

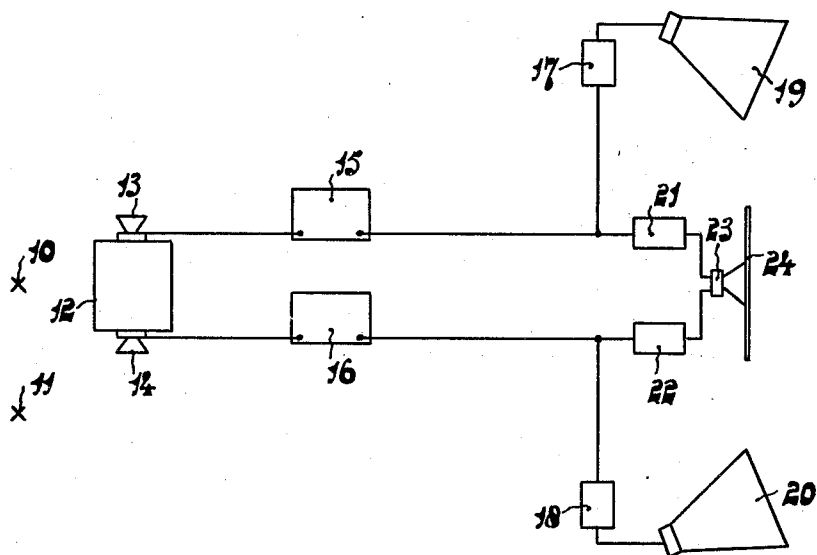
Aug. 29, 1950

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2,520,798

DEVICE FOR THE STEREOPHONIC TRANSMISSION OF SOUND

Filed May 2, 1947



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UNITED STATES PATENT OFFICE

2,520,798

DEVICE FOR THE STEREOPHONIC
TRANSMISSION OF SOUND

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Application May 2, 1947, Serial No. 745,374
In the Netherlands November 27, 1940

Section 1, Public Law 690, August 8, 1946
Patent expires November 27, 1960

4 Claims. (Cl. 179-1)

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This invention relates to a device for the stereophonic transmission of sound by means of a plurality of separate channels, in which the sound receivers are separated by a sphere of at least 14 cms. in diameter or any other object equivalent thereto as an acoustic obstacle and which comprises separate reproducing devices for the reproduction of the high-frequency ranges and a single reproducing device for the reproduction of the low-frequency ranges, the latter device being arranged intermediate the reproducing devices for the high-frequency ranges.

The requirement which is to be imposed in realising such a transmission is that a linear relation exists between the different values of the angle φ at which the sound source is arranged with respect to the plane of symmetry of the receiving microphones and the deviation μ of the sound image produced from the plane of symmetry. This will be referred to hereinafter as "linear projection."

If in such a device the microphones are secured to an artificial head of the kind which is commonly employed, that is to say a sphere of about 22 cms. in diameter, then the disadvantage arises, that linear projection is obtained over an angle φ of 45° only. This disadvantage occurs, for example, when radio plays are required to be picked-up, of which a linear reproduction over angles larger than 45° is required. An explanation of the said phenomenon may be found in the fact that an artificial head of approximately 22 cms. in diameter, the stereophonic action of which corresponds to that of the human head, has so great a shielding action for the microphone which is remote from the sound source that a disproportionately great stereophonic effect occurs at the reproducing ends, that is to say that even a small lateral displacement of the original sound source results at the reproducing side in a strong variation of the direction from which the sound appears to originate.

An improvement may be obtained if use is made of artificial heads which are smaller in diameter. When using, for example, an artificial head of 12 cms. in diameter, a linear projection is obtained over an angle φ of 90°. For this improvement protection has previously been claimed in U. S. A. patent application Ser. No. 472,778.

Consequently, the most satisfactory stereophonic transmission would be obtained if for each individual case an artificial head were used of a diameter which ensures the required linear-

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ity with the freedom of action necessary in this case within a determined angle φ . From the point of view of uniformity and practical pick-up technique this method is complicated since a series of artificial heads of different diameters would be required. In view thereof the aim will be to realise all pick-ups occurring in practice with the use of the same type of artificial head. For reasons of constructional nature one is in many cases bound to objects to which the microphones are to be secured, for example a column in the pick-up space, which are of a size larger than that of a sphere of a diameter of 12 cms.

The present invention provides a means by which a sphere of at least 14 cms. in diameter nevertheless permits of obtaining linear projection over an angle φ up to 90°. As is well-known, an artificial head of 22 cms. in diameter begins to constitute an acoustic obstacle at a frequency of about 300 cycles/sec. The differences in intensity brought about at the ears of the observer by heads of different diameters consequently exhibit different dependences on frequency.

On the ground thereof the separation between the high-frequency and low-frequency ranges in the device according to the invention is chosen to be not higher than 1200 cycles/sec. and so much higher than 600 cycles/sec. that the excessive stereophonic action of the pick-up device is neutralised by the absence of the stereophonic action of the low portion of the high-frequency range exhibiting stereophonic action. The disadvantage inherent in the use of artificial heads of at least 14 cms. in diameter is thus suppressed by admitting a decrease of the differences in intensity of the sound at the ears of the observer over a determined frequency range comprising the range of low frequencies and a portion of the range of high frequencies up to a determined limit, according to the diameter of the head.

In the device according to American patent specification 2,126,929 the differences in intensity at the ears of the listener are likewise reduced but in this case either for the whole of the frequency range to an equal extent, or for the range of high tones only, since a third loudspeaker arranged intermediate the two high-tone loudspeakers reproduces either the whole of the frequency range, or the range of the high frequencies only. Since in this case the reductions in intensity are always required to comprise the range of the high frequencies, variation of the maximum angle φ within which the artificial head is still capable of linear projec-

tion, does not take place here when the device would cooperate with an artificial head, in contradistinction to the operation of the device according to the invention.

In order that the invention may be more clearly understood and readily carried into effect, it will now be described more fully by reference to the accompanying drawing.

In the figure reference numeral 12 indicates an acoustic obstacle, for example a desk or a pillar of the hall, to which microphones 13 and 14 respectively are secured on each side. The microphones are connected to amplifiers 15 and 16 via separate wires. The output ends of the amplifiers are connected to loudspeakers 19 and 20 respectively through filters 17 and 18 which only allow passage of the high-frequency range. The lower limit of the filters is comprised between 1000 and 1200 cycles/sec. The amplifiers also serve to feed a loudspeaker 23, intended for the reproduction of the low-frequency ranges of both microphones, the frequencies of which above a limit of 1000 to 1200 cycles/sec. are suppressed by means of filters 21 and 22. The energies of the two microphones are mixed behind the filters.

In the example as shown this reproducing unit comprises a single loudspeaker 23 having a baffle board 24, which is arranged centrally intermediate the loudspeakers 19 and 20. More particularly in large installations the reproduction of the low-frequency range is generally divided over a plurality of loudspeakers which are jointly arranged on one baffle board. In this case all of the loudspeakers may be connected in parallel and fed via the filters 21 and 22, or each of the filters is connected to a number of the total quantity of low-frequency loudspeakers. The reproduction of the high-frequency range may, if desired, likewise be divided over a plurality of parallel-connected loudspeakers arranged side by side, instead of over a single loudspeaker 19 or 20.

The dimensions of the object 12 are, for constructional reasons, such that the minimum dimension is equal to at least the width of the human head, hence at least 14 cms. Consequently, the shielding action for sound waves originating from the sound source 11 is such that for oscillations to which a directional effect is to be attributed, that is to say for those above 300 cycles/sec., the microphone 13 receives a sound intensity which is considerably smaller than that of the microphone 14.

Displacement of the sound source 10, symmetrically with respect to the microphones 13 and 14, towards the position 11 will consequently have the effect that the sound, instead of coming through the loudspeakers 19 and 20 strength, seems to originate substantially from the loudspeaker 20. Further displacement of the sound source in the lateral direction does not bring about further variation in the intensity ratio of the sound transmitted by the loudspeakers 19 and 20, so that the auditor will not notice further displacement.

If loudspeaker 23 transmits the low-frequency range with the upper frequency limit of 300 to 500 cycles/sec. the direction from which the sound at the reproducing side apparently originates does not vary in practice since these low frequencies have no directional effect. The auditor cannot determine the direction of sound having such low frequencies. By extension of the frequency range, if those higher frequencies

are emitted by the sound source, energy from both microphones will always be transmitted also to loudspeaker 23, which consequently reproduces sound waves which do have a directional effect. The auditor hears sound from three different directions, that is to say from the loudspeakers 19, 23 and 20. The human ear combines this sound into a single apparent direction of the sound source. Since the loudspeaker 23 is arranged midway intermediate the two others, the apparent direction of the sound is closer to the loudspeaker 23 than it would be the case if no sound waves with directional effect were emitted. The apparent lateral displacement is therefore decreased and since the maximum stereophonic effect remains substantially unchanged, comparatively large lateral displacements of the sound source are still perceivable. This phenomenon is stronger as the loudspeaker 23 reproduces a larger proportion of the frequencies above 300 cycles/sec., in other words as the separation between the high-frequency and low-frequency ranges is shifted to higher frequencies. It has been found in practice that with the use of a sphere of 22 cms. in diameter, which is commonly employed, separation in the range between 1000 and 1200 cycles/sec. yields satisfactory results.

What I claim is:

1. A device for the stereophonic transmission of sound comprising a plurality of sound receivers, an acoustic obstacle separating said receivers, said obstacle having a diameter of at least 14 cms., a plurality of separate high-frequency range reproducing devices, a low-frequency range reproducing device arranged between at least two of said plurality of devices, means connecting one of said receivers with one of said plurality of devices and with said low-frequency range reproducing device, means connecting another of said receivers with another of said plurality of devices and with said low-frequency range reproducing device, and means in said connections for separating the high-frequency and low-frequency ranges at a point not higher than 1200 cycles/sec. and above 600 cycles/sec., whereby an excessive stereophonic action of the device as a whole is compensated for by the absence of stereophonic action for the low portion of the high-frequency range which shows stereophonic action.

2. A device for the stereophonic transmission of sound comprising a plurality of sound receivers, an acoustic obstacle separating said receivers, said obstacle having a diameter of approximately 22 cms., a plurality of separate high-frequency range reproducing devices, a low-frequency range reproducing device arranged between at least two of said plurality of devices, means connecting one of said receivers with one of said plurality of devices and with said low-frequency range reproducing device, means connecting another of said receivers with another of said plurality of devices and with said low-frequency range reproducing device, and electrical filter devices in said connecting means for transmitting high frequencies to said plurality of reproducing devices and low frequencies to said low-frequency reproduction device, said filter devices having a frequency separation value of between 1000 and 1200 cycles/sec.

3. A device for the stereophonic transmission of sound comprising a pair of sound receivers, an acoustic obstacle separating said receivers, said obstacle having a diameter of at least 14 cms., a pair of separate high-frequency range

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reproducing devices, a low-frequency reproducing device arranged between said pair of devices, means connecting one of said receivers with one of said pair of devices and with said low-frequency range reproducing device, means connecting the other of said receivers with the other of said pair of devices and with said low-frequency range reproducing device, and means in said connections for separating the high-frequency and low-frequency ranges at a point not higher than 1200 cycles/sec. and above 600 cycles/sec., whereby any excessive stereophonic action of the device as a whole is compensated for by the absence of stereophonic action for the low portion of the high-frequency range which shows stereophonic action.

4. A device for the stereophonic transmission of sound comprising a pair of sound receivers, an acoustic obstacle separating said receivers, said obstacle having a diameter of approximately 22 cms., a pair of separate high-frequency range reproducing devices, a low-frequency range reproducing device arranged between said two devices, means connecting one of said receivers

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with one of said pair of devices and with said low-frequency range reproducing device, means connecting the other of said receivers with the other of said pair of devices and with said low-frequency range reproducing device, and electrical filter devices in said correcting means for transmitting high-frequencies to said pair of reproducing devices and low-frequencies to said low-frequency reproducing device, said filter devices having a frequency separation value of between 1000 and 1200 cycles/sec.

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