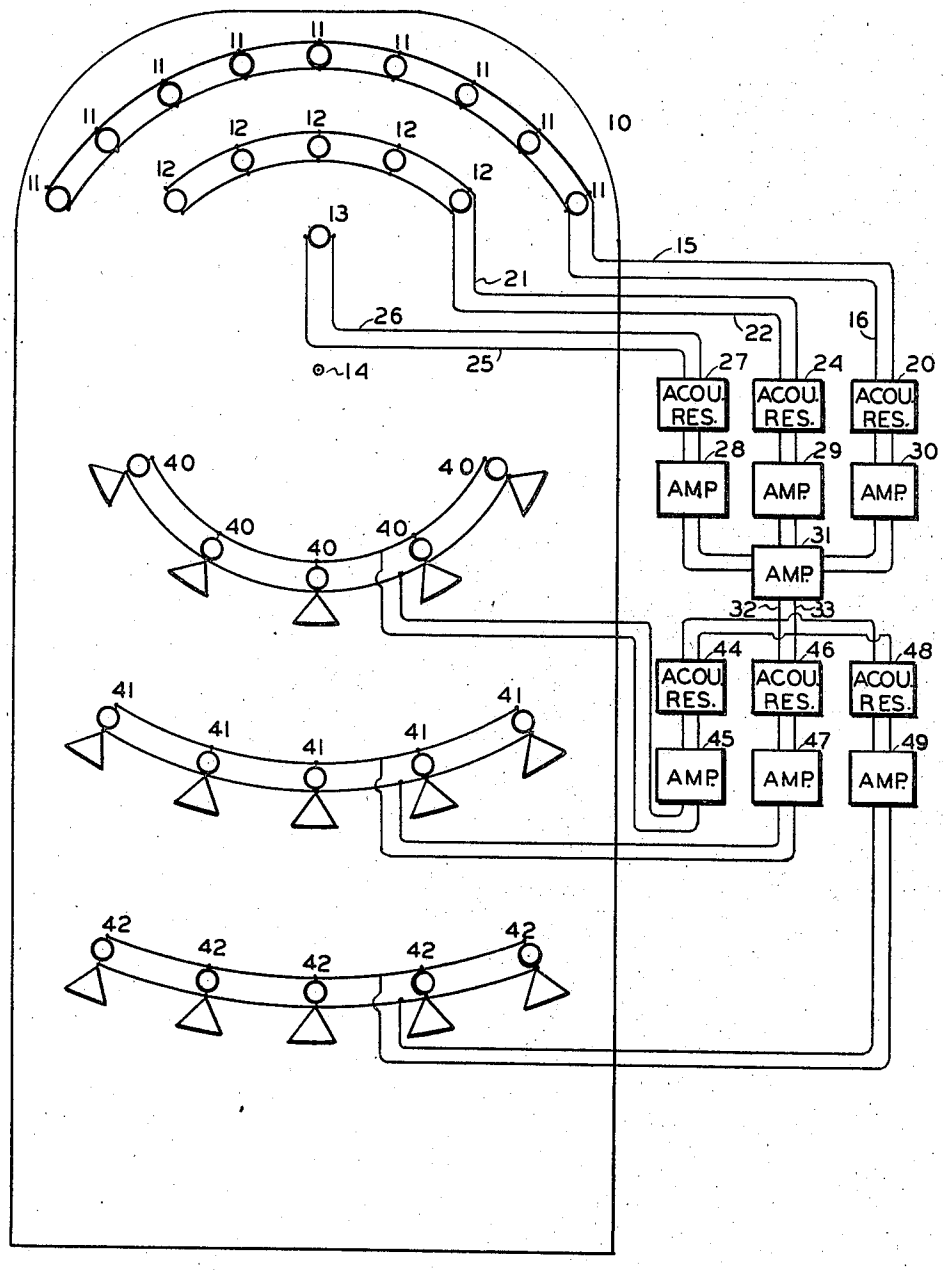
July 29, 1947. F. RIEBER 2,424,634

THEATER AMPLIFYING AND SOUND DISTRIBUTION SYSTEM

Filed May 19, 1944



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Patented July 29, 1947

2,424,634

UNITED STATES PATENT OFFICE

2,424,634

THEATER AMPLIFYING AND SOUND DISTRIBUTION SYSTEM

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Application May 19, 1944, Serial No. 536,412

3 Claims. (Cl. 179—1)

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This invention relates to a theatre amplifying system, more particularly to a system for amplifying the various sounds given off from a stage and recombining them to produce harmonious results, and then reproducing them within the amphitheatre harmoniously with each other and with the sounds arriving at that point in the amphitheatre through the air.

In a large theatre, such for example as an outdoor amphitheatre, there has been difficulty in conveying the sounds to the audience. If loud speakers are placed at or near the stage, throwing the sound out toward the audience, those persons seated in the first few rows receive an intensity of sound so high as to be disagreeable or even painful, whereas those in the last rows or in the back of the theatre may not receive sufficient intensity of sound for good reception.

Moreover, sounds of different frequencies, that is, of different pitch, are not transmitted equally well through the air, with the result that if the proper quality of sound is emitted from the loud speaker, the quality received by the distant portions of the audience may be notably deficient in the higher frequencies.

Moreover, if sufficient sound is produced at or near the screen or stage to reach all portions of the auditorium, many neighboring residents may be unduly annoyed by the volume of the sound reaching them.

To overcome these difficulties, attempts have been made to utilize a number of loud speakers distributed through the audience, which may be placed apart by a very considerable distance. Under such conditions interference zones or "sound shadows" exist wherever the sound arriving from one loud speaker, at a given pitch, is in phase opposition to a substantially equal sound from another. Other corresponding zones exist where the sound coming from two different loud speakers reinforce each other at a given pitch and exaggerate that sound far above its proper level.

It is a further object to provide a system including a number of microphones so arranged and controlled that the total reception will very closely resemble in its harmonious effects a sound reception at a single fixed point of reference within the auditorium, thus reinforcing the sounds given off at distant portions of the stage and bringing a proper balance throughout the whole scale range, and for all of the various instruments.

It is a further object to provide a system of sound reproduction which will produce throughout the amphitheatre, even at a point remote from the stage, the same harmonious effect that is produced by the air-borne sound coming from a common point but reinforced by amplified sound.

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It is thus an object of this invention to provide a reproducing system for a theatre which will to the maximum extent transmit to the audience in reinforced form the same artistic blending of sounds which would be heard in the most desirable portions of the amphitheatre.

The invention accordingly comprises a device possessing the features, properties and the relation of elements which will be exemplified in the article hereinafter described and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawing, in which:

The figure illustrates the amphitheatre with the apparatus installed therein in accordance with this invention.

In the drawing, the numeral 10 designates the stage of an amphitheatre on which there may be presented, for example, an orchestra. Distributed about the stage are a plurality of microphones arranged in concentric arcs. As shown, there are three such groups of microphones designated respectively as 11, 12 and 13, these arcs all being concentric about a reference point 14 which, as shown, is in the amphitheatre in front of the center of the stage. The wires 15 and 16 connect all the microphones 11 together to an acoustic reservoir 20. Similarly, the wires 21 and 22 connect all the microphones 12 to an acoustic reservoir 24, and all the microphones in the next circle comprising, in this instance, only one connected by wires 25 and 26 with an acoustic reservoir 27.

In my copending application filed of even date herewith and bearing Serial No. 536,407, I disclosed an acoustic reservoir eminently suited for use in this invention, said reservoir comprising primarily a disc on the periphery of which is helically wound a magnetic wire and mounted about the periphery of the disc are three magnets, one for making a magnetic record on the wire, one for reproducing sound from that magnetic record, and one for wiping off the magnetic record. This disc is driven at a constant speed. The angle between the reproducing magnet and the recording magnet may be varied at will in order to vary the timing of the reproduction. The

details of this reservoir need not be shown here, as these details form no part of the present invention.

If we consider the point 14 as the point of reference, it will be seen that the sound reaching the point 14 from the points where the microphones 12 are situated, will lag behind the sound coming from the point of the microphone 13, and similarly the sound coming from the location of the microphones 11 will lag still further behind. This error increases with the size of the orchestra, where necessarily the players are placed at greater distances from each other. To correct these difficulties in reception, the acoustic reservoir 24 is arranged to delay the reception of the input from the microphones 12 long enough to bring it into phase with the reception from the microphones 11. Similarly, the acoustic reservoir 27 will delay the reception coming from the microphone 13 to bring it into phase with that coming from the microphones 11. In accordance with these inventions, these three reproduced records with their properly correlated timed delays are now united for reproduction.

It will be noted, however, that this delay of reception from the microphone 13 until the sound from the microphones 11 has caught up with it, is a correction in the right direction to bring that sound into synchronism with the air-borne sound, at the point A.

By an arrangement following the same principle, the reproducing loud speakers are similarly harmonized. As shown in the diagram, each of the variables coming from these microphones respectively is passed through an amplifier 28, 29 or 30, and the output of these amplifiers is carried through a mixing amplifier 31, the secondary 32—33 of which could be fed to a loud speaker which at any given point in the amphitheatre would give a harmonious reproduction of all of the sound coming from the orchestra with the harmonious sounds emphasized, and those which were not harmonious because of being improperly delayed, blanketed out. For the purpose of introducing this sound to the audience, however, there is arranged within the amphitheatre a plurality of loud speakers in concentric arcs, those nearest the reference point 14 being designated by the number 40, the next row by the number 41, and the next row by the number 42.

Where it is desired to reproduce music with fidelity, the reproductions of these microphones will be timed to reinforce the sound waves coming from the stage, and for this purpose the reproductions will be delayed to time them to bring them into phase with the air-borne waves. For this purpose, the leads 32 and 33 from the mixing amplifier 31 are carried through an acoustic reservoir 44 and an amplifier 45 to feed the loud speakers 40, and a second acoustic reservoir 46 and an amplifier 47 feed the loud speakers 41, and a third acoustic reservoir 48 and amplifier 49 feed the loud speakers 42. The acoustic reservoir 44 will be adjusted to delay the reproductions by the loud speaker 40 by precisely the amount of time which is required for the sound to reach the position of the loud speakers 40, so that the reproduced sound will be in exact phase with the air-borne sound. The acoustic reservoirs 46 and 48 will provide a correspondingly greater delay, and thus each group of loud speakers produces its own reproduction in exact phase with the air-borne sound.

This construction, therefore, produces an effect at any point in the auditorium, having the complete harmony of the instruments reproduced in synchronism and having all the reproductions and the original sound united to form a harmonious result.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A theatre sound amplification system, comprising a plurality of spaced microphones, means for combining the variables from said microphones, including means for adjusting the timing of said microphones to bring them into synchronism, and means for distributing the variables so produced to a plurality of spaced loud speakers, including means to adjust the timing to each loud speaker to bring the reproduced sound into synchronism with air-borne sound.

2. A theatre sound amplification system, comprising a plurality of spaced microphones arranged in groups in concentric circles about a reference point, means for combining the sound variables coming from said groups, including means for delaying each variable by an amount inversely corresponding to the distance from the microphones to the reference point, means for distributing the combined variable to a plurality of spaced loud speakers arranged in concentric circles from the reference point, including means to delay the timing to each group directly as its distance from the reference point.

3. In a sound amplification system, in combination, a plurality of microphones arranged in groups at different distances from a point of reference, an acoustic reservoir for each group, means connecting the microphones in each group to make a record on one of said acoustic reservoirs, and means for reproducing a variable from each record after a time delay corresponding to the location of the group from the point of reference, and means for uniting said reproductions.

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