PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

A Microphone Arrangement

We, AKUSTISCHE U.KINO-GERATE GESELLSCHAFT M.B.H., an Austrian Company, of 50 Nobilegasse, Vienna XV, Austria, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to microphone arrangements.

The requirement that sound waves must act on both sides of the diaphragm of a moving coil microphone in order to obtain a unidirectional response involves difficulties if a frequency response substantially throughout the range of audibility is to be obtained. This is due to the fact that mass control of the diaphragm necessitates a compliant mounting of the diaphragm (low acoustical capacitance or stiffness). It has been found in practice that this results in an irregular frequency response in the treble range (1500—3500 cycles per second).

To provide dynamic microphone arrangements having a unidirectional response pattern, two self-contained microphones, namely, a moving coil microphone and a ribbon microphone, have, to our knowledge, been arranged one beside the other and electrically connected together. This resulted in a transformation of the omnidirectional and bidirectional response patterns into a unidirectional response pattern.

The invention provides a microphone arrangement comprising a common support, two self-contained microphones carried by said support, and electrical circuitry connected to said microphones to produce a common output, each of said microphones having acoustically effective parts comprising a diaphragm and an acoustic delay line coupled to said diaphragm to impart a unidirectional response pattern to said microphone, said unidirectional response patterns being the same for both microphones, said microphones being arranged to have substantially the same direction of maximum sensitivity, one of said microphones having in any given direction a greater frequency response than the other in a bass range and a lesser frequency response than the other in a treble range and both microphones having in any given direction the same frequency response at an intermediate frequency between said bass and treble ranges, said microphones being spaced apart so that the distance between their acoustically effective parts is less than one half of the wave-length of sound in air at said intermediate frequency.

It is known to allocate different frequency ranges to two or more self-contained loudspeakers. This allocation has the purpose of obtaining the necessary sound volume in the bass range by the use of a bass speaker having a relatively large diaphragm and of obtaining a propagation of sound at treble frequencies over a wide area by the use of a treble speaker having a small, stiff diaphragm. These known loudspeaker arrangement, however, do not have a directional response pattern which is independent of frequency.

In one embodiment of the invention, the microphone diaphragms have substantially the same area but substantially different mountings, and substantially different acoustic elements are coupled to the diaphragms.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing, in which an embodiment of the invention is diagrammatically illustrated and in which:

Fig. 1 is a block diaphragm showing the microphone arrangement,

Fig. 2 is a diagrammatic representation of a treble microphone provided with an acoustic resistance-capacitance delay line.

Fig. 3 is a diagrammatic representation

of a bass microphone provided with an acoustic inductance-resistance delay line.

In Fig. 1, a treble microphone 1 and a bass microphone 2 are shown. They are secured in a common housing 3 and are electrically connected together in series and to an amplifier 4. These microphones have the same directional response patterns and are arranged to have substantially the same direction of maximum sensitivity. They are of the moving coil type.

In the microphone shown in Fig. 2, a shallow air chamber 5 is defined by a diaphragm 6 and a rear wall 12, which carries three acoustic resistances 7, 8 and 9 consisting, e.g., of textile fibre material. The resistances 7 and 9 lead to the outside air. The resistance 8 leads to a closed chamber 10 defined by a pot-shaped member 11.

In the microphone shown in Fig. 3, a shallow air chamber 13 is defined by a diaphragm 14 and a rear wall 15 carrying an acoustic resistance 16, e.g., of textile fibre material, leading to a closed chamber 17 defined by a pot-shaped member 18. Tubes 19 disposed radially outwardly of the chamber 17 open into the air chamber 13 at the rear wall 15. At their other end, these tubes 19 open into the atmosphere. Hence, these tubes 19 each contain an air plug, which is a mass of air in a laterally closed, elongated space open at both ends and coupled to the diaphragm.

The diaphragm of the bass microphone has suitably coupled to its rear side an acoustic inductance-resistance delay line whereas an acoustic resistance-capacitance delay line is suitably coupled to the rear side of the diaphragm of the treble microphone. The inductance-resistance delay line of the bass microphone comprises the masses of the air in the ducts 19 which open into the shallow air chamber 13 disposed behind the diaphragm 14. The air chamber 13 has connected to it the acoustic resistance 16, which opens into the chamber 17. The acoustic resistance-capacitance delay line of the treble microphone comprises the air chamber 10 and the acoustic resistance 8 coupled to the rear side of the diaphragm. The resistances 7 and 9 lead to the external sound field. Both delay lines are designed to provide for such a phase shifting as to ensure a constant acoustic delay throughout the frequency range which is transmittable by the respective microphone. Each of the two microphones of the microphone arrangement may have an acoustic resistance-capacitance delay line and an acoustic inductance-resistance delay line coupled to it. More particularly, an acoustic inductance-resistance delay line may be coupled to the diaphragm of the treble microphone.

In any given direction, the bass microphone 2 has a greater frequency response than the treble microphone 1 in a bass range and the treble microphone 1 has a greater frequency response than the bass microphone 2 in a treble range whereas both microphones 1 and 2 have the same frequency response at an intermediate frequency between said bass and treble ranges. This intermediate frequency range lies below any frequency above which the bass microphone 2 has an irregular frequency response. In practice, the intermediate frequency may lie between 300 and 1000 cycles per second, depending on the design of the individual microphones.

The microphones 1 and 2 are pressure gradient microphones having mass-controlled diaphragms. The diaphragm 14 of the bass microphone is arranged to resonate at a frequency between 120 and 400 cycles per second without mass control. The mass control effected by the acoustic inductance constituted by the mass of the air in the ducts 19 shifts the resonant frequency of the diaphragm 14 in known manner to a lower value, e.g., of 40 cycles per second. This causes the driving force of the sound field to increase in proportion with frequency in the bass range. To increase the pressure gradient, an open tube 10—30 centimetres long and containing an air plug may be coupled to the diaphragm in known manner. In this case, the frequency response of the bass microphone above the aforementioned intermediate frequency is improved and can be expected to be regular up to 500 to 1000 cycles per second.

Because the treble microphone 1 need not have a response in the bass range, it may be optimally designed with known means to provide for a better unidirectional response in the treble range than can be achieved with a microphone required to be responsive both in the bass and treble ranges. The diaphragm 6 of the treble microphone is arranged to resonate at a frequency between 400 and 800 cycles per second. The acoustic delay means which are coupled to the rear side of the diaphragm 6 and may comprise a resistance-capacitance system, as shown, and/or an inductance-resistance system, are designed to ensure a very smooth frequency response and a constant front-to-back discrimination of the treble microphone 1 throughout the treble range.

The microphones 1 and 2 have unidirectional response patterns centred on substantially coinciding axes and the front of the diaphragm 14 of the bass microphone 2 faces the rear of the treble microphone 1. The microphones 1 and 2 are spaced apart so that the distance between their acoustically effective means, comprising the diaphragm and the acoustical delay lines, is less than one half of the wavelength of sound at the intermediate frequency between the bass and treble ranges. This arrangement will preclude a disturbance of the frequency and directional response patterns of the microphone arrangement in the frequency range adjacent to said intermediate frequency.

The electrical circuitry connecting the microphone may include electrical filters. The microphone outputs may be directly connected to a common amplifying channel or the output of each microphone may be connected to an amplifying channel associated with it and the outputs of these amplifying channels may be combined.

It will be understood that the invention may be embodied in microphone arrangements comprising more than two microphones having the same unidirectional response pattern, each of which microphones has a greater frequency response than any of the other microphones in a predetermined frequency range in any given direction and said frequency ranges combine to form a continuous, overall frequency range transmittable by the microphone arrangement, each of said microphones being related to another one like the bass and treble microphones described hereinbefore.

WHAT WE CLAIM IS:—

1. A microphone arrangement comprising a common support, two self-contained microphones carried by said support, and electrical circuitry connected to said microphones to produce a common output, each of said microphones having acoustically effective parts comprising a diaphragm and an acoustic delay line coupled to said diaphragm to impart a unidirectional response pattern to said microphone, said unidirectional response patterns being the same for both microphones, said microphones being arranged to have substantially the same direction of maximum sensitivity, one of said microphones having in any given direction a greater frequency response than the other in a bass range and a lesser frequency response than the other in a treble range and both microphones having in any given direction the same frequency response at an intermediate frequency between said bass and treble ranges, said microphones being spaced apart so that the distance between their acoustically effective parts is less than one half of the wavelength of sound in air at said intermediate frequency.

2. A microphone arrangement as claimed in claim 1, in which said intermediate frequency is between 300 and 1000 cycles per second.

3. A microphone arrangement as claimed in claim 1 or 2, in which said one microphone has a mass-controlled diaphragm arranged to resonate at a frequency between 120 and 400 cycles per second when released from mass control.

4. A microphone arrangement as claimed in any of claims 1 to 3, which comprises a tube coupled to said one microphone to improve its frequency response above said intermediate frequency.

5. A microphone arrangement as claimed in any of claims 1 to 4, in which said other microphone has a diaphragm arrange to resonate at a frequency between 400 and 800 cycles per second.

6. A microphone arrangement as claimed in any of claims 1 to 5, characterized in that the unidirectional response patterns of said microphones are centred on substantially coinciding axes and the front of the diaphragm of said one microphone faces the rear of said other microphone.

7. A microphone arrangement as claimed in any of claims 1 to 6, in which said electric circuitry comprises electrical filter means.

8. A microphone arrangement as claimed in any of claims 1 to 7, in which said microphones are moving-coil microphones.

9. A microphone arrangement, substantially as described hereinbefore with reference to Figs. 1, 2 and 3 of the accompanying drawing.

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I SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig. 1

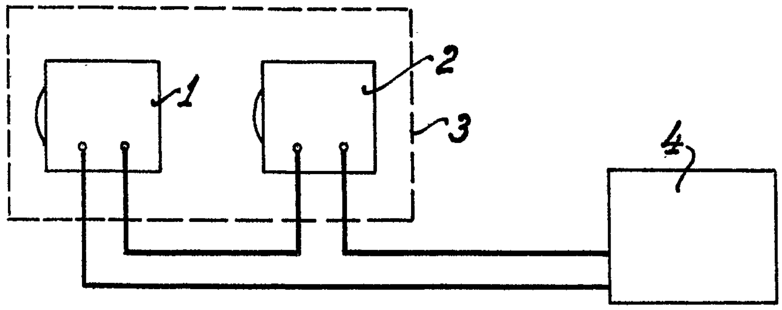

Fig. 2

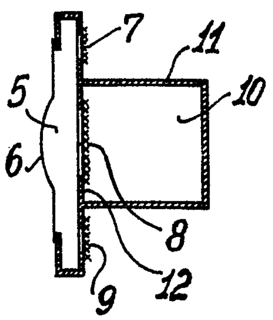

Fig. 3