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1,778,779

CONTROL CIRCUIT FOR TRANSMISSION SYSTEMS

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FIG. 1

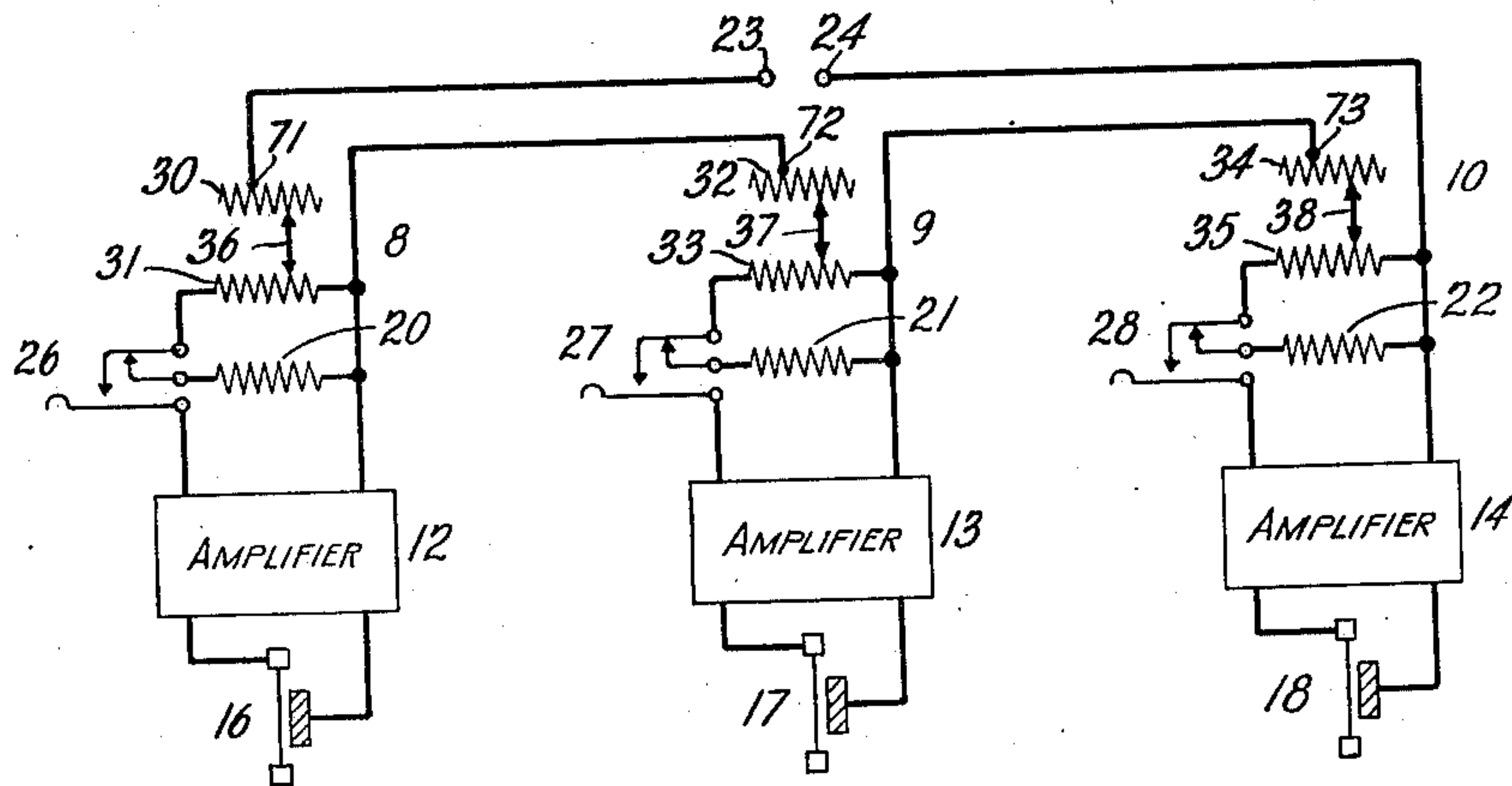
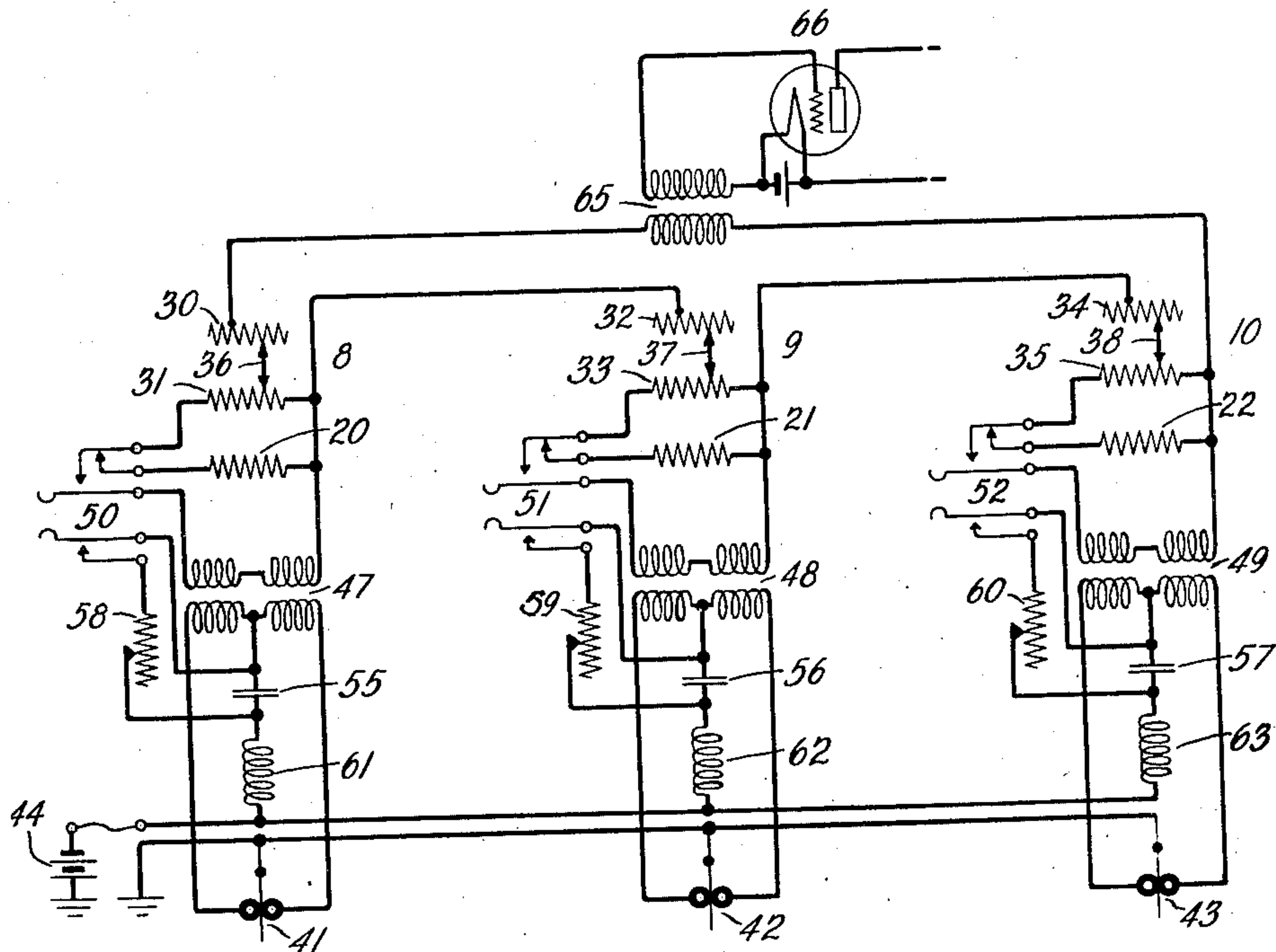


FIG. 2



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CONTROL CIRCUIT FOR TRANSMISSION SYSTEMS

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This invention relates to electrical transmission circuits and particularly to circuits interconnecting electrical elements, such as transmitters and amplifying apparatus.

5 In apparatus where pick-up devices, such as microphones are employed to change acoustic vibrations into electrical vibrations, the electrical vibrations may be amplified by amplifiers. Intermediate the microphones and amplifiers are usually placed potentiometers or the like for controlling the volume output of the microphones either individually or collectively. For high quality transmission between the pick-up devices and the amplifiers or to whatever apparatus the devices are connected, certain well-known impedance relations should exist. For example, the impedances should be matched and remain substantially so during any operating condition of the circuit. This allows a good energy transfer and prevents reflections between the elements which cause distortion.

15 A potentiometer for controlling the transmission between two circuit elements while maintaining substantially constant impedance relations therebetween during operation is disclosed in my Patent No. 1,530,633 of March 24, 1925.

20 An object of this invention is to maintain substantially constant impedance relations between a plurality of elements, such as microphones, and another element, such as an amplifier, while varying the transmission of any one or all of the microphones.

25 Another object is to provide a mixing circuit which enables the volume output of any individual microphone to be varied without interfering with the transmission of the others.

30 A further object of this invention is to improve the mechanical operation of the potentiometers so as to vary the gain without introducing extraneous noise in the circuits.

35 These objects and various features and advantages of the invention will be more fully understood in the following detailed description taken in connection with the following drawing in which:

40 Fig. 1 represents diagrammatically a circuit embodying the invention and adapted to a plurality of condenser transmitters; and

Fig. 2 represents diagrammatically a circuit embodying the invention and adapted to a plurality of carbon transmitters.

55 In Fig. 1 potentiometers 8, 9 and 10 control the volume output from amplifiers 12, 13 and 14. The inputs of these amplifiers are connected to condenser microphones 16, 17 and 18. The condenser microphone-amplifier arrangement may be of any well known type such as where the amplifier is located in close proximity to the microphones to reduce losses and conductor capacitances. Resistances 20, 21 and 22 are employed to substitute for the output impedances of the amplifiers when respective microphones are disconnected from the system. Output terminals 23 and 24 may lead to apparatus such as an amplifier or a transmission line which is to have a definite impedance looking into the potentiometer circuit. Switches 26, 27 and 28 are make-before-break switches which substitute the resistances 20, 21 and 22 across the potentiometers before breaking the amplifier circuits and make these latter circuits before disconnecting the resistances. This tends to prevent undue clicks and thumps in the output circuit, the output circuit being considered in this description as the apparatus between terminals 23 and 24 in series with the potentiometers 8, 9, and 10. The potentiometers 8, 9, and 10 comprise two stationary resistance elements 30—31, 32—33 and 34—35, respectively, and sliders 36, 37 and 38, respectively, the operation of which will be described hereinafter.

60 In Fig. 2 the elements corresponding with those in Fig. 1 are numbered identically. This circuit is adapted for carbon transmitters 41, 42 and 43 of the double button type which are supplied with operating current from a battery 44. Currents generated in the microphones are transmitted to the potentiometer circuit through transformers 47, 48 and 49, the transformers serving to obtain the correct impedance relations between the microphones and the output circuit. Switches 50, 51 and 52 are the same as those in Fig. 1, with the addition of a contact for 100

making and breaking the energy supply circuit. These switches are constructed to have a time delay between the making of this latter contact and the operation of the portion of the switches shown in Fig. 1 and vice versa, in order to allow the current to build up in the microphone circuits before the output circuit is connected thereto. This prevents noise of switching operations and transient current changes from interfering with transmission. Condensers 55, 56 and 57 across the switch contacts reduce packing of the granular particles during switching operations. Variable resistances 58, 59 and 60 control the amount of direct current taken by each microphone while choke coils 61, 62 and 63 prevent the alternating currents of one microphone circuit from interfering with those of the other circuits. These elements do not form part of the invention but are described to explain the operation of the circuits.

The output of the circuit shown in Fig. 2 is through transformer 65 and into the input of a vacuum tube amplifier 66 shown in part. It is to be understood, however, that other types of circuits may be substituted for the amplifier 66. Resistance elements 20, 21 and 22 of Fig. 2 are substituted for the secondary windings of transformers 47, 48 and 49, respectively, when microphones 41, 42 and 43 are disconnected.

The operation of the invention as embodied in the two circuits of Figs. 1 and 2 will now be described. The slider 36 of potentiometer 8 moves along a resistance element 31 in the manner of the usual potentiometer and varies the potential in the output circuit. With only this resistance element 31, the impedance as well as the voltage impressed on the output circuit may vary from zero to a maximum. However, slider 36 moves along resistance element 30 simultaneously with its action on element 31, but in a series relation which substantially maintains the impedances in the output circuit constant. This action is duplicated in potentiometers 9 and 10, the outputs of all the potentiometers being connected in series. This particular potentiometer construction eliminates flexible leads which might change the impedance undesirably.

To explain the action of these potentiometers an actual example will be taken. Referring to Fig. 2 the impedance of the secondary windings of the transformers 47, 48 and 49 will be assumed to be 50 ohms, which will also be the value of the resistance elements 20, 21 and 22 to be substituted therefor. If we assume that the transformer 65 has an input impedance of 200 ohms, then it is desirable to construct the potentiometer circuit to have this value of impedance or substantially so. To accomplish this, the elements 31, 33 and 35 will be constructed with a resistance of 190 ohms each and the

elements 30, 32 and 34 with a resistance of 95 ohms each, the taps 71, 72 and 73 being located so that the resistance of the left hand portion is 35 ohms and the remainder, of course, 60 ohms. The relative positions of the pairs of elements 30—31, 32—33 and 34—35 is such that when the sliders 36, 37 and 38 are at taps 71, 72 and 73, respectively, the resistance of elements 31, 33 and 35 on the left hand side of the sliders is 70 ohms and the resistance on the right hand side 120 ohms.

With these values of the elements in this arrangement the maximum range of variation for the three potentiometers is 45 ohms, that is, the impedance varies from 180 ohms to 225 ohms, while the individual potentiometer variation is between 60 and 75 ohms. This variation occurs when all three potentiometers are varied simultaneously from zero to 190 ohms. In the case of the operation of a single potentiometer, the others remaining either at zero or at the 190-ohm position, the total variation is only 15 ohms, which in either case is maintaining the impedance within satisfactory limits for high quality transmission. It is to be understood, however, that if tapered or graduated resistance elements are used the output impedance may be held constant, but this example is based on an actual practical circuit in which the elements were relatively inexpensive uniformly wound wire resistances.

To compute the impedance at one position of the sliders say when the potentiometers are at the 120-ohm position on elements 31, 33 and 35 the resistance of elements 30, 32 and 34 may be neglected since the sliders are at taps 71, 72 and 73. The only impedance in series with the primary winding of transformer 65 is then the 120 ohms of elements 31, 33 and 35, shunted by the remaining 70 ohms of these elements in series with the 50 ohms impedance of the secondaries of transformers 47, 48 and 49, respectively. This totals 60 ohms per potentiometer or 180 ohms for the total impedance. The impedance of the circuit with the sliders in other positions may be determined in a similar manner.

While in the specific circuits illustrated and described the potentiometers are serially related, the invention comprehends other types of connection, for example, a parallel connection. The disclosure herein of particular means for carrying out the invention, therefore, and the reference to numerical values are not to be taken as in anywise limiting the invention, but the appended claims are intended to cover such equivalent combinations as the state of the art will allow.

What is claimed is:

1. In a transmission circuit, a plurality of microphone circuits, an amplifier, and means intermediate said microphone circuits

and said amplifier for connecting said microphone circuits in series with each other and for varying the output of each microphone individually, said means matching the total impedance of said microphone circuits and the impedance of said amplifier, and permitting the volume output of the individual microphone circuits to be varied while maintaining the total input impedance to said amplifier substantially matched to that of said amplifier.

2. A transmission circuit according to claim 1 in which said means comprises potentiometers individual to said microphone circuits connected in series with the input of said amplifier.

3. A transmission circuit according to claim 1 in which said means comprises potentiometers each having series and shunt elements and a variable slider which traverses each element simultaneously for varying the volume output of said microphone circuits, the output circuit of said potentiometers being connected in series through said sliders with the input of said amplifier.

4. A transmission circuit comprising a plurality of transmitters for detecting sound waves, an amplifier for said waves, a transformer connected to each of said transmitters and a voltage varying device connected to each of said transformers respectively having input and output terminals, said input terminals being connected to the respective secondary windings of said transformers, and said output terminals being connected in series and to the input circuit of said amplifier, said voltage varying devices comprising means for varying the transmission from said transmitters while maintaining impedance relations between said transformers and said amplifier substantially constant.

5. In a sound pick-up system, a plurality of transmitters for changing sound vibrations into electrical vibrations, an amplifier for said electrical vibrations, and means interconnecting said microphones and amplifier for varying the output of at least one of said microphones while maintaining voltage and impedance conditions substantially constant within said system, said means comprising a plurality of potentiometers serially connected to said amplifier, said potentiometers being in parallel individually with said transmitters.

6. In a sound pick-up system, a plurality of microphones for changing sound vibrations into electrical vibrations, a common output circuit for said microphones, a plurality of transformers connected to said microphones, and volume varying devices comprising two resistance elements, one of which is serially connected in said output circuit, said devices being individual to said transformers and interconnecting said transformers and said output circuit for relative-

ly adjusting the volume of respective microphones in small uniform stages, the output of said devices being connected in said common output circuit in a series relationship for maintaining the impedance of said plurality of devices substantially equal to the impedance of said output circuit during adjustments of said devices and preventing the adjustment of one circuit from interfering with the transmission of any other circuit.

7. In a sound pick-up system, a plurality of transmitters for changing sound vibrations into electrical vibrations, a common output circuit, transformers for each of said transmitters connected between said output circuit and said transmitters, volume varying devices, each having series and shunt elements, connected between said transformers and said output circuit, said devices being connected in series with said output circuit and maintaining substantially constant impedance relations between said transmitters and said output circuit, and switches connected to said transformers for connecting and disconnecting any one of said transmitters from said output circuit.

8. In a system of transmission, a plurality of incoming circuits, an outgoing circuit common thereto, and impedance adjusting devices connecting each incoming circuit to the others and to said common outgoing circuit, each such device comprising a loss element connected in shunt to a respective incoming circuit, an adjustable portion of each such element being connected in series with the corresponding element of the next incoming circuit through the medium of a series adjustable loss element, the first incoming circuit having an adjustable portion of its respective shunt element connected through a respective series loss element to one terminal of the outgoing circuit the other terminal of which is connected to the remaining terminal of the last incoming circuit, and means for making corresponding adjustments in the series and shunt loss elements of the respective incoming circuits to vary the loss in the individual incoming circuits while maintaining the impedance presented to the common outgoing circuit substantially constant.

9. In a sound pick-up system, a plurality of transmitters for changing sound vibrations into electrical vibrations, a common output circuit, volume varying devices, each having series and shunt elements, connected between said transmitters and said output circuit, said devices being connected in series with said output circuit and maintaining substantially constant impedance relations between said transmitters and said output circuit.

10. In a sound pick-up system, a plurality of telephonic transmitters for changing sound vibrations into current waves, a com-

mon output circuit, and means associated with said transmitters for controlling the amplitude of the current wave of at least one of said transmitters, said last mentioned means comprising a plurality of impedance devices each having series and shunt elements electrically connected in parallel individually with said transmitters and the output connections to said impedance devices electrically connected in series with each other and with said common output circuit.

11. In a transmission circuit, a plurality of incoming circuits, an amplifier, and means intermediate said incoming circuits and said amplifier for connecting said incoming circuits in series with each other and for varying the output level of certain of said incoming circuits individually, said means matching the total impedance of said incoming circuits and the impedance of said amplifier, and permitting the output level of the said certain incoming circuits to be varied while maintaining the total input impedance to said amplifier substantially matched to that of said amplifier.

12. In a system of transmission, a plurality of incoming circuits, an outgoing circuit common thereto, and means associated with said incoming circuits for controlling the impedance of at least one of said incoming circuits, said last mentioned means comprising a plurality of impedance devices each having series and shunt elements electrically connected in parallel individually with said incoming circuits and electrically connected in series with each other and with said output circuit.

13. In a transmission circuit, a plurality of incoming circuits, an outgoing circuit common thereto, and means associated with said incoming circuits for connecting said incoming circuits in series with each other and for varying the output level of at least one of said incoming circuits, said means matching the total impedance of said incoming circuits and the impedance of said outgoing circuit, and permitting the output level of said last mentioned incoming circuits to be varied while maintaining the total input impedance to said outgoing circuit substantially matched to that of said outgoing circuit.

14. In a transmission circuit, a plurality of incoming circuits, an outgoing circuit common thereto, means associated with said incoming circuits for connecting said incoming circuits in series with each other and for varying the output level of at least one of said incoming circuits, said means matching the total impedance of said incoming circuits and the impedance of said outgoing circuit, and permitting the output level of said last mentioned incoming circuits to be varied while maintaining the total input impedance to said outgoing circuit substantially matched to that of said outgoing circuit, and other means associated with said incoming circuits

for connecting and disconnecting certain of said incoming circuits to and from said outgoing circuit without substantially changing the total input impedance of said outgoing circuit.

In witness whereof I hereunto subscribe my name this 20th day of October, A. D., 1927.

DONALD F. WHITING.

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