Jan. 31, 1939. O. BÖHM ET AL 2,145,288

METHOD OF AND MEANS FOR INFLUENCING THE FIELD OF SOUND

Filed Sept. 5, 1936

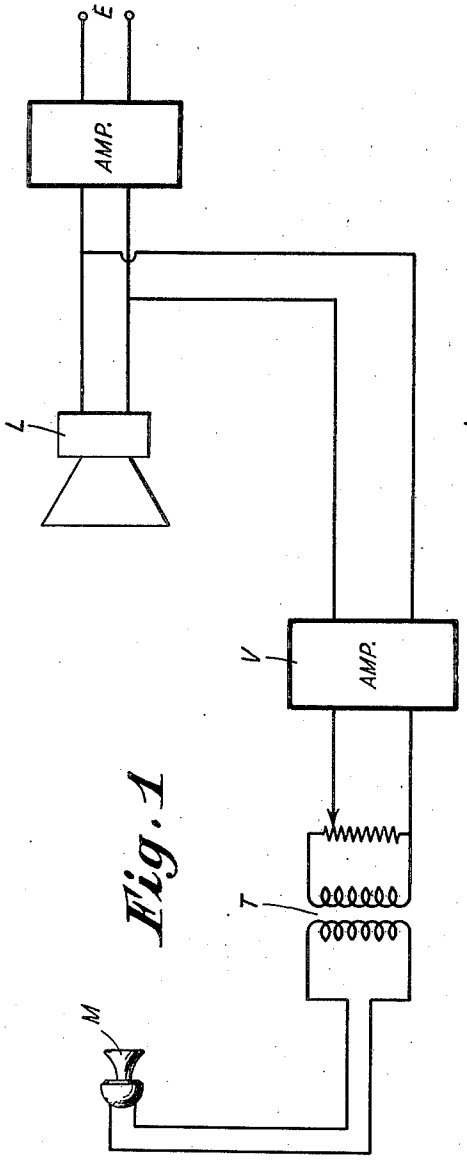


Fig. 1

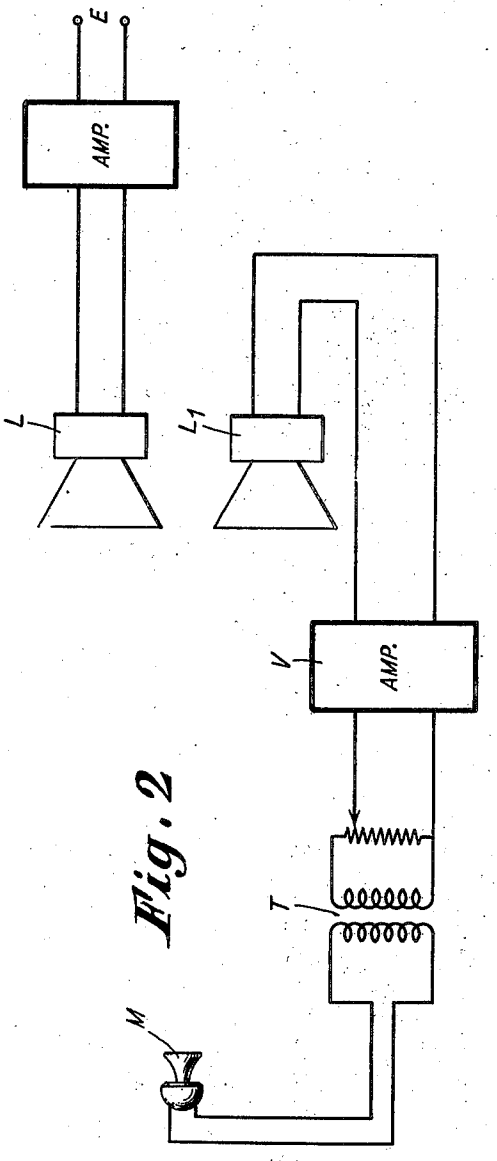


Fig. 2

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Patented Jan. 31, 1939 2,145,288

# UNITED STATES PATENT OFFICE

2,145,288

## METHOD OF AND MEANS FOR INFLUENCING THE FIELD OF SOUND

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Application September 5, 1936, Serial No. 99,514
In Germany July 13, 1935

5 Claims. (Cl. 179—1)

When reproducing sound by means of loudspeakers in the open, or in greatly damped spaces, especially, the reproduction by electrical means such as tube generators, rotating generators, or the like, of produced music, was found to be of a dead and colorless nature. This condition is to be explained by the lack of echo. The same phenomena also appear sometimes when reproducing recorded sound oscillations or when modulating a microphone under most unfavorable conditions.

It is therefore an object of the invention to insure a more favorable reproduction of sound by means of loudspeakers in open air or in places with poor reverberation. This is accomplished by providing a microphone disposed at a distance from the loudspeaker corresponding to the desired reverberation, and which is actuated by the sound waves coming from the loudspeaker. The speaking currents furnished by the microphone are brought through an amplifier to the same loudspeaker or to a second one disposed near the other. In order to prevent feed-back, measures known as such in the prior art must be taken.

It has already been proposed artificially to add the echo by providing mechanical recording devices and to reproduce the impulses directly as well as across the recording devices acting as delay means. The reproduction may be a singular or a multiple one whereby through the time elapse between recording and reproduction the desired echo effect can be controlled.

This proposal entails the disadvantage that special recording methods must be used requiring additional drives and like arrangements. Moreover, the quality of reproduction may eventually also be jeopardized through the known properties of the recording apparatus.

Another known means resides in electrically exciting two loudspeakers simultaneously and in taking care that the sound waves radiated by the one loudspeaker meet the ear of the listener approximately $\frac{1}{10}$ second later than the sound waves of the other loudspeaker. This is accomplished by having the delay loudspeaker acting through a tube having the length of 33 m., and passing the tube through the space in a suitable manner. However, this arrangement requires such a large space and high cost, and involves such acoustic disadvantages of the tube (energy losses etc.) that this proposal has never been put into practice.

In accordance with the invention, these disadvantages are overcome by mounting a microphone at a distance corresponding to the desired influencing of the sound field (for instance, obtaining a desired echo) and which is thereby modulated by the sounds and transforms the acoustic impulses into electrical impulses. These electrical impulses are then re-carried, preferably controlled, to the aforementioned loudspeaker, or to a special echo-loudspeaker. The impulses furnished by the microphone and suitably amplified, are introduced into the loudspeaker circuit preferably through a screening arrangement, by means of which the value of the returned impulses can be adjusted at will in accordance with the conditions desired. Eventually, additional damping resistors, or compensating circuits may be provided, reducing to a minimum the danger of an acoustic feed back which may exist under certain conditions.

The effect obtained is a really surprising one. The sound radiated which appears flat and without color when the echo-microphone is disconnected, gains color and fullness in a surprising manner when the microphone is put in operation.

Corresponding to a time of oscillation of the sound of approximately $\frac{1}{10}$ second, a distance of from about 25 m. to 35 m. was found to be suitable.

In order to compensate for eventual differences in the duration of the echo of individual frequencies, it may be advisable to insert elements depending upon frequency, into the circuit for the feed back energy, whereby the frequency range can be influenced in any desired sense. For instance, it may be desirable in loudspeakers in which the low range of frequency predominates, to utilize a microphone which responds more readily to the upper frequency range. Where certain echo effects are to be attained, it is obvious that distortion reducing circuits with inductances, capacities, and combinations of these elements may be provided in the amplification train.

Special effects may also be produced by using several microphones at different places with eventually different properties. These microphones must be placed at various distances from the primary loudspeaker.

In the accompanying drawing Figs. 1 and 2 illustrate, by way of example, two modifications for carrying out the invention. In Fig. 1, E shows the input terminals of the amplifier feeding loudspeaker L. The sound waves coming from loudspeaker L impinge on microphone M after having passed an air distance of abou 25–35 meters corresponding to a running time of the sound of about $\frac{1}{10}$ of a second. The speaking currents are brought in a leveled or regulated range through transformer T to amplifier V and from

there are again cut in the circuit of loudspeaker L. In the second alternative, shown in Fig. 2, the sound waves are picked up and amplified as before and the potentials furnished by amplifier V are led to a special loudspeaker $L_1$ as shown. Loudspeaker $L_1$ must of course be located in the vicinity of loudspeaker L in order to insure the correct reverberating impression.

What is claimed is:

1. In a system for the radiation of sound energy by means of a loudspeaker which converts electrical energy into acoustic energy, the method of improving the quality and naturalness of the radiated sound which consists in picking up appreciably delayed radiated sound at a point remote from the loudspeaker, converting said picked up sound into electrical energy, amplifying said electrical energy and feeding back the same to said loudspeaker.

2. The method of influencing the radiated sound energy of a loudspeaker in order that there may be produced an artificial echo, the method consisting in disposing a pick-up microphone at a distance from the loudspeaker where the radiated sound is reached after the lapse of an appreciable time interval, reconverting the delayed sound impulses picked up by the microphone into electrical impulses, and reconverting said electrical impulses into sound impulses which are radiated in the vicinity of the loudspeaker.

3. The method of influencing the radiated sound energy of a loudspeaker in order that there may be produced an artificial echo, the method consisting in disposing of a pick-up microphone at a distance from the loudspeaker where the radiated sound is reached after the lapse of an appreciable time interval, reconverting the delayed sound impulses picked up by the microphone into electrical impulses, and combining said electrical impulses with those originally fed to the loudspeaker.

4. A system for the reproduction of sound comprising a loudspeaker and a circuit for energizing the same, a microphone located at an appreciable distance from said loudspeaker equivalent to the travel of sound in approximately one tenth of a second and arranged to pick up sound energy radiated from said loudspeaker, means for controlling and amplifying the microphone currents, and means for feeding said controlled and amplified currents to the loudspeaker energizing circuit to be reconverted into sound energy.

5. A system as defined in the preceding claim wherein a second loudspeaker is located near the first speaker and the controlled and amplified microphone currents are fed to said second speaker instead of to the energizing circuit of the first speaker.

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