Feb. 26, 1924. 1,484,988

H. S. HAMILTON

PUBLIC ADDRESS CIRCUITS

Filed Feb. 9, 1923 2 Sheets-Sheet 1

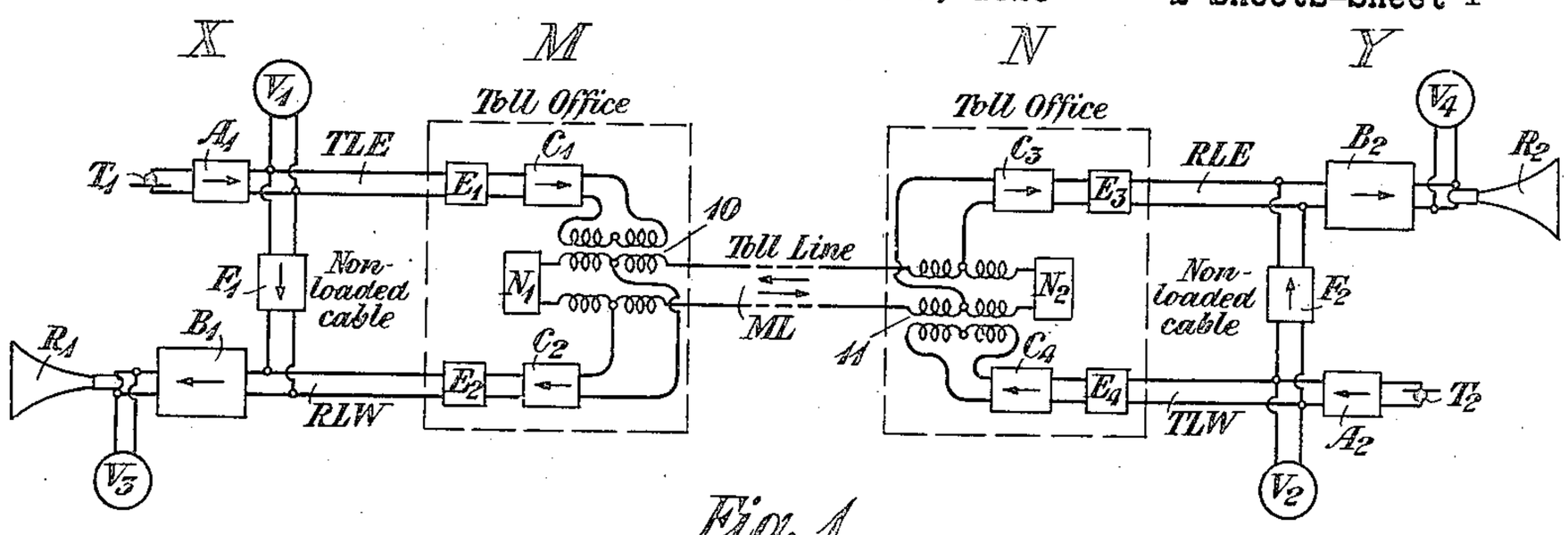

Fig. 1

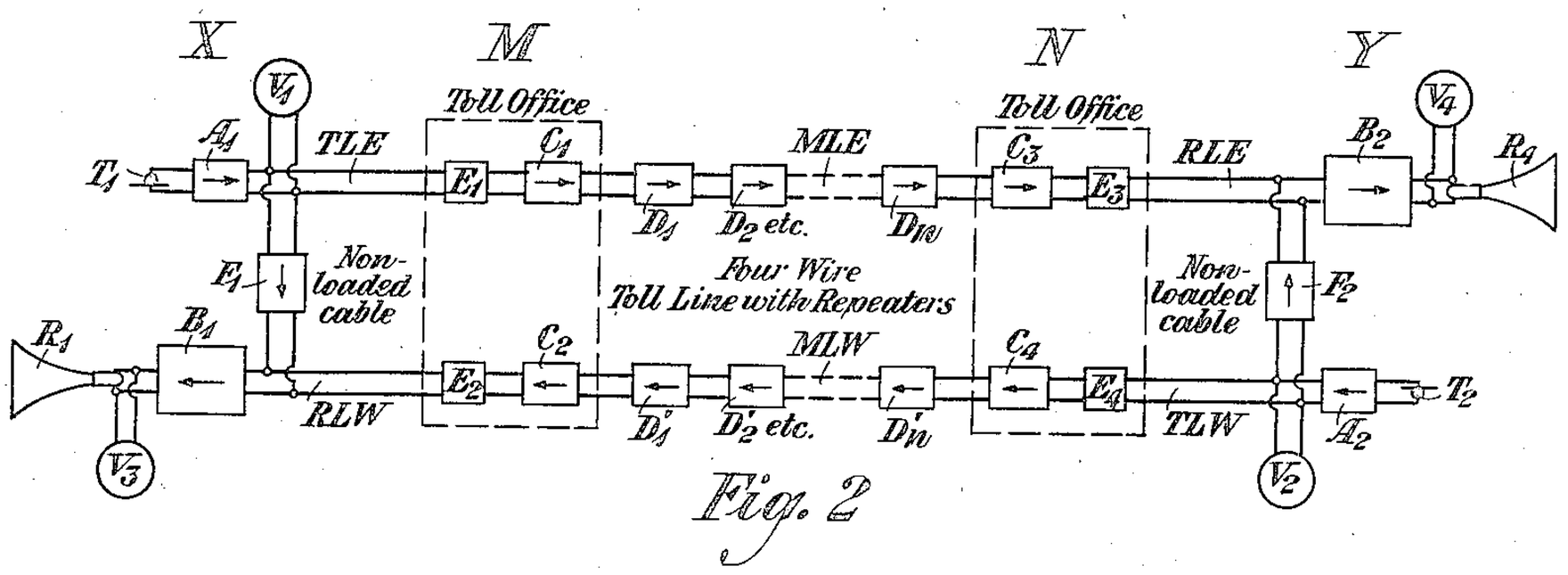

Fig. 2

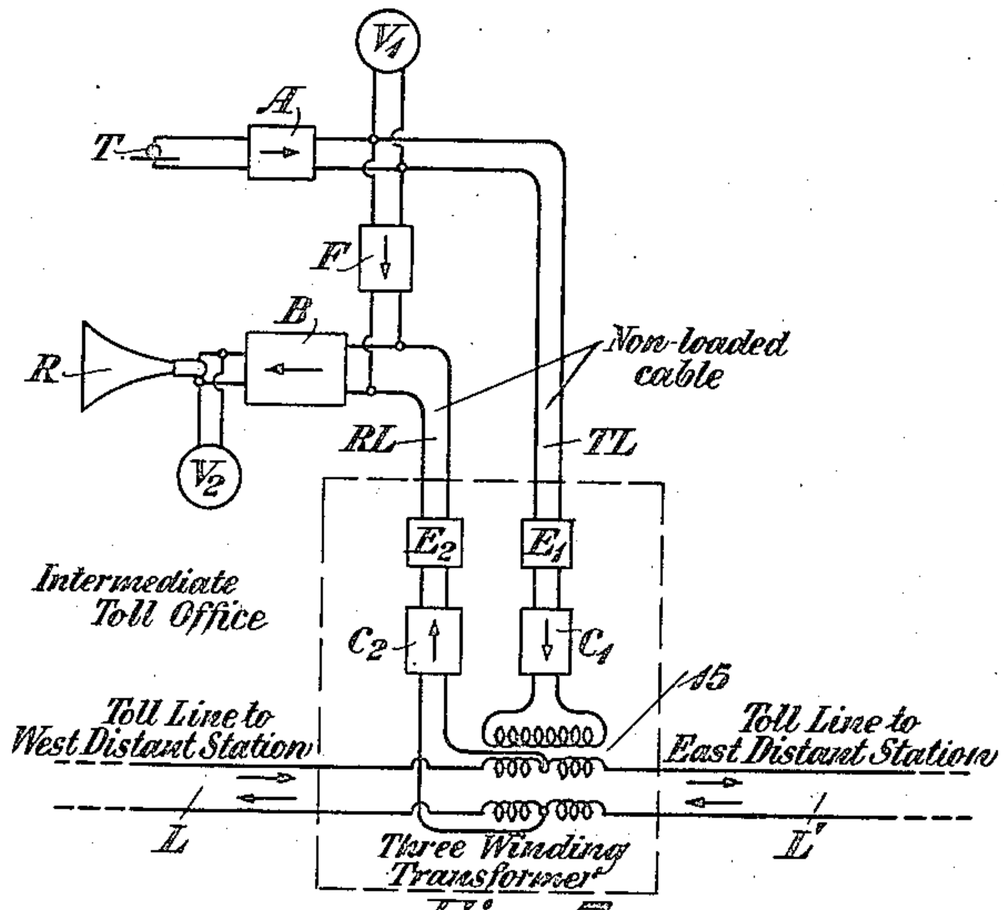

Fig. 3

INVENTOR
H. S. Hamilton
BY
ATTORNEY

Feb. 26, 1924. 1,484,988

H. S. HAMILTON

PUBLIC ADDRESS CIRCUITS

Filed Feb. 9, 1923 2 Sheets-Sheet 2

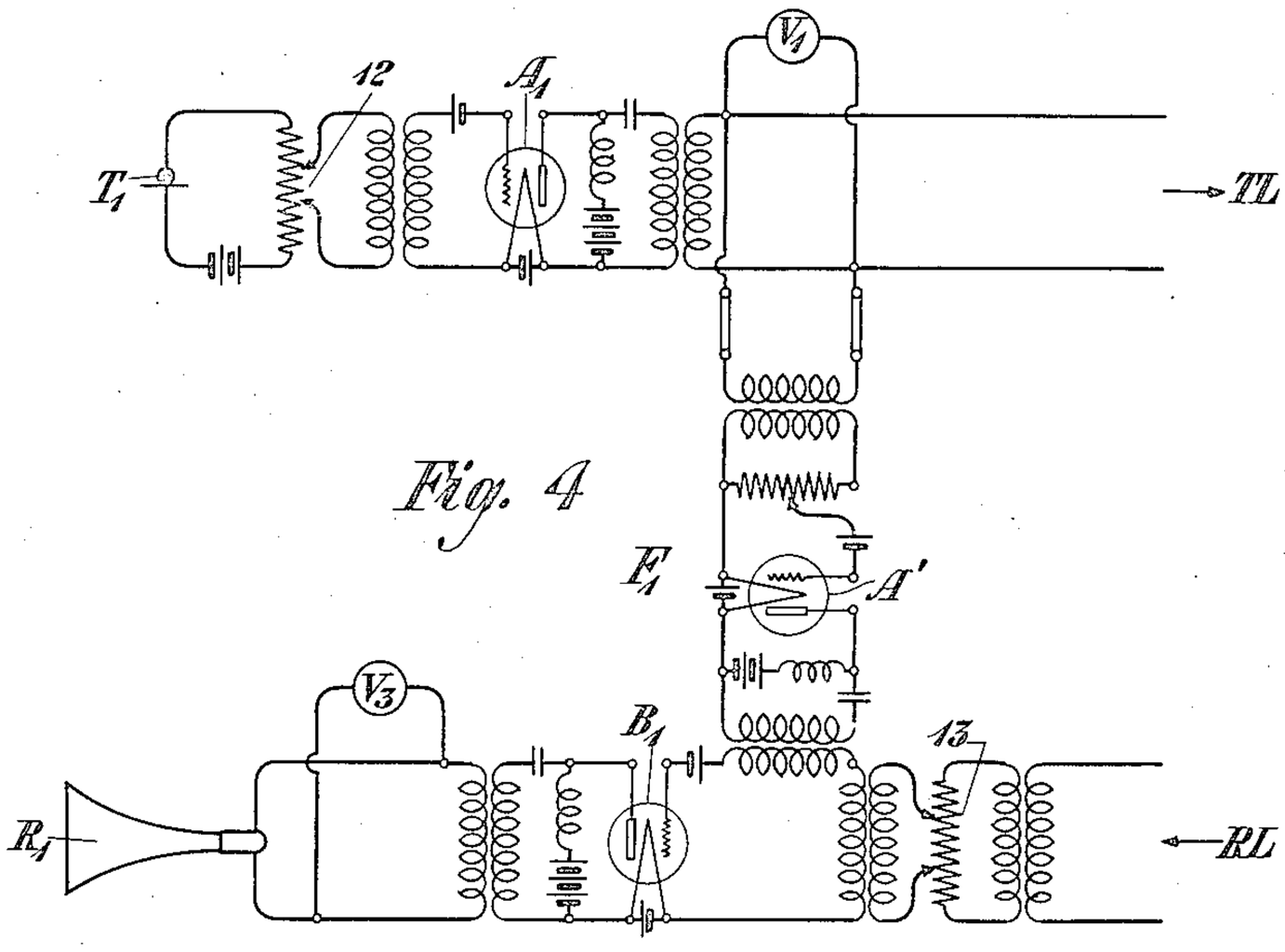

Fig. 4

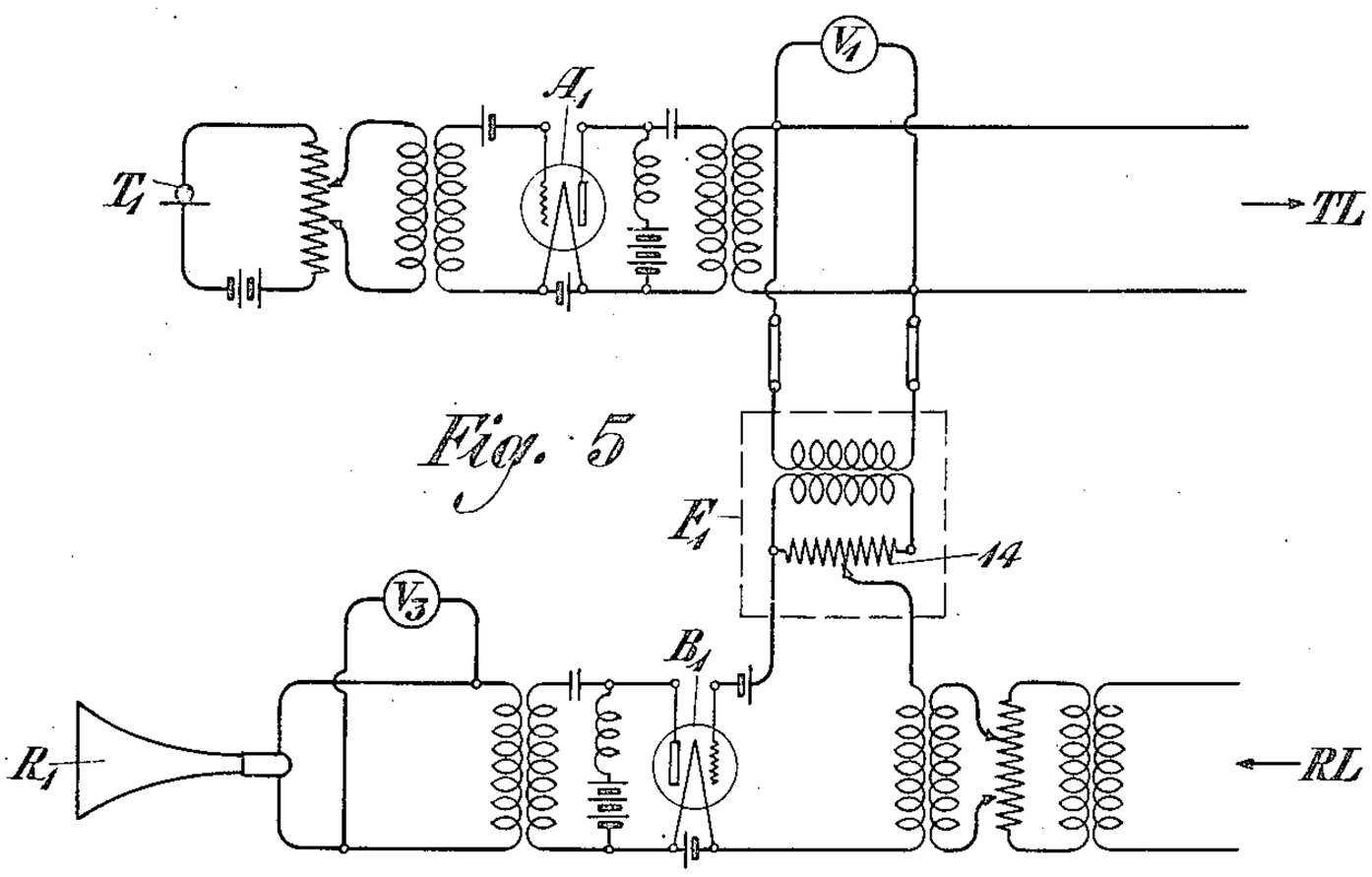

Fig. 5

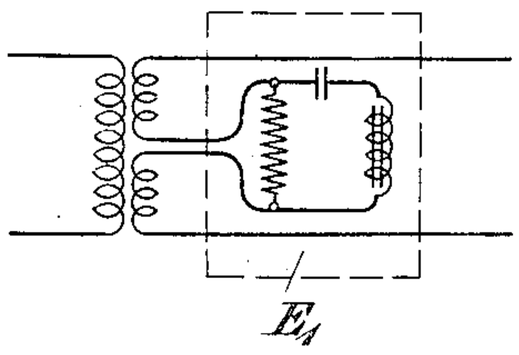

Fig. 6

INVENTOR
H. S. Hamilton
BY
ATTORNEY

Patented Feb. 26, 1924. 1,484,988

UNITED STATES PATENT OFFICE.

HAROLD S. HAMILTON, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

PUBLIC-ADDRESS CIRCUITS.

Application filed February 9, 1923. Serial No. 618,072.

To all whom it may concern:

Be it known that I, HAROLD S. HAMILTON, residing at New York, in the county of Bronx and State of New York, have invented certain Improvements in Public-Address Circuits, of which the following is a specification.

This invention relates to electrical means for transmitting addresses, music and the like to public assemblages, and more particularly to arrangements whereby a so-called public address system may be associated with long distance telephone lines, so that speech, music or the like may be transmitted from one point to an audience at a distant point.

Where a public address system is to be associated with a long distance line so that an audience may be addressed from a distant point, it is usually necessary to provide some arrangement whereby a local audience may be addressed at the same time, and quite frequently it is desirable that each of two speakers at two distant points may be able to address not only a local audience but an audience at the other point. It is one of the principal objects of the invention to provide circuit arrangements whereby the above results may be accomplished in a simple, economical and satisfactory manner.

The invention may now be more fully understood by the following description when read in connection with the accompanying drawing in which Figures 1, 2 and 3 illustrate three simplified circuit diagrams embodying the principles of the invention while Figs. 4, 5 and 6 are detailed circuits showing portions of the apparatus involved.

Referring to Fig. 1, two distant stations X and Y are shown, at each of which is arranged apparatus to be used in addressing an audience. This apparatus is illustrated conventionally and comprises a high quality transmitter of a type well known in the art which picks up the music or speech to be transmitted and impresses it on an amplifier A_1. Upon the output side of the amplifier a volume indicator V_1 is provided so that the attendant may determine the amplitude of the currents which are to be transmitted. This volume indicator may be, for example, a device of the type illustrated in the United States application of E. L. Nelson, Serial No. 585,357, filed August 31, 1922. The output side of the amplifier is connected to a line TLE, which may, for example, be a non-loaded cable leading to a long distance toll office M. The receiving portion of the apparatus comprises an amplifier B_1 associated with a receiving line RLW which may also be of non-loaded cable. The line RLW leads from the toll office M to the local station X. The output side of the amplifier B, is connected to loud speaking apparatus which may comprise one or more loud speakers of a well known type. The loud speaking apparatus is indicated conventionally at R_1. A volume indicator V_8 similar to that already described is bridged across the output side of the amplifier B_1 for the purpose of indicating to the attendant the volume of the transmission to the loud speaker.

At the toll office M the transmitting line TLE and receiving line RLW are associated with the toll line ML which interconnects the toll offices M and N through a hybrid coil connection 10, and the toll line ML is balanced by an artificial line or network N_1 to render the lines TLE and RLW conjugate. At the toll office N an attenuation equalizer E_1 is provided in the line TLE for the purpose of compensating for the distortion due to the fact that the non-loaded cable attenuates the higher frequencies much more than the lower frequencies. This attenuation equalizer may be any one of a number of known types, such, for example, as the attenuation equalizer illustrated in application of R. S. Hoyt, Serial No. 242,567, filed June 29, 1918, now Patent No. 1,453,980, dated May 1, 1923. One form of the equalizer whose principle of operation is fully described in the Hoyt application referred to is illustrated in Fig. 6 and consists of a serial combination of inductance and capacity in parallel with a resistance, the elements being so proportioned as to introduce distortion complementary to that due to the line. The amplifier C_1 is also provided at the toll office for amplifying the currents to the proper volume for transmission over the toll line. This amplifier may be of any well known type such, for example, as a vacuum tube amplifier.

The receiving circuit RLW at the toll office M includes a receiving amplifier C_2 which may be similar to the amplifier C_1. The line RLW also includes an equalizer E_2

similar to the equalizer E_1 already described and having a similar function, viz, to compensate for the distortion introduced by the line RLW. The toll line ML interconnecting the toll offices M and N may be of any known type, and when the toll line is of sufficient length repeaters will, of course, be provided, although as these repeaters form no part of the present invention they are not illustrated. The apparatus at the toll office N and station Y is similar to that described at toll office M and station X respectively and need not be further described.

Returning to the station X, a by-pass connection F_1 is provided between the output of the amplifier A_1 included in the transmitting circuit, and the input of the amplifier B_1 included in the receiving circuit, in order to enable a speaker at the transmitter T_1 to address his local audience listening to the loud speaker R_1. A similar by-pass circuit F_2 is also provided at station Y. If a by-pass such as F_1 were not provided, transmission from the transmitter T_1 to the local loud speaker R_1 could only take place due to the unbalance of the hybrid coil 10, which would be a very unsatisfactory arrangement.

Upon the other hand, the provision of a two-way connection as F_1 between the circuits TLE and RLW would enable the energy transmitted over the outgoing circuit TLE to be transmitted through the hybrid coil 10 to the incoming circuit RLW, due to unbalance of the hybrid coil, and from the incoming circuit RLW the energy would be transmitted directly to the outgoing circuit TLE so that singing might be set up. It is therefore desirable that the by-pass circuit F_1 be a one-way circuit, so that transmission can only take place from the output of the amplifier A_1 to the input of the amplifier B_1, while no transmission takes place in the reverse direction.

Fig. 4 illustrates a detailed circuit arrangement for accomplishing this result. In this figure the amplifier A_1 is shown as a vacuum tube amplifier of known type, and a potentiometer 12 is shown associated with the input circuit of the amplifier for cointrolling its gain. The amplifier B_1 is likewise shown as a vacuum tube amplifier, and a potentiometer 13 is associated with its input circuit for adjusting the gain. The by-pass circuit F_1 is provided with an amplifier A′ of the vacuum tube type. As is well known, an amplifier of this type will transmit in one direction only, and no current can be transmitted from the circuit RL through the amplifier A′ to the circuit TL.

A modified arrangement for accomplishing the same result is shown in Fig. 5. Here the amplifier A′ is omitted and the by-pass F_1 includes merely a transformer for coupling the by-pass circuit to the input of the amplifier B_1. If desired, a potentiometer 14 may be included upon the secondary side of the transformer. Owing to the fact that the grid of the amplifier B_1 is made ultranegative with respect to the filament by means of the C battery, no current can flow in the input circuit of the amplifier B_1, and the only effect of currents impressed upon said input circuit through the input transformer or the transformer of the by-pass F_1 is to produce potential variations in the input circuit without producing any corresponding current flow. The result is that current flowing in the primary winding of the transformer of the by-pass F_1 produces potential variations in the input circuit of the amplifier B_1 thereby causing the amplifier to produce corresponding currents in its output circuit to actuate the loud speaker R_1. Upon the other hand, currents incoming from the line RL and producing only potential variations without corresponding current flow in the input circuit of the amplifier B_1 do not induce any currents in the upper or primary winding of the transformer of the by-pass F_1, because only potential variations are produced in the lower winding, and no current flows to induce current in the upper winding. Consequently, transmission can take place in one direction only.

The provision of the volume indicator V_1 upon the output side of the amplifier A_1 is an important feature of the circuit, as it enables proper adjustment of the potentiometer upon the input side of the amplifier A_1 to insure that the power delivered to the toll line ML will be within proper limits. If the volume at the toll office is allowed to become too great, the telephone repeaters (if any) on the toll line will be overloaded and serious distortion will result. Upon the other hand, if the volume is allowed to become too weak, extraneous noise and cross-talk upon the toll line will tend to obliterate the direct transmission. In adjusting the gain of the amplifier A_1 it is necessary to take into account the loss introduced by the non-loaded cable and the equalizer E_1 together with the gain of the repeater C_1 in order to deliver volume within proper limits to the toll line.

The volume indicator V_3, on the other hand, is provided to facilitate adjustment of the potentiometer or amplifier, as the case may be, in the by-pass circuit F_1 and also adjustment of the potentiometer on the input side of the amplifier B_1 with respect to the line RL so as to deliver proper volume for the loud speaker R_1 both for the local talking circuit and for the reception of addresses from the distant end of the circuit. The volume indicators V_2 and

V_4 at the station Y have functions similar to those of the devices V_1 and V_3 respectively.

It will be seen that the circuit above described interconnects the toll line with the transmitter and loud speaker of the public address system through a four-wire circuit. It will also be apparent that a speaker at transmitter T_1 may simultaneously address audiences at X and Y through the projector apparatus R_1 and R_2 respectively. Likewise a speaker using the transmitter T_2 may simultaneously address both audiences.

Fig. 2 illustrates a circuit arrangement similar to that of Fig. 1 except that the toll circuit connecting the toll offices M and N is of the four-wire type. A two-wire toll line MLE interconnects the toll offices M and N for transmission from west to east. This toll line is provided at suitable points with one-way repeaters D_1, D_2, etc. Similarly a two-wire toll line MLW for transmitting from east to west interconnects the toll offices M and N and is provided with one-way amplifiers D_1' and D_2', etc. The local lines TLE and RLW, instead of being interconnected to the toll line through a hybrid coil, are each separately connected to corresponding lines of the four-wire circuit, the line TLE being connected through the apparatus at the toll office to the toll line MLE, and the receiving line RLW being connected through the toll office to the toll line MLW. The connections at the station N are similar to those above described. The operation of the circuit will be apparent from the operation of the circuit of Fig. 1 and need not be further described.

Fig. 3 illustrates an arrangement whereby public address apparatus may be associated with the toll line at some intermediate point. In Fig. 3, L and L′ indicate sections of a toll line connecting distance toll offices which may be associated with public address systems at each end in the manner described in connection with Fig. 1. In order to associate the public address apparatus with the toll line at an intermediate point, a hybrid coil 15 is provided whereby local circuits TL and RL leading from the toll office to the auditorium are interconnected with the toll line. The apparatus associated with the local circuits RL and TL at the toll office will be similar to that associated with the circuits TLE and RLW in Fig. 1. The apparatus located at the auditorium will also be identical with that described in connection with Fig. 1, and description thereof would be superfluous. It should be noted that the hybrid coil 15 may be so designed that the impedance which it introduces into the toll circuit is so small as to avoid any serious irregularity. The talking currents from the local line TL pass to the line sections L and L′ through the hybrid coil. The received transmission from the toll line is obtained through a high impedance bridge across the midpoints of two of the windings of the three-winding hybrid coil 15. The amplifiers C_1 and C_2 introduce sufficient gain to overcome the loss due to the inefficient coupling of the telephone line.

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. A public address system for the two-way interconnection of distant auditoriums comprising a toll circuit interconnecting two distant toll offices, a four-wire circuit from each toll office to the associated auditorium, a transmitter connected to one line of the four-wire circuit, a loud speaking receiver connected to the other line of the four-wire circuit, and a by-pass circuit between the two lines of the four-wire circuit for enabling the transmitter to actuate the local loud speaker.

2. A public address system for the two-way interconnection of distant auditoriums comprising a toll circuit interconnecting two distant toll offices, a four-wire circuit from each toll office to the associated auditorium, a transmitter connected to one line of the four-wire circuit, a loud speaking receiver connected to the other line of the four-wire circuit, and a by-pass circuit between the two lines of the four-wire circuit for enabling the transmitter to actuate the local loud speaker, said by-pass transmitting in one direction only.

3. A public address system for the two-way interconnection of distant auditoriums comprising a toll circuit interconnecting two distant toll offices, a four-wire circuit from each toll office to the associated auditorium, a transmitter connected to one line of the four-wire circuit, a loud speaking receiver connected to the other line of the four-wire circuit and a by-pass circuit between the two lines of the four-wire circuit for enabling the transmitter to actuate the local loud speaker, said by-pass including a one-way device for preventing transmission from the receiving circuit to the transmitting circuit.

4. A telephone system comprising a telephone circuit interconnecting two offices, four-wire circuits interconnecting the offices with local stations, a hybrid coil at the offices for associating the four-wire circuit with the telephone circuit, a transmitter connected to one line of each four-wire circuit, a receiver connected to the other line of each four-wire circuit, and a by-pass con-

nection from one line of each four-wire circuit to the other for enabling the transmitter to actuate the local receiver.

5. A telephone system comprising a telephone circuit interconnecting two offices, four-wire circuits interconnecting the offices with local stations, a hybrid coil at the offices for associating the four-wire circuit with the telephone circuit, a transmitter connected to one line of each four-wire circuit, a receiver connected to the other line of each four-wire circuit, and a by-pass connection from one line of each four-wire circuit to the other for enabling the transmitter to actuate the local receiver, said by-pass circuit transmitting in one direction only.

6. A telephone system comprising a telephone circuit interconnecting two offices, four-wire circuits interconnecting the offices with local stations, a hybrid coil at the offices for associating the four-wire circuit with the telephone circuit, a transmitter connected to one line of each four-wire circuit, a receiver connected to the other line of each four-wire circuit, and a by-pass connection from one line of each four-wire circuit to the other for enabling the transmitter to actuate the local receiver, said by-pass circuit having a one-way device for preventing transmission from the receiver circuit to the transmitter circuit.

In testimony whereof, I have signed my name to this specification this 8th day of February, 1923.

HAROLD S. HAMILTON.