Jan. 13. 1925.

1,523,102

W. L. BETTS

RECEIVING CIRCUITS

Filed Dec. 30, 1922

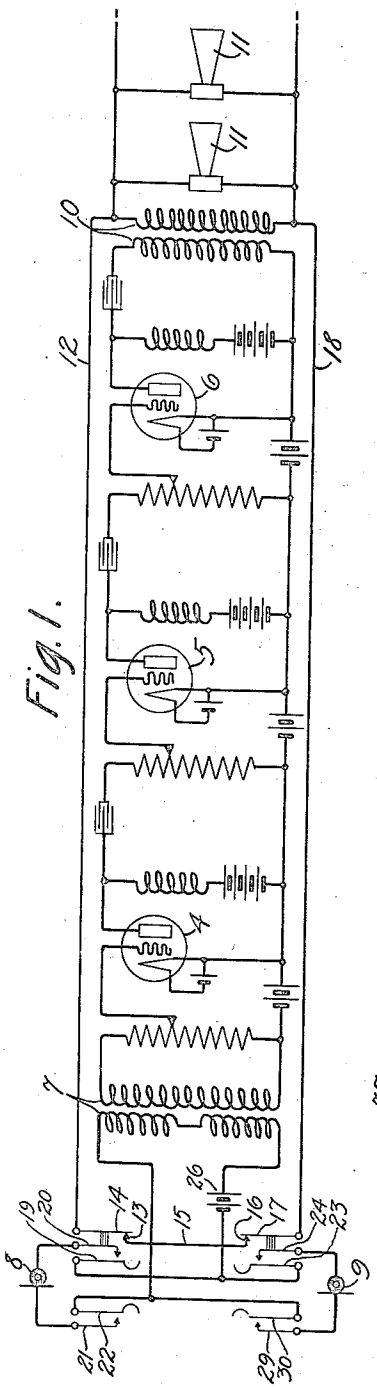


Fig. 1.

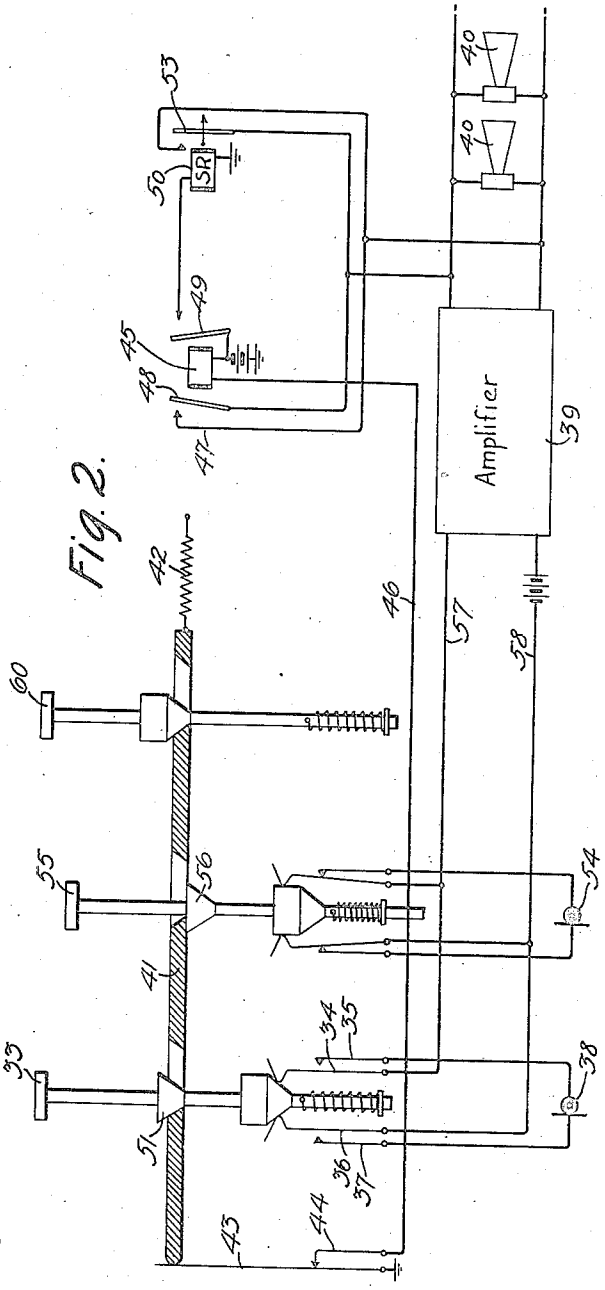


Fig. 2.

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UNITED STATES PATENT OFFICE.

WALTER L. BETTS, OF BROOKLYN, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

RECEIVING CIRCUIT.

Application filed December 30, 1922. Serial No. 609,958.

To all whom it may concern:

Be it known that I, WALTER L. BETTS, a citizen of the United States, residing at Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Receiving Circuits, of which the following is a full, clear, concise, and exact description.

This invention relates to receiving circuits, and has for an object the reduction of noise in a receiving circuit, particularly one in which amplifying means are employed.

While this invention is capable of general use, it is of particular utility in connection with the use of high power amplifiers employed for impressing upon loud speaking telephone receivers amplified currents from one or more telephone transmitters. In such a system it frequently becomes desirable to change the input circuit connections of the amplifier, to switch, for example, from one transmitter to a second transmitter. The opening and closing of the input circuit to perform this switching will generally produce loud crashes in the loud speaking receiver, which of course, are highly objectionable, if for example, the receivers are being employed during the switching of transmitters for a public address system. It has been found that these crashing noises in the receiver, however, can be substantially eliminated by short-circuiting the output of the amplifier prior to opening the input circuit connections and maintaining the short-circuit until after the switching operation has been completed. Unitary switching means may be provided for causing the short-circuit and for changing from one transmitter to a second transmitter.

Referring to the drawings, Fig. 1 discloses a multi-stage amplifier provided with unitary switching means in accordance with this invention, and Fig. 2 is a modification of Fig. 1 in which relays are employed for opening and closing the short-circuiting path for the amplifier.

Fig. 1 discloses a three-stage amplifier, comprising vacuum tubes 4, 5 and 6 connected in tandem. The input circuit of tube 4 by a suitable step-up input transformer 7, is adapted, by suitable switching means, to be connected either to a transmitter 8 or a second transmitter 9. The output circuit of tube 6, by an output transformer 10, is coupled to a plurality of loud speaking receivers 11, connected in parallel, or in any other suitable relation. The manner in which the three amplifiers 4, 5 and 6 are arranged and coupled to each other is not a part of this invention, since any high quality multi-stage amplifier may be substituted for the particular amplifier shown in Fig. 1. The type of amplifier shown is quite similar to that described and claimed in the Arnold Patent No. 1,403,475, January 17, 1922.

Such an amplifier as that shown in Fig. 1 is capable of producing an enormous amplification of the signals from transmitters 8 or 9 before impressing them upon the loud speaking receivers 11.

When such a system is employed in a public address system, for example, it frequently becomes desirable to switch the input terminals of the amplifier from one transmitter to a second transmitter for a variety of reasons, such as a sudden failure of one transmitter to operate, or to connect the amplifier to a transmitter located at some point remote from the first transmitter. This last case is met when it is desired to employ the amplifier and the loud speaking receivers for amplifying the power of a local speaker at one time and subsequently to employ the amplifier and the loud speaker for a person who is speaking into a second transmitter located in a distant city and connected to the local amplifier by a suitable telephone line. Such a switching is further desirable, when after a person has finished speaking into one transmitter it is desired to couple the loud speaking receivers to a transmitter located near a phonograph for the purpose of entertaining the audience with music or other sound records.

It has been found, however, that when the input circuit connections of a high power amplifier are suddenly broken or made while the amplifier is operative and coupled to the loud speaking receivers, extremely loud crashes are heard in the receivers, which are not only objectionable from the standpoint of the audience, but are also liable to produce permanent injuries to the loud speaking receivers themselves, or to the amplifiers. For example, one type of transmitter which might be employed in such a system requires an energizing current of approximately 5 volts, so that when the energizing circuit is broken, a change of 5 volts would be suddenly impressed upon the primary of input

transformer 7 which may be stepped up in voltage in the usual way by the step-up transformer to a much larger voltage. This voltage would then be amplified by the multi-stage amplifier; up to the point where the amplifier becomes overloaded so that it will be seen that the voltage impressed upon these receivers, due to the sudden breaking of the five-volt circuit, produces enormously greater voltage changes at the receiver than the speech frequency currents generated by the transmitter, which for the transmitter referred to, are of the order of nine one-thousandths of a volt instead of 5 volts.

In accordance with this invention it has been found that if the output of the amplifier is short-circuited prior to breaking the input circuit connections, and this short-circuit maintained until after the first transmitter has been removed and replaced by a second transmitter, these loud crashes in the loud speaking receivers are entirely eliminated.

Referring to Fig. 1, a double key is shown therein for connecting either transmitter 8 or transmitter 9 to the input of the amplifier. With the double key in the position shown, neither transmitter is coupled to the amplifier, and the secondary winding of the output transformer 10 is short-circuited by the following path: conductor 12, contacts 13 and 14 of the double key, conductor 15, contacts 16 and 17 of the double key to conductor 18. If now it is desired to connect transmitter 8 to the amplifier, the key is thrown to connect contacts 19 and 20 and contacts 21 and 22, whereby the transmitter 8 is obviously connected in circuit with battery 26 and the primary winding of transformer 7. After the contacts just mentioned have been made, the key is adapted to be moved still farther, whereby contact is broken between members 13 and 14. The breaking of this contact serves to remove the short-circuit path which previously was made across the secondary winding of output transformer 10. With the short-circuit closed, the operation of the key was therefore to first connect transmitter 8 to the amplifier and to its energizing battery, and after such a connection was made, the short-circuit was removed from the amplifier. The arrangement of the key therefore, insures that no loud crashes will be heard in the loud speakers 11, due to the sudden making of the circuit, comprising the source of voltage 26, transmitter 8 and the primary winding of transformer 7.

If now it should be desired to remove transmitter 8 from the circuit and substitute transmitter 9 therefor, the key is operated in the reverse manner from that just described whereby contacts 13 and 14 are first connected to short-circuit the amplifier and thereafter contacts 19 and 20 and 21, 22 are separated to remove transmitter 8. The key is then depressed to make contact between contacts 29 and 30, and between contacts 23 and 24, which connections by obvious circuits, serve to connect transmitter 9 in circuit with the source of voltage 26 and the primary winding of transformer 7. The next instant after the transmitter 9 is so connected, the further operation of the key serves to separate contacts 16 and 17, thereby removing the short-circuit from the amplifier. It is thus seen that when transferring from transmitter 8 to transmitter 9, the operation is as follows; first, the output of the amplifier is short-circuited; second, transmitter 8 is removed from the circuit; third, transmitter 9 is connected in circuit; and fourth, the short-circuit on the amplifier is removed.

It is obvious that the arrangement just described may be extended to include a desired number of transmitters, suitable unitary switching means being provided to insure the short-circuiting of the amplifier whenever the input circuit connections of the amplifier are going to be changed, the short-circuit on the amplifier being maintained until after the desired changes have been made.

It will generally be preferable to have the contacts on the unitary switching means short-circuit the output of the amplifier instead of opening the output circuit connections, since in the latter case, natural capacity couplings existing between various parts of the amplifier apparatus may be sufficient to cause the amplifier to sing, and impress the voltages produced by singing, upon the loud speaking receivers. This is particularly true when the opening of the circuit is attempted between the anode and cathode of one of the vacuum tubes employed in an intermediate stage of the amplifier circuit.

The arrangement of the apparatus in Fig. 1 is particularly suitable when the switching means for changing from one transmitter to the other is located adjacent the output of the amplifier, since in such a case the short-circuiting leads 12 and 18 can be made of negligible length. In some cases, however, it may be found desirable to have the switching means located in the room where the plurality of transmitters are located, while the amplifier may be located in a remote part of the building. In such a case, it has been found undesirable, in general, to bring the short-circuiting leads from the control room up to the switching keys located near the transmitters, since such an arrangement is liable to produce singing as well as other objectionable features.

Fig. 2 discloses an arrangement whereby the short-circuiting leads may be made of

negligible length, while still maintaining the switching key in such a position where the operator can observe the persons employing the various transmitters under his control. Unitary switching means are disclosed in Fig. 2, comprising a plunger 33, which on being depressed, serves to connect contacts 34 and 35 and 36 and 37, whereby the transmitter 38 is coupled to the input of a suitable amplifier 39, the output of which is connected to a plurality of loud speaking receivers 40. Before plunger 33 is depressed to an extent sufficient to make contact between numbers 34 and 35, a latch plate 41 is caused to be moved against the action of a spring 42 whereby the circuit is broken between contact members 43 and 44. Prior to the breaking of this connection relay 45 had been energized by a circuit including ground, battery, winding of relay 45, conductor 46, contacts 44 and 43 to ground. As soon as plunger 33 has been depressed and caused to separate contact members 43 and 44, relay 45 is deenergized, thereby allowing contacts 48 and 49 to fall off. Contact member 48 being now connected to the stationary contact 47 provides a short-circuit for the output of amplifier 39. Contact 49 in falling off, causes an obvious energizing circuit for the slow release relay 50 which on being energized causes an additional short-circuit across the amplifier.

As soon, however, as the plunger 33 has been depressed to a sufficient extent to not only break contacts 43 and 44, but also to make contacts 34 and 35 and 36 and 37, the upper edge of the member 51 is reached and the latch plate 41 is allowed to return and close again the contact between members 43 and 44. This allows relay 45 to be energized again, which in pulling up movable contact 48, removes one of the short-circuits from the amplifier, and in pulling up movable contact 49 deenergizes relay 50. Relay 50, being slow release, takes an appreciable time to pull up contact 53 to remove the second short-circuit from the output of the amplifier. The time required for the slow release relay to operate should be sufficient to allow the amplifier and its associated circuits to reach a stable condition after the connection of transmitter 38 to the amplifier.

If now it is desired to connect transmitter 54 to the amplifier, plunger 55 is depressed whereby the member 56 moves the latch plate 41 so as to deenergize relay 45 and cause the amplifier to be short-circuited, and thereafter to cause the contacts of the key to connect transmitter 54 to leads 57 and 58. Member 56 is so positioned that when the movable contacts for transmitter 54 are closed, the latch plate 41 is in such a position as to release plunger 51, and allow it to return to its uppermost position. After transmitter 54 has been connected in circuit the upper edge of member 56 will be reached and a further depression of the key will allow latch plate 41 to return to its former position, thereby removing the short-circuits from the amplifier. In case it is desired to remove from the circuit all of the transmitters which may be connected at any particular time to the amplifier, an additional plunger 60 is provided for operating in an obvious manner to release all of the transmitter plungers which may at any particular time be held down by the latch plate 41.

It is to be understood that this invention is not limited to the particular circuit arrangements above described, but that these arrangements may be variously modified without departing in anywise from the spirit of this invention as defined in the appended claims.

The invention claimed is:

1. An amplifier having an input circuit and an output circuit, a receiving device connected to said output circuit, a transmitter coupled to said input circuit and unitary switching means for short-circuiting said device, and for subsequently disconnecting said transmitter from said input circuit while said device is short-circuited.

2. In combination, an amplifier having an input circuit and an output circuit, a receiving device connected to said output circuit, a transmitter coupled to said input circuit, and unitary switching means for short-circuiting said output circuit, subsequently disconnecting said transmitter from said input circuit while maintaining said device short-circuited, and for removing said short-circuit after said transmitter has been disconnected.

3. In combination, an amplifier having an input circuit and an output circuit, a receiving device connected to said output circuit, a transmitter coupled to said input circuit and unitary switching means for rendering said receiving device inoperative and subsequently disconnecting said transmitter while maintaining said device inoperative, and rendering said device operative after the transmitter has been disconnected.

4. In combination, an amplifier having an input and an output circuit, a receiving device connected to said output circuit, a plurality of transmitters, and unitary switching means for coupling one of said transmitters to said input circuit at certain times, and for coupling a second one of said transmitters to said input circuit at other times, said switching means operating to render said device inoperative while the input circuit is being changed from one transmitter to the other.

5. In combination, an amplifier having an

input circuit and an output circuit, a receiving device connected to said output circuit, a transmitter coupled to said input circuit, a second transmitter, a unitary switching means for performing the following steps in the order given; first, rendering said receiving device inoperative; second, disconnecting said first transmitter from said input circuit; third, connecting said second transmitter to said input circuit; and fourth, rendering said device operative.

6. In combination, a vacuum tube amplifier having an input and an output circuit, a telephone receiver connected to said output circuit, a telephone transmitter coupled to said input circuit, a second telephone transmitter and unitary switching means for performing the following steps in the order given; first, short-circuiting said amplifier; second, disconnecting said first transmitter from said input circuit; third, connecting said second transmitter to said input circuit; and fourth, removing said short-circuit.

7. In combination, an amplifier having an input circuit and an output circuit, a telephone receiver connected to said output circuit, a telephone transmitter connected to said input circuit, a second telephone transmitter switching means for switching said input circuit from said first transmitter to said second transmitter and relay means responsive to the operation of said switching means for short-circuiting the output of said amplifier prior to the actual disconnection of said first transmitter and for maintaining said short-circuit until said second transmitter has been connected to said input circuit.

In witness whereof, I hereunto subscribe my name this 28th day of December A. D., 1922.

WALTER L. BETTS.