

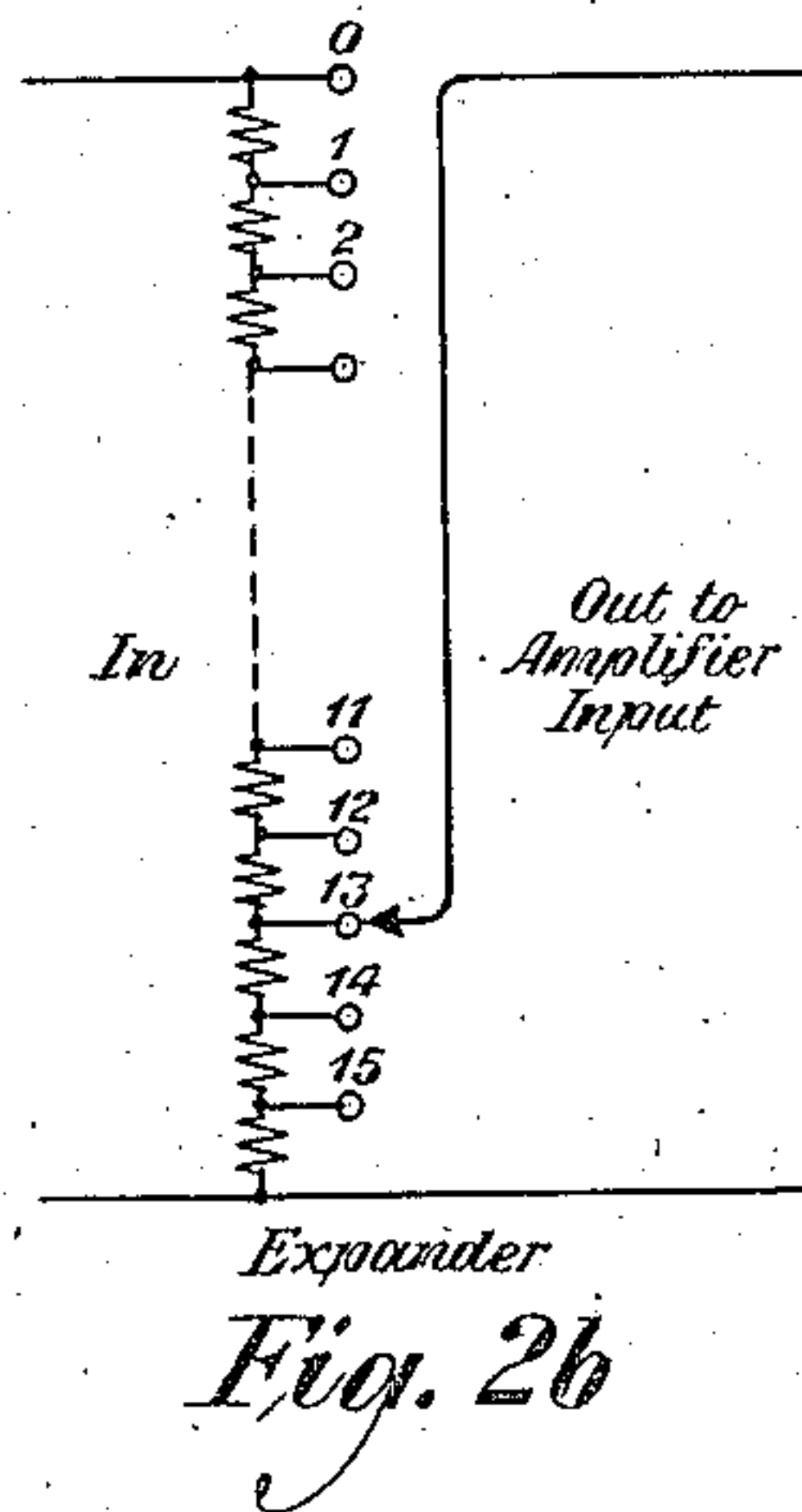
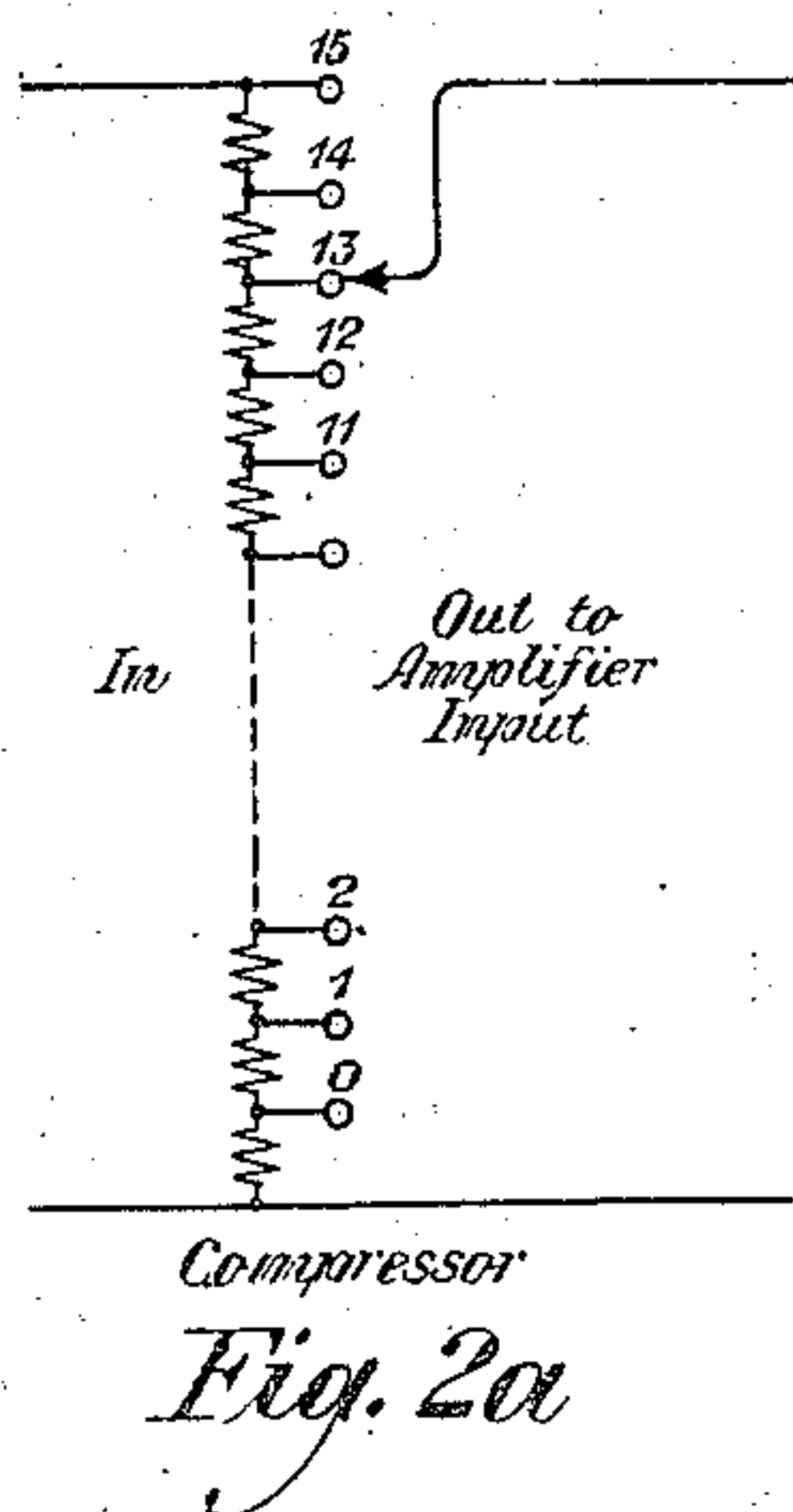
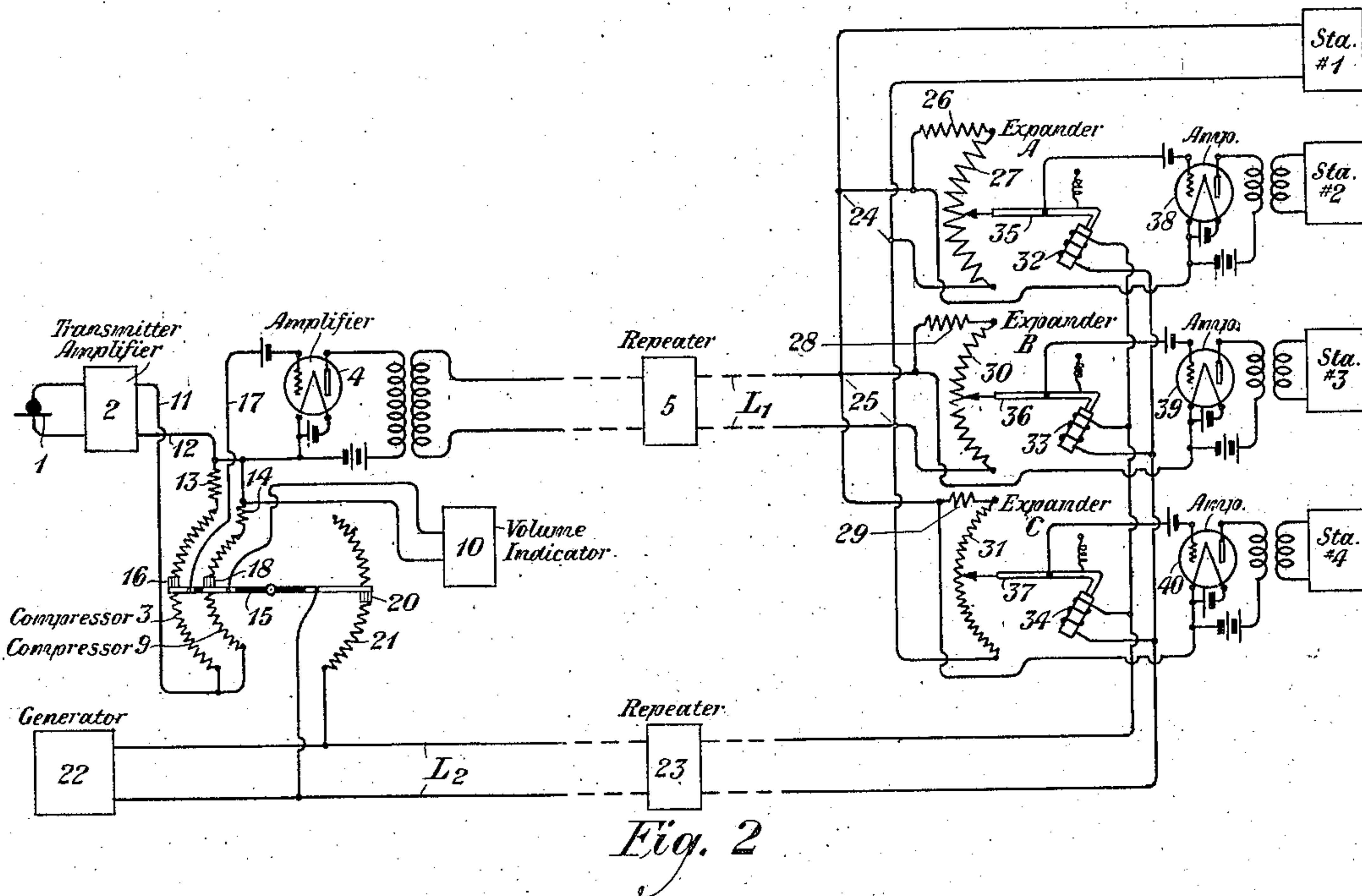
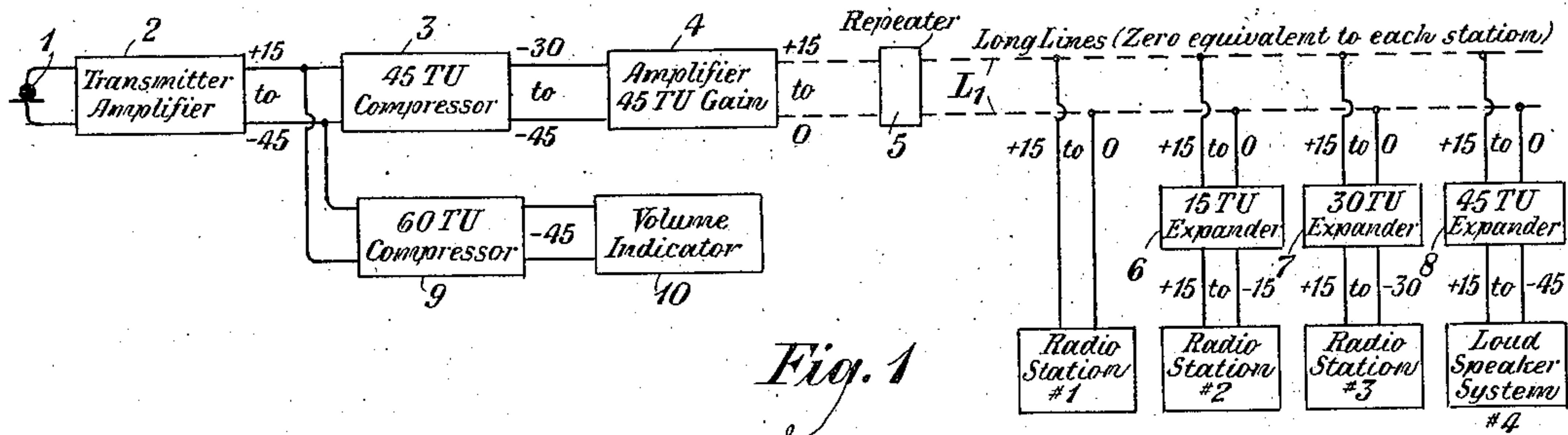
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VOLUME CONTROL SYSTEM

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VOLUME-CONTROL SYSTEM.

Application filed December 19, 1925. Serial No. 76,548.

This invention relates to volume range control systems, and particularly to a system adapted to compress the volume range to be transmitted over or through the medium connecting the parts of the system and to expand it at the receiving points of the system, controlling the degree of expansion in accordance with the particular requirements of each receiving station.

10 In the broadcast system in which a plurality of radio broadcast stations are connected by a transmission circuit with a transmitting station to effect the broadcasting of the same program from all of said broadcast
15 stations, it is desirable to compress the volume range of the output of the transmitter-amplifier at the transmitting station in order to bring such volume range within the range that the transmitting medium, such as a wire
20 line, is capable of transmitting, and to expand the volume range at the receiving stations, so as to bring the music, speech or whatever constitutes the transmitted material, back to its volume range before compression took
25 place at the transmitting station. A method and means for simultaneously controlling the compression and expansion at the transmitting and receiving stations, respectively, are disclosed in the patent to A. B. Clark, No.
30 1,565,548, that issued on December 15, 1925.

Experience has shown that where several radio broadcast stations are connected with the transmission line, it has been found desirable to supply each of the different stations
35 with different volume ranges, depending upon the conditions prevailing in the zone in which each station broadcasts.

This invention resides in a method and means for compressing the volume range
40 of the output of the transmitting station before impressing it upon the transmission line and expanding the volume range at radio broadcast stations or at a loud-speaker installation, the degree of expansion depending upon the particular requirements of each
45 station.

This invention will be clearly understood from the following description when read in connection with the attached drawing, of
50 which Figure 1 shows schematically an arrangement for carrying out the invention, Fig. 2 shows in greater detail a circuit for carrying out the invention, and Figs. 2^a and

2^b illustrate the arrangements for compressing and expanding the volume.

55 In Fig. 1, the transmitter 1 represents symbolically the pick-up device by which music or speech, or other sounds, are picked up and impressed upon a transmitter-amplifier such as is represented by 2. The output of this
60 amplifier, which will, for the purpose of illustrating this invention, be assumed to have a volume range from +15 TU to -45 TU, is connected with a compressor 3 which has a range
65 of 45 TU. This compressor is connected with the input side of the amplifier 4 which has its output side connected with the line L₁. This line may have one or more repeaters such as is represented by 5, and may be connected at
70 various points throughout its length with a plurality of radio broadcast stations 1, 2 and 3, and with a loud speaker system designated No. 4. The radio station No. 1 is connected
75 directly with the line L₁, but the other radio stations and the loud speaker system have expanders 6, 7 and 8 inserted between the station or system and the points of connection
80 with the line. Bridged across the output of the transmitter-amplifier 2 is a compressor 9 which is connected with the volume indicator 10.

Let it be assumed that a symphony concert is being picked up by the transmitter 1 for broadcasting from the radio stations Nos. 1 to 3, and from the loud speaker system No. 4.
85 Let it also be assumed that the volume at the output of the transmitter-amplifier 2 has a range varying from +15 TU to -45 TU. Owing to the presence of the compressor 3, the output volume of the amplifier 2 will be
90 compressed within the range of -30 and -45 TU. This volume is impressed upon the amplifier 4 having the gain of 45 TU so that the output volume of this amplifier has a range extending from zero to +15 TU,
95 which is a range of volume and which represents the levels adapted for transmission over the long lines to the radio broadcast stations and the loud speaker system. Since the radio station 1 desires a volume range of only
100 15 TU, it would be directly connected with the line L₁ inasmuch as such is the volume range transmitted by the said line. If a station such as No. 2 desires a greater range of volume, it is necessary only to use an ex-
105 pander of the proper size, which, in the case il-

lustrated, is that giving a volume range of 30 TU, that is to say, from +15 TU to -15 TU. Another station such as No. 3 desiring a still greater range would have a 30 TU expander

5 inserted between the station and the line L_1 . While it is probable that the volume range represented by station No. 3 would be the maximum required by a radio station, it may be desirable to further expand the volume for the purpose of reproducing the concert in a hall at a distant point by means of a loud speaker system, which would expand the music to the original volume range possessed by it at the hall where the concert was being performed. In such an event, a 45 TU ex-
10 pander would expand the volume range of the line from +15 TU to -45 TU, which would be the volume range in the output of the transmitter-amplifier 2.

20 The devices 9 and 10 constitute a novel arrangement for controlling the operation of the system. The compressor 9 has a range of 60 TU, which, as will be noted, is the range of volume in the output of the transmitter-amplifier, namely from 15 TU to -45 TU. The effect of this compressor is to reduce the volume as indicated by the indicator 10 to -45 TU. As will be clearly seen in Fig. 2, the contact points or brushes of the poten-
25 tiometers constituting the compressors 3 and 9 are so connected that the movement of one of the contact points produces a corresponding movement of the contact point of the other. Accordingly, when the operator at the control station moves the arm of the com-
30 pressor 9 so as to keep the reading of the volume indicator 10 constant at a level of -45 TU, such movement of the arm will produce a corresponding movement of the contact point of the compressor 3, thereby insur-
40 ing that the volume applied to the input side of the amplifier 4 will range between -30 TU and -45 TU.

The manner in which the various devices at the sending and the receiving ends of the line L_1 are inter-controlled is shown clearly in Fig. 2, in which the same numerals have been used to indicate similar parts. The con-
45 ductor 11 of the output circuit of the transmitter-amplifier 2 is connected with one of the terminals of the potentiometer designated compressor 3, and conductor 12 is connected with the other terminal of this poten-
50 tiometer winding, the connection including a fixed resistance 13. In like manner, the conductor 11 is also connected with the winding of the potentiometer designated compressor 9, and conductor 12 is connected with the other terminal of this winding, the connec-
55 tion including a fixed resistance 14. The contact points of these potentiometer windings, which are represented by brushes, are carried by a single control arm 15, but are insulated each from the other. Thus the
60 brush 16 of the compressor 3 is connected by

conductor 17 with the grid of the amplifier 4. The brush 18 of the compressor 9 is connected by conductor 19 with one terminal of the volume indicator 10, the other terminal of which is effectively connected with conduc-
70 tor 12. The other end of the arm 15 carries a brush 20 which moves along the winding 21 so as to effectively bridge portions of this winding, which is a resistance element, across the line L_2 , which connects the generator 22
75 with the control apparatus at the distant stations. This line may have therein one or more repeaters such as 23. The line L_1 is connected directly with the station No. 1, that is to say, without the interposition of any
80 expanding device. Bridged across the line L_2 at the points 24 and 25 are the expanders designated A, B and C. Expander A includes a relatively large fixed resistance 26 in series with a variable element of lower
85 resistance 27. Similarly, expanders B and C comprise fixed resistances 28 and 29, respectively, 29 being smaller than 28, and variable resistances 30 and 31, respectively, the resistance 30 being less than 31. A plurality
90 of solenoids, 32, 33 and 34, are effectively bridged across the line L_2 and control the arms 35, 36 and 37 of the expanders A, B and C, respectively. The arms 35 to 37, inclusive,
95 are connected with the grids of the amplifiers 38 to 40, respectively, the outputs of which are connected with stations 2 to 4, respectively. The filaments of each of the ampli-
100 fiers 38, 39 and 40 are connected with the upper conductor of the line L_2 .

Assuming, as in Fig. 1, that the trans-
mitter-amplifier has a volume output range of 60 TU comprised between the levels of +15 TU and -45 TU, the operator at the transmitting station will operate the arm 15
105 of the potentiometer control system in order to keep the reading of the volume indicator substantially constant at the -45 point upon the scale. In doing this, the operator also effects the movement of the brush 16 upon the
110 winding of the compressor 3 so as to fix the volume, that will be applied to the amplifier 4, between the limits of the -30 TU and the -45 TU. If the volume of the transmitter output would indicate an upward trend by
115 the device 10, the operator would make such adjustment as to lower the volume range, and in so doing, he would not only control the limit applied to the input of the amplifier 4, but would also effect an adjustment of the
120 variable resistance 21, which is shunted across the line L_2 . This controls the power supplied to the solenoids 32 to 34 at the stations at the distant end of the line L_2 , and the
125 arms 35, 36 and 37 of the expanders A, B and C will take a position depending upon the strength of the current flowing through the solenoids, which depends upon the setting of the brush 20 upon the resistance 21 at the sending station. The volume range applied
130

to the amplifiers 38, 39 and 40 will thereby be controlled. Thus, if the volume at the output of the amplifier 2 is reduced by the compressor, it is automatically increased at each of the stations Nos. 2, 3 and 4, and vice versa, if the volume is increased at the sending station, so as to bring it within the range intended for the line L_1 , it will be reduced by the expanders A, B and C, which will be controlled by the current sent over the line L_2 from the generator 22.

It is desirable to mention that while the stations 1 to 4, inclusive, seem to be connected with the line L_1 at the same point, such arrangement has been made to render the drawing more compact. However, as stated in connection with Fig. 1, the broadcasting stations and the loud speaker system may be connected with the line at different points throughout its length.

It is to be understood, of course, that the arrangement shown in Fig. 2 may be varied in its details in many ways that will suggest themselves to persons skilled in the art. Thus, in place of a generator such as 22, whose output current is controlled by the shunting device 20—21, it is possible to use a step-by-step method of control to effect the operation of the expanders A, B and C at the radio stations, and other devices may be readily used in other parts of the system in place of those shown.

While the invention has been disclosed as embodied in particular forms, it is capable of embodiment in other forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In an arrangement for controlling the volume range of an electrical transmission system comprising a plurality of receiving stations, a transmitting station common to the receiving stations, and a wire line connecting the said transmitting station with all of the receiving stations, the method which consists in compressing the range of volume of power at the transmitting station to bring it within the range that the wire line is capable of efficiently handling, and expanding the volume range at each of the said receiving stations to different degrees, the degree of expansion at each station depending upon the requirements of the particular station.

2. In an arrangement for controlling the volume range of an electrical transmission system, the combination with a transmitting medium of a source capable of producing a volume of power having a wide range between its upper and lower levels, a volume range compressor and an amplifier connected in sequence between the said source and the said transmitting medium, the said compressor being adjusted to compress the volume range of the said source to the degree necessary to bring it within the volume range that the said medium is capable of transmitting, and the said amplifier being adjusted to control the levels of the said volume without changing the range of the said volume for transmission over the said medium, a volume indicator and a second compressor connected between the said indicator and the said source, the said compressors being so connected that the adjustment of the second compressor to keep the reading of the volume indicator at a predetermined point, automatically adjusts the first compressor to keep the levels at such points as to compress the volume range produced by said source to the range that the said transmitting medium is capable of transmitting.

3. In an arrangement for controlling the volume range of an electrical transmission system comprising a plurality of receiving stations, a transmitting station common to the receiving stations, and a wire line connecting the said transmitting station to all of the receiving stations, the method which consists in compressing the range of volume at the transmitting station to bring it within the range that the wire line is capable of efficiently handling, varying the level of the volume as thus compressed without changing its range, transmitting the said volume and expanding the volume range at each of the receiving stations to different degrees, the degree of expansion at each station depending upon the requirements of the particular station.

In testimony whereof, we have signed our names to this specification this 18th day of December, 1925.

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