

June 16, 1931.

J. L. HOGG

1,810,015

TRANSMISSION SYSTEM

Filed July 3, 1929

2 Sheets-Sheet 1

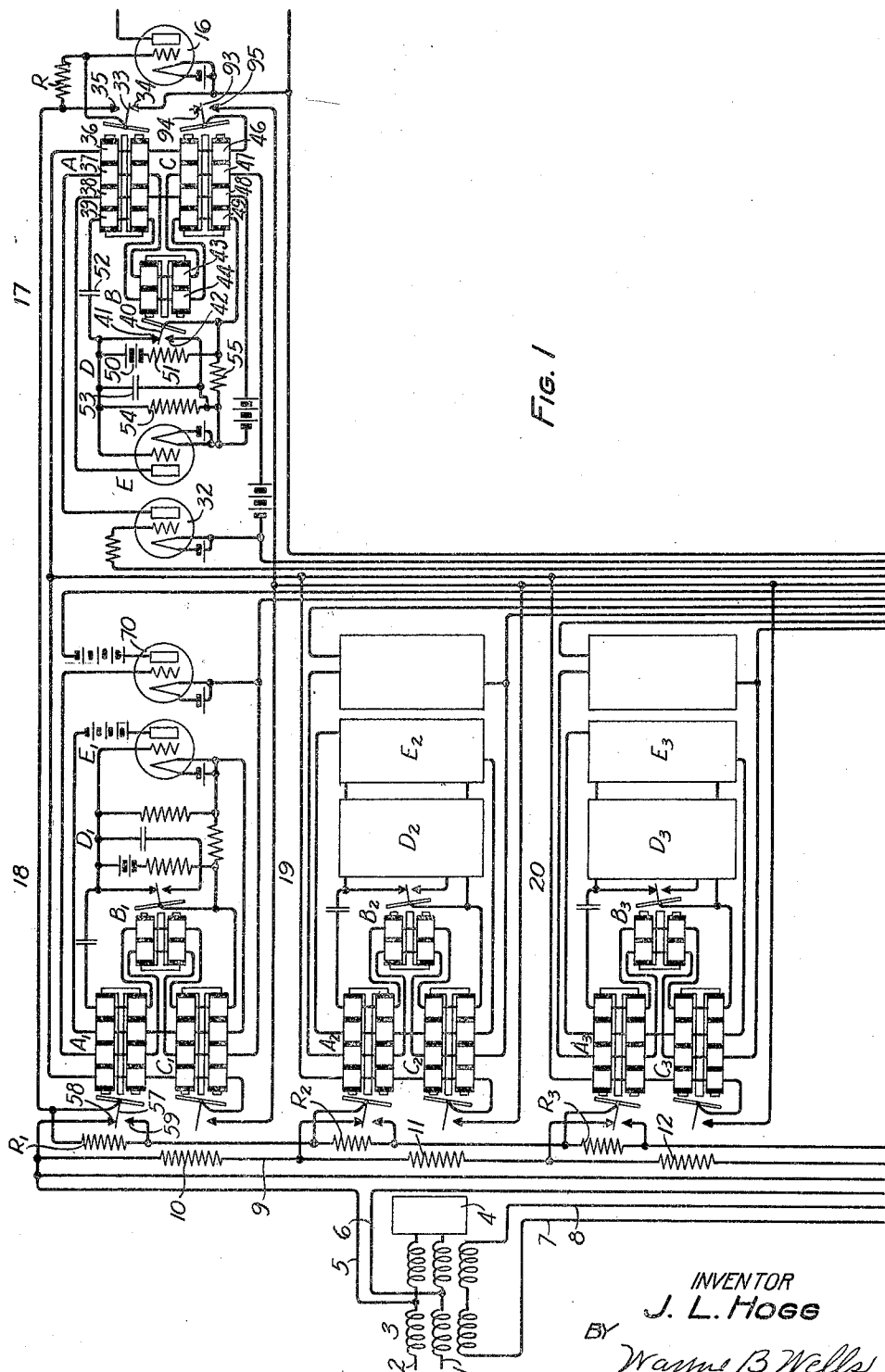


Fig. 1

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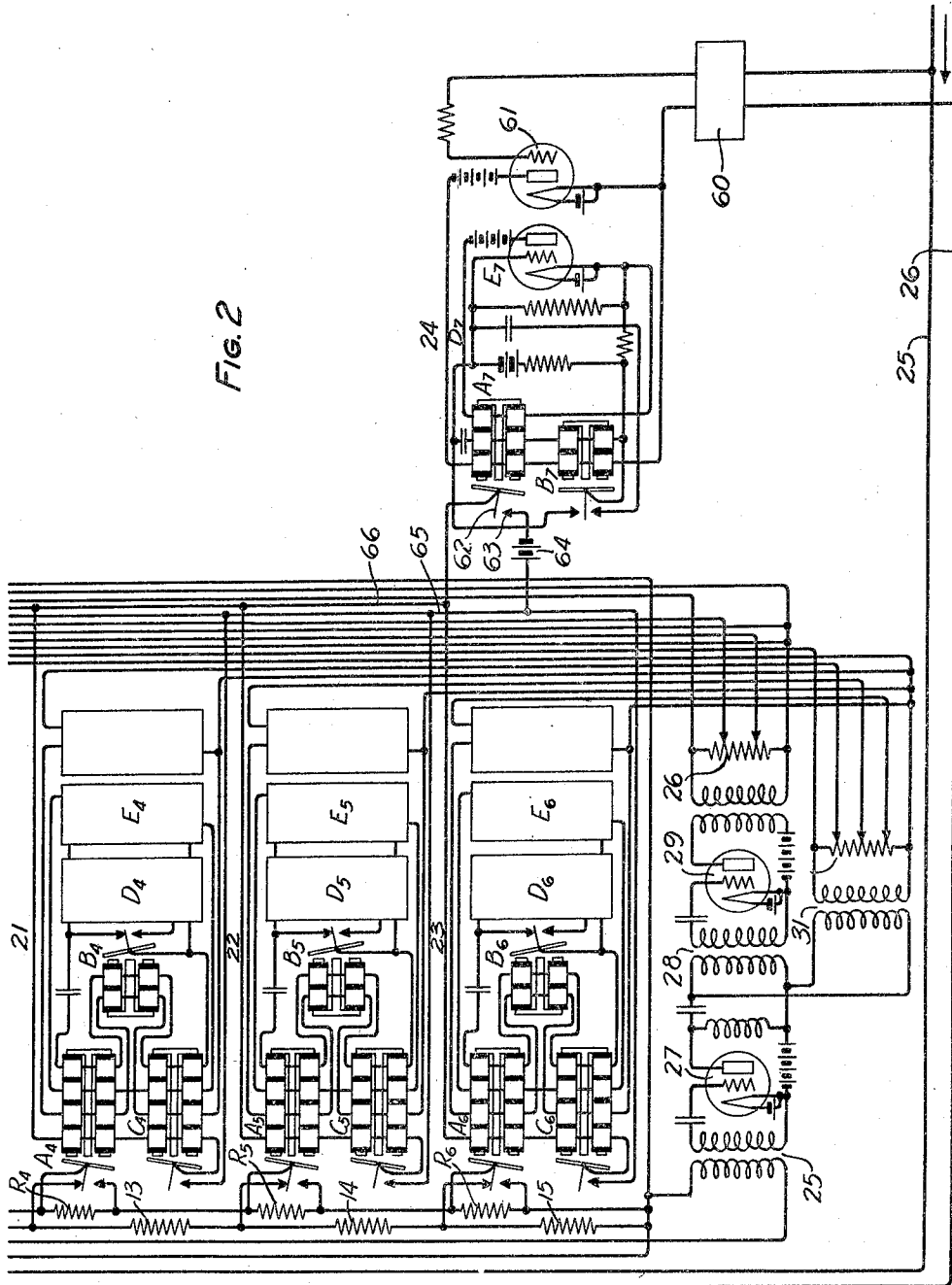
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FIG. 2



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TRANSMISSION SYSTEM

Application filed July 3, 1929. Serial No. 375,629.

This invention relates to signal transmission systems and particularly to volume control circuits for governing the energy level at desired points in transmission systems.

5 One object of the invention is to provide a signal transmission system with improved volume control circuits that shall operate to effect a quick change in the level of transmitted energy in a signal channel and insure
10 the holding of the level at a fixed point for a predetermined length of time after a setting of the energy level has been made.

Another object of the invention is to provide a transmission system having transmitting and receiving channels with improved
15 means for controlling a potentiometer in the transmitting channel to maintain the energy level in such channel substantially constant beyond the potentiometer and means under
20 the control of the receiving channel for holding the potentiometer in the transmitting channel in any set position during a receiving period.

A further object of the invention is to provide a transmitting channel in a transmission system with a potentiometer divided into sections, means controlled from a point before the potentiometer to maintain the volume substantially constant in the transmitting
25 channel beyond the potentiometer, said control means serving to effect a quick setting of the potentiometer for any change in the level of the received energy and to hold the potentiometer in a set position for a predetermined
30 length of time, and control means governed from a receiving channel to hold the potentiometer in a set position during a receiving period.

In telephone communication systems transmission can only be satisfactorily effected above a fixed minimum level and below a fixed maximum level. The minimum level is determined according to the noise level and
35 the maximum level is generally determined by a transmitter or some relay device in the circuit. In transmitting speech or musical programs over a telephone line to a radio broadcasting station it is desirable to hold
40 the volume substantially constant in the

transmitting line without interfering with the program.

In accordance with the disclosed invention a transmission system having a transmitting and receiving channel is provided with a potentiometer in the transmitting channel to
55 maintain the energy level substantially constant in the transmitting channel beyond the potentiometer. The potentiometer is divided into sections which are controlled by relays governed in accordance with the energy level received in the transmitting channel. The potentiometer shown in the drawings is very similar to the potentiometer disclosed in the application of R. C. Mathes,
60 Serial No. 372,951, filed June 22, 1929.

A set of three relays are associated with each potentiometer section. The first relay in each set serves to change the setting of the potentiometer by one section when a predetermined level is reached in the transmitting channel before the potentiometer. The second relay in each set serves to effect acceleration in the operation of the first relay and to insure the holding of the first relay in operative position for a predetermined length of time after the operation thereof. The third relay in each set of relays is controlled from the receiving channel and serves to hold the potentiometer in any set position during a
70 receiving period.

Another set of three relays which is similar in operation to the relays associated with each potentiometer section is provided for changing the potentiometer from its least efficient to its most efficient position upon starting the transmission of any signal. The first relay of this last mentioned set of relays serves in the released position to place the potentiometer in its least efficient position and upon operation changes the potentiometer to its most efficient position. The other two relays of this last mentioned set of relays operate in a manner similar to the second and third relays of each set associated with the
75 potentiometer sections.

An amplifier which is connected to the transmitting channel before the potentiometer, supplies potential to two auxiliary potentiometers. The first auxiliary potentiometer
80

ter operates the set of starting relays and the two sets of relays associated with the first two sections of the main potentiometer. The second auxiliary potentiometer controls the sets of relays associated with the remaining main potentiometer sections. Thermionic amplifier-rectifiers which are respectively associated with each of said sets of relays are connected to different points on the auxiliary potentiometers in order to effect selective operation of the sets of relays in accordance with the energy level obtaining in the transmission channels before the main potentiometer. Each amplifier-rectifier connected to an auxiliary potentiometer effects operation of the three relays in the set associated therewith. The specific means controlled by the second relay in each set for effecting quick operation and slow release of the first relay is disclosed and claimed in an application of J. L. Hogg, Serial No. 368,955 filed June 6, 1929.

In the accompanying drawings Figures 1 and 2 disclose a volume control system constructed in accordance with the invention. Referring to Figs. 1 and 2, a two-wire telephone system comprising conductors 1 and 2 terminates in a hybrid coil 3 and balancing network 4. Conductors 5 and 6 of a transmitting channel and conductors 7 and 8 of a receiving channel for a four-wire system are connected to the hybrid coil 3, as shown in Fig. 1 of the drawings. The transmitting channel is provided with volume control means to maintain the volume of the transmitted signals substantially constant. A detailed showing of the receiving channel connected to the hybrid coil is deemed unnecessary for the disclosure of this invention.

A main potentiometer 9 comprising sections 10 to 15, inclusive, is connected across the transmitting channel and is controlled in a manner to be hereinafter set forth for governing the volume level in the transmitting channel. A line amplifier 16 is provided in the transmitting channel beyond the potentiometer 4 and is controlled in accordance with the setting of the potentiometer. Seven auxiliary control circuits 17 to 23, inclusive, are provided for controlling the potentiometer 9 and the line amplifier 16. An additional auxiliary control circuit 24, Fig. 2, which is governed by the receiving channel comprising conductors 25 and 26, is similar in construction and operation to the auxiliary control circuits 17 to 23, inclusive. The auxiliary control circuit 24 serves to maintain the potentiometer 9 in a fixed position when the talker at the transmitting station stops to permit talking by the person at the distant station.

The control of the system disclosed is obtained from a point on the transmitting channel before the potentiometer 9. This system may be called a forward acting system. The main control circuits for the auxiliary control

circuits 17 to 23, inclusive, comprise a transformer 25, the primary of which is connected across the transmitting channel at a point ahead of the potentiometer 9. The transformer 25 is connected to an auxiliary potentiometer 26 by means of the thermionic amplifier 27, a transformer 28 and a thermionic amplifier 29. The transformer 25 is also connected to a second auxiliary potentiometer 30 by means of the amplifier 27 and the transformer 31. The auxiliary potentiometer 26 controls the operation of the auxiliary control circuits 17, 18 and 19. The auxiliary potentiometer 30 controls the operation of the auxiliary control circuits 20, 21, 22 and 23.

Inasmuch as the auxiliary control circuits 19 to 24 inclusive are similar in construction and operation, a detailed description of only one of them will be given. The auxiliary control circuit 17 comprises a thermionic rectifier tube 32 having the input circuit thereof connected across the auxiliary potentiometer 26. The potentiometer 26 is assumed to impress sufficient voltage on the auxiliary control circuit 17 for effecting the operation thereof when a weak voice is on the transmitting channel. The operation of the auxiliary control circuit 17 serves to change the potentiometer 9 from its least efficient position to its most efficient position. The rectifier 32 controls three relays, A, B and C. A kick-off hangover circuit D and a thermionic tube E are under the control of the relay B for assisting in operating the relays A and C.

The relay A comprises an armature 33 which is normally in engagement with a contact member 34. The armature is adapted to be moved into engagement with a contact member 35. Windings 36, 37, 38 and 39 are provided for effecting operation of the relay and for holding it in an operative position. The relay B comprises an armature 40 which is normally held in engagement with a contact member 41. Upon operation of relay B the armature 40 is moved in engagement with a contact member 42. Windings 43 and 44 are provided for operating a relay B in the manner to be hereinafter set forth. The relay C comprises an armature 93 which is normally held in engagement with the stop member 94 and out of engagement with the contact member 95. Windings 46, 47, 48 and 49 are provided for effecting operation of the relay C.

The kick-off hangover circuit D comprises a battery 50 which is normally shunted through a resistance element 51 when the armature 40 of the relay B is in the release position and in engagement with the contact member 41. A condenser 52 charges through the windings 39, 44 and 49 when the armature 40 of the relay B is in transit between the contact members 41 and 42. A

condenser 53 is provided for discharging in parallel through resistance elements 54 and 55 to control the thermionic tube E. Space current for tube E energizes the windings 38 and 48 of the relays A and C for a limited period after the party on the transmitting channel has ceased talking. The limit of the hangover period is controlled by the size of the resistance elements 54 and 55. A more detailed description of the operation of the hangover circuit will be given when the complete operation of the system is considered.

A resistance element R of relatively high value when compared with the sections of the potentiometer 9 is connected between the armature 33 of the relay A and the contact member 35. This resistance element serves to prevent opening of the transmitting channel and interruption of conversation when the armature 33 is in transit between the contact members 34 and 35. The relay A serves to connect the main potentiometer 9 from its least efficient position to its most efficient position. When the armature 33 is in engagement with contact member 34 the input circuit for the line amplifier 16 is disconnected from the main potentiometer 9 entirely. When the armature 33 is in engagement with the contact member 35 the input circuit for the line amplifier 16 is connected across all sections of the main potentiometer 9. The relay B as before stated controls the kick-off hangover circuit D and the amplifier E to assist in the control of the relays A and C. The relay C is assisted by the auxiliary control circuit 24 and serves to maintain the setting of the auxiliary control circuit 17 in a fixed position during a receiving period.

The auxiliary control circuit 18 comprises relays A₁, B₁, and C₁, which are similar in construction and operation to the relays A, B and C in the auxiliary control circuit 17. The relay A₁ is provided with an armature 57 which is normally in engagement with a contact member 58 and is adapted to be moved into engagement with a contact member 59. When the armature 57 is moved out of engagement with the contact member 58 and into engagement with the contact member 59 the section 10 of the main potentiometer 9 is excluded from the input circuit of the line amplifier 16. A resistance element R₁ is connected between the contact member 59 and the armature 57 for preventing opening of the transmitting channel when the armature 57 is in transit between the contact members 58 and 59. The resistance element R₁ is relatively large as compared with the impedance of a section of the main potentiometer 9 and has a relatively small impedance as compared with the impedance of the input circuit for the line amplifier 16.

The relay B₁ controls a kick-off hangover

circuit D₁ and a thermionic tube E₁ similar in construction and operation to like parts in the auxiliary control circuit 17. The relay C₁ is controlled by the auxiliary control circuit 24 from the receiving channel in the same manner as the relay C and controls windings of the relays A₁ and B₁ in the same manner as the relay C controls windings 36 and 46 of the relays A and B.

The auxiliary control circuits 19 to 23 inclusive, are respectively provided with relays A₂ to A₆ inclusive, which are similar in construction and operation to the relay A₁ for respectively controlling the potentiometer sections 11 to 15 inclusive. Resistance elements R₂ to R₆ inclusive, are associated respectively with the relays A₂ to A₆ inclusive in the same manner as the resistance element R₁ is associated with the relay A₁. Similar parts in the auxiliary control circuits 19 to 23 inclusive, to those shown in the auxiliary control circuit 18 have been designated by like reference characters but with different subscripts.

The auxiliary control circuit 24 is connected to the receiving conductors 25 and 26 by means of a thermionic amplifier 60. The amplifier 60 is connected to a rectifier 61, which is similar in construction and operation to the rectifier 32 in the auxiliary control circuit 17. Two relays A₇ and B₇, which are similar in construction and operation to relays A and B in auxiliary circuit 17, are operated by the rectifier 61. The relay A₇ is provided with an armature 62 which is adapted to engage the contact member 63 when the receiving channel is in operation. The operation of the relay A₇ impresses potential from a battery 64 on conductors 65 and 66, which are connected to the relays C₁, C₂, C₃, C₄, C₅ and C₆ of the auxiliary control circuits 17 to 23 inclusive. The relays C₁, C₂, etc., when in operative position and supplied with potential from the battery 64 establish locking circuits for themselves and the corresponding relays A₁, A₂, etc. The relay B₇ controls a kick-off hangover circuit D₇ and an amplifier E₇ similar in construction and operation to like parts D and E in the auxiliary control circuit 17. No relay is provided or necessary in the auxiliary control circuit 24 corresponding to the relay C in the auxiliary control circuit 17.

Assuming that a weak voice is impressing voice waves on the transmitting channel conductors 5 and 6 and that the voltages of the peaks of this weak voice are just within the range of operation of the volume control circuits, potential from the transmitting channel before the main potentiometer 9 is impressed on the auxiliary potentiometer 26 by the transformer 25, amplifier 27, transformer 28 and the amplifier 29. Potential from across the potentiometer 26 is rectified by the tube 32 for energizing windings 37,

43 and 47 of the relays A, B and C, respectively, in the auxiliary control circuit 17. The armature 40 of the relay B disengages the contact member 41 to open the shunt circuit through the resistance element 51 around the battery 50. Upon opening of the shunt circuit the condenser 52 charges through windings 39, 44 and 49 of the relays A, B and C to accelerate the operation of such relays. Furthermore, the opening of the shunt circuit around the battery 50 impresses positive potential on the grid of the tube E from battery 50 so as to effect a sudden flow of current through the windings 38 and 48 of the relays A and C. Accordingly, the relays A, B and C are accelerated and operated in rapid manner.

When the armature 40 of the relay B engages the contact member 42 current from the thermionic tube E through the windings 38 and 48 of the relays A and C will be increased since the resistance element 55 is removed from the circuit of the battery 50 to the tube E. It is apparent that the armature 33 of the relay A is thrown into and held tightly in engagement with the contact member 35. In a like manner the armature 93 is thrown into and held in engagement with the contact member 95.

The operation of the relay A as set forth above connects the input circuit of the line amplifier 16 across all sections of the main potentiometer 9. The operation of the relay C connects windings 36 and 46 of the relays A and C across conductors 65 and 66 for partially completing a holding circuit for relays A and C. The holding circuit is completed by the auxiliary control circuit 24 in case the transmitting channel is deenergized and a receiving period is started.

When the current from the rectifier 32 is lowered as is the case between peaks of speech, the relay B will be deenergized and released. When the armature 40 of the relay B disengages the contact member 42, the resistance element 55 is again inserted in the circuit of the battery 50 to the thermionic tube E and when the armature 40 engages the upper contact member 41 the condenser 53 discharges through the resistance elements 54 and 55 in parallel. Such discharge from the condenser 53 impresses potential on the grid of the thermionic amplifier E for maintaining current flow through the windings 38 and 48 of the relays A and C. The resistance elements 54 and 55 may be varied to control the time during which the condenser 53 discharges. The discharge of the condenser 53 controls the time during which the relays A and C will remain operated after the current flow through the rectifier 32 has fallen below the value necessary to effect operation of the relays in the auxiliary control circuit 17. Thus, the interval of time during which the input circuit of the line amplifier 16 may be con-

nected across the complete main potentiometer 9 after the voice energy has fallen too low to maintain its connection is under control.

If the voltage on the transmitting channel before the main potentiometer 9 falls to zero as it may between syllables of speech of setting of the volume control apparatus will be maintained and the adjustment will not be disturbed as long as the talker proceeds. If talking were to cease for a time longer than the hangover time of the circuit D, then the relay armatures will fall back to normal position and the line amplifier 16 will be connected to one side only of the main potentiometer 9.

If before the lapse of the hangover period a distant talker replies, then the power of his voice effects operation of the auxiliary control circuit 24. The auxiliary control circuit in the manner hereinbefore set forth impresses energy from the battery 64 on conductors 65 and 66 for energizing the holding circuit through the coils 36 and 46 of the relays A and C. When the distant talker ceases the hang over circuit D, of the auxiliary control circuit 24 will keep current flowing through the windings 36 and 46 of the relays A and C until the talker on the transmitting channel again resumes the conversation. The above adjustment is maintained as long as the conversation continues, unless both parties cease talking for a time longer than the hangover time for the auxiliary control circuits. In such a case the voice energy of the talker on the transmitting channel would have to again establish the adjustment.

If a stronger voice is on the transmitting channel the same process will occur as above considered in describing the operation of the volume control apparatus when a weak voice is on the transmitting channel. If the peaks of the strong talker's speech rise five transmission units above those of the weak voice previously considered, the rectifier 70 in the auxiliary control circuit 18 will be actuated to effect operation of the relays A₁, B₁ and C₁. The relays A₁, B₁ and C₁ operate in a manner similar to the relays A, B and C in the auxiliary control circuit 17. The relay A₁ excludes the potentiometer section 10 from an input circuit of the land line amplifier 16 to reduce the volume on the transmitting channel beyond the line amplifier.

If a stronger voice comes in on the transmitting channel, the auxiliary control circuits 19 to 23 inclusive, may be operated according to the peaks of speech to control the potentiometer sections 11 to 15 inclusive, and maintain the volume level of transmitting channel beyond the line amplifier 16 substantially constant. The auxiliary control circuits 19 to 23 inclusive, are similar in operation to the auxiliary control circuit 17 and each auxiliary control circuit is under the control of the auxiliary circuit 24 from the

receiving channel in the same manner as described with respect to the operation of the relays A and C in the auxiliary control circuit 17.

5 Modifications in the system and in the arrangement and location of parts may be made within the spirit and scope of the invention and such modifications are intended to be covered by the appended claims.

10 What is claimed is:

1. In a transmission system, impedance means for controlling the volume in a signal channel, means for automatically controlling said impedance means according to a characteristic of the signal channel to maintain the volume substantially constant at a point in said channel, and means operative upon starting the operation of said automatic means for accelerating the operation thereof.

20 2. In a transmission system, impedance means for controlling the volume in a signal channel, means for automatically controlling said impedance means according to a characteristic of the signal channel to maintain the volume substantially constant at a point in said channel, and means operative upon starting the operation of said automatic means for accelerating the operation thereof and for insuring the holding of said automatic means in an operated position for a predetermined length of time after operation thereof.

3. A transmission system having an electrical transmitting channel, impedance means for controlling the volume in the transmitting channel, means controlled by the volume level before said impedance means for automatically controlling said impedance means to maintain the volume level substantially constant in the transmitting channel beyond the impedance means, and means operative upon starting the operation of said automatic means for accelerating the operation thereof.

4. A transmission system having a transmitting channel, a potentiometer for controlling the volume in the transmitting channel, means for automatically controlling said potentiometer to maintain the volume level substantially constant in the transmitting channel beyond the potentiometer, and means operative upon starting the operation of said automatic means for accelerating the operation thereof.

5. A transmission system having a transmitting channel, a potentiometer for controlling the volume in the transmitting channel, means for automatically controlling said potentiometer to maintain the volume substantially constant in the transmitting channel beyond the potentiometer, and means effective upon starting the operation of said automatic means for accelerating the operation thereof and for insuring the holding of said first mentioned means in a set position for a

predetermined length of time after each operation thereof.

6. In a transmission system, a potentiometer divided into sections included in a transmitting channel, means controlled from the transmitting channel for governing said potentiometer sections to maintain the volume substantially constant in the channel beyond the potentiometer, and means operative upon starting the operation of said first mentioned means for accelerating the operation thereof.

7. In a transmission system, a potentiometer divided into sections included in a transmitting channel, means controlled from the transmitting channel for governing said potentiometer sections to maintain the volume substantially constant in the channel beyond the potentiometer, and means operative upon starting the operation of said first mentioned means for accelerating the operation thereof and for insuring the holding of said first mentioned means in a set position for a predetermined length of time after operation thereof.

8. In a transmission system, a potentiometer divided into sections for controlling the volume in a transmitting channel, automatic means for controlling the potentiometer sections according to the energy level received in the transmitting channel to maintain a constant volume beyond the potentiometer, and means operative upon starting the operation of said automatic means for accelerating the operation thereof and for insuring the holding of said automatic means in an operated position for a predetermined length of time after setting thereof.

9. In a transmission system having transmitting and receiving channels, a potentiometer for controlling the volume in the transmitting channel, automatic means for controlling said potentiometer according to the energy level received in said transmitting channel to maintain a constant volume level beyond the potentiometer, and means for holding said automatic means in any set position during a receiving period.

10. In a transmitting system, a potentiometer divided into sections for controlling the volume in a transmitting channel, automatic means for controlling the potentiometer sections according to the energy level received in said channel to maintain a constant volume beyond the potentiometer, and means for holding said automatic means in any set position during a receiving period.

11. In a transmission system having transmitting and receiving channels, a potentiometer for controlling the volume in the transmitting channel, automatic means for controlling said potentiometer according to the energy level received in said transmitting channel to maintain a constant volume level beyond the potentiometer, means for accelerating the operation of said automatic

means, and means for holding said automatic means in any set position during a receiving period.

12. In a transmitting system, impedance means for controlling the volume in a transmitting channel, means for automatically controlling said impedance means to maintain the volume substantially constant at a point in said transmitting channel, means for accelerating said automatic means and for insuring the holding of said automatic means in an operated position for a predetermined length of time after each operation thereof, and means for holding said automatic means in any set position during a receiving period.

13. In a transmitting system, impedance means for controlling the volume in a transmitting channel, means controlled from a point before said impedance means in the transmitting channel for automatically governing said impedance means to maintain the volume substantially constant at a point beyond the impedance means in the transmitting channel, means for insuring holding the automatic means in any set position a predetermined length of time after each operation thereof, and means for holding said automatic means in any set position during a receiving period.

14. In a transmission system, a potentiometer divided into sections included in a transmitting channel, a relay associated with each of said potentiometer sections, said relays serving to vary the efficiency of the potentiometer, means controlled from the transmitting channel for operating said relays to maintain the volume substantially constant in the transmitting channel beyond the potentiometer and control means for accelerating the operation of the first mentioned relays and for insuring their operation for a predetermined time after each operation thereof and comprising a second set of relays respectively associated with said first mentioned relays.

15. In a transmission system having a transmitting and a receiving channel, a potentiometer divided into sections included in said transmitting channel, a relay associated with each potentiometer section, said relays serving when in operative position to lower the efficiency of the potentiometer, means controlled from the transmitting channel before the potentiometer for governing said relays to maintain the volume constant in the transmitting channel beyond the potentiometer, means comprising a second set of relays respectively associated with the potentiometer sections for accelerating the operation of the first mentioned relays and for holding the first mentioned relays in operated position a predetermined length of time after each operation thereof, and a third set of relays respectively associated with said potentiometer sections and operated from the

receiving channel for holding said first set of relays in a set position during a receiving period.

16. In a transmission system having a transmitting and a receiving channel, a potentiometer divided into sections included in said transmitting channel, a relay associated with each potentiometer section, said relays serving to vary the efficiency of the potentiometer, means controlled from the transmitting channel for operating said relays to maintain the volume substantially constant in the transmitting channel beyond the potentiometer, means comprising a second set of relays respectively associated with the potentiometer sections for accelerating the operation of the first mentioned relays and for holding the first mentioned relays in operated position a predetermined length of time and a third set of relays for holding said first mentioned set of relays in a set position during a receiving period.

17. In a transmission system having a transmitting and a receiving channel, a main potentiometer divided into sections included in the transmitting channel, a set of relays respectively associated with said potentiometer sections for varying the potentiometer setting, means comprising an amplifier and potentiometer connected to the transmitting channel before said main potentiometer for operating said relays to control the main potentiometer sections and maintain the volume constant in the transmitting channel beyond the main potentiometer, means for accelerating the operation of said relays and for insuring holding them in a set position for a predetermined time after each operation thereof, and means operated from the receiving channel for holding said relays in any set position during a receiving period.

18. In a signal transmission system, a signal channel, a potentiometer divided into sections and included in said channel, and means comprising relays for controlling said potentiometer sections to hold the volume of the signals in the channel substantially constant, said means serving to hold said potentiometer in its lowest impedance position when no signals are passing through the channel and to change the potentiometer to its highest impedance position upon starting of any signals through the channel having a volume at least equal to that of a weak talker.

In witness whereof, I hereunto subscribe my name this 28th day of June, 1929.

JOHN L. HOGG.