operated, they will not be locked up nor will they have any effect, since the battery 26 has been removed from the "jump action" volume relays 21 and 22 by the transfer relay. If the speaker pauses long enough to allow restoration of the transfer relay, the cycle will be repeated, but as he probably will begin speaking at approximately the same volume as when he left off, no undesirable action will take place.

In the arrangements of Fig. 3 there is shown the operating shaft of the potentiometer P_1. There are provided four friction wheels 51, 52, 53 and 54 all driven at the same speed by the motor M. The wheels at the right are small as compared with the wheels at the left. Hence the speed of the frictional surface of the right wheels will be less than that of the left wheels. The right wheels are used to operate the potentiometer shaft at normal speed. The left wheels operate it at fast speed. The upper wheels revolve in different directions from the lower wheels. Hence the shaft may be moved up or down. The various wheels may be moved into frictional engagement with the shaft selectively by pivoted levers controlled by the magnets 59, 60, 61 and 62 in the following manner. If, for example, battery is applied to the fast operate lead and ground to the increase gain lead by the relay arrangements a circuit will be closed through magnet 62 and cause wheel 53 to frictionally engage shaft 50 to increase gain rapidly. If battery is applied to fast operate lead and ground to decrease gain lead by the relay arrangements, a circuit will be completed for magnet 61 and cause wheel 54 to frictionally engage shaft 50 to rapidly decrease gain. If battery is connected to slow operate lead and ground to increase gain lead by the relay arrangements, a circuit will be completed for magnet 59 to cause wheel 51 to frictionally engage shaft 50 to normally increase gain. If battery is connected to slow operate lead and ground to decrease gain lead by the relay arrangements a circuit will be completed for relay 60 to normally decrease gain. Rectifiers 63, 65, 67 and 69 have been inserted in the individual magnet connections to prevent false operation.

It is pointed out that the "jump action" or high speed control arrangements of the invention may be associated with other modifications of the basic relay chain than those illustrated in Fig. 1. Accordingly, while the arrangements of the invention have been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that they are capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A transmission system comprising a one-way line section, a gain control device included in said line section, automatic control apparatus for adjusting the setting of said gain control device, a basic relay chain comprising a plurality of relays of different marginal adjustments associated with said line section on each side of said gain control device, circuit arrangements under the joint control of said basic relay chain for operating said automatic control apparatus, a second chain of relays associated with said line section on the incoming side of said gain control device, said relays having different marginal adjustments whereby there may be set up thereon a register of the initial amplitude of the signal wave coming in over said line section, means controlled by said second chain of relays for operating said automatic control apparatus to adjust the setting of said gain control device in accordance with the registered amplitude of said incoming signal wave, and means effective when said automatic control apparatus is so adjusted to transfer control over said automatic control apparatus from said second relay chain to said basic relay chain.

2. A transmission system comprising a one-way line section, a gain control device included in said line section, automatic control apparatus for adjusting the setting of said gain control device in accordance with the volume of the signals sent over said line section, and auxiliary relay means associated with said line section on the incoming side of said gain control device and responsive to the amplitude of the incoming signal wave

for controlling the initial setting of said gain control device.

3. A transmission system comprising a one-way line section, a gain control device included in said line section, automatic control apparatus for adjusting the setting of said gain control device, a basic relay chain comprising a plurality of relays of different marginal adjustments associated with said line section on each side of said gain control device, circuit arrangements under the joint control of said basic relay chain for operating said automatic control apparatus at a normal rate of speed, a second chain of relays associated with said line section on the incoming side of said gain control device, said relays having different marginal adjustments whereby there may be set up thereon a register of the initial amplitude of the signal wave coming in over said line section, and means controlled by said second chain of relays for operating said automatic control apparatus to adjust at a high rate of speed the setting of said gain control apparatus in accordance with the registered amplitude of said initial incoming signal wave.

4. A transmission system comprising a one-way line section, a gain control device included in said line section, automatic control apparatus for adjusting the setting of said gain control device, a basic relay chain comprising a plurality of relays of different marginal adjustments associated with said line section on each side of said gain control device, circuit arrangements under the joint control of said basic relay chain for operating said automatic control apparatus at a normal rate of speed, a second chain of relays associated with said line section on the incoming side of said gain control device, said relays having different marginal adjustments whereby there may be set up thereon a register of the initial amplitude of the signal wave coming in over said line section, means controlled by said second chain of relays for operating said automatic control apparatus to adjust at a high rate of speed the setting of said gain control apparatus in accordance with the registered amplitude of said initial incoming signal wave, and means effective when said second relay chain has caused said automatic control apparatus to complete its initial functioning at high speed to transfer control over said automatic control apparatus from said second relay chain to said basic relay chain.

In testimony whereof, we have signed our names to this specification this 15th day of December, 1928.

DOREN MITCHELL.
HAROLD C. SILENT.