

April 18, 1939.

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REFLECTOR MICROPHONE  
Filed Feb. 15, 1936

2,155,163

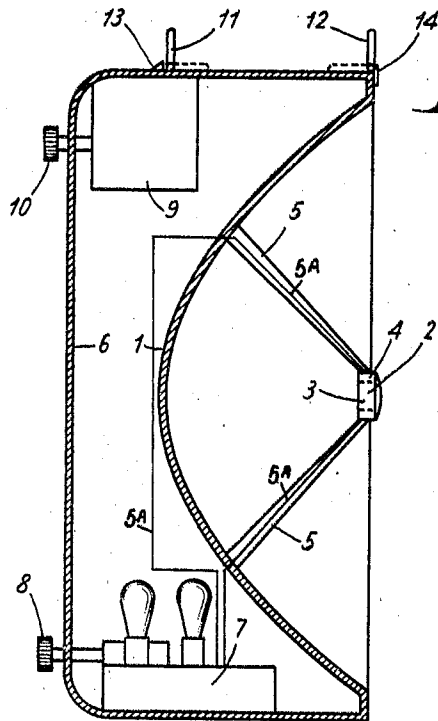


*Fig. 1*

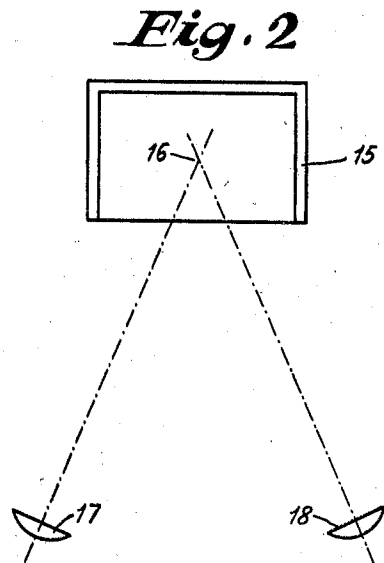


*Fig. 2*

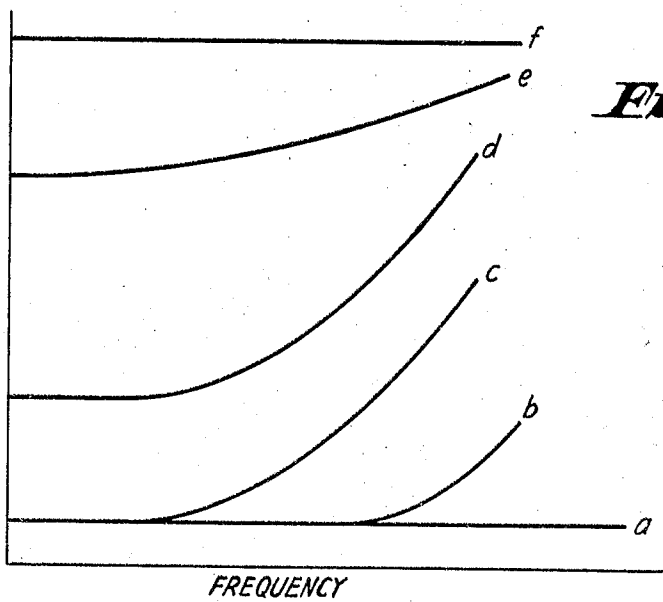


*Fig. 3*

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## UNITED STATES PATENT OFFICE

2,155,163

## REFLECTOR MICROPHONE

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Application February 15, 1936, Serial No. 64,053  
In Germany March 4, 1935

6 Claims. (Cl. 179-1)

This invention relates to a novel type of reflector microphone.

It is known from the art to mount microphones, preferably of the condenser or electrostatic type, in the focus of reflectors. These arrangements known from the prior art, however, involve the drawback that, where the frequencies are high, disturbances and irregularities will arise in the frequency response of the microphone, and this impairs the quality of reproduction. These disturbances are caused by that while the sound waves are all reflected to the focus when impinging upon the reflector, the said focus of the reflector in the case of acoustic waves is not a very small point, but is only small in comparison with the wave length of the sound waves.

If the sound, after striking the reflector, is directed to the focus, it will strike the microphone which is mounted at the focus. The customary types of condenser microphone have a diameter of the diaphragm of around 60 to 75 mm. If high frequencies, that is to say, sound waves with small wave length, happen to impinge upon the surface of the diaphragm, it will be seen that the latter will not be acted upon simultaneously in a uniform manner throughout its entire surface area. On the contrary, while at a given instant a maximum of pressure will prevail at one place, a pressure minimum will be active at some other point on the diaphragm surface.

This action will chiefly arise in the case of sound waves which are not reflected in axial direction of the reflector towards the focus. This phenomenon is extremely striking and evident in the case of sound waves which, for instance, are thrown in the plane of the diaphragm surface towards the focus, in other words, waves which are reflected at right angles to the axial direction of the reflector.

For example, if at a definite instant a sinuous wave having a wave length equal to, say, the diameter of the diaphragm, impinges upon the reflector in such a way that it will be reflected in the plane of the diaphragm surface (while all other sound waves also striking the reflector shall here be left out of consideration), it will be seen that, if an entire wave train of the sound wave lies above the diameter of the diaphragm, the first half cycle or alternation will occasion upon the diaphragm a pressure crest, while the second half wave will create a pressure minimum or trough. The pressure maximum and the pressure minimum, in the instance here assumed for sake

of argument, at a definite instant, are placed diametrically opposite upon the diaphragm surface. Among the acoustic waves impinging upon the diaphragm surface obliquely to the axial direction, only definite components will result in identical effects.

Now, the distribution of the different pressures (the number of which is a function of the frequency) will have this effect that, for instance, in the presence of an equal number of maxima and minima, practically no potential will be delivered by the microphone for the reason that no externally appreciable alteration of the electrical field between the electrodes of the microphone arises. This condition is due to the circumstance that, while in the presence of a pressure crest a change in the electrical field will be brought about, an adjacent pressure minimum will result in a corresponding equal, but opposite alteration to the pressure maximum in the electrical field.

Where the number of pressure maxima and minima is unequal, a voltage variation will become noticeable across the terminals of the condenser microphone. However, this variation is comparatively slight inasmuch as only the amount of an outstanding or salient maximum or minimum of pressure will manifest itself in the form of a voltage variation. The effects of the rest of the pressure maxima and minima, on the contrary, will practically neutralize or offset one another.

The space around the focus presenting practically uniform pressure is also correspondingly small where high frequencies are dealt with. If a rotation symmetric reflector is used, the said space presenting practically uniform pressure, because of the spherical expansion and propagation of the acoustic waves, will roughly assume a spherical shape. The diameter of the said space of relatively like pressure roughly corresponds to the phase length. What is meant here by "phase-length" is this value

$$\frac{\lambda}{2\pi}$$

This is that part of the wave length by which two sound waves may differ from each other without this difference becoming noticeable upon reproduction.

With a drop in frequency, the space about the focus having relatively equal pressure grows more and more in diameter, in fact, where very low frequencies are dealt with, it may assume values which are way beyond the dimensions of a normal reflector.

For low frequencies and great wave lengths, the dimensions of the diaphragm in standard condenser microphones in contrast to the wave length are so small throughout the whole area of the diaphragm, at a definite instant, that practically like pressures come to act in the same direction. Now, the more the frequency grows, the more will the wave length naturally decrease until finally starting at a frequency around 1000 cycles, the interfering effects of the pressure maxima and minima coming to act upon the diaphragm surface become noticeable during reproduction.

These drawbacks which have been found to inhere in the kind of reflector microphones known in the prior art are obviated according to this invention by that, in the focus of the reflector there is mounted a microphone having dimensions that are reduced in contrast to the sound waves to be handled and transmitted. For instance, a condenser microphone is used whose diaphragm has a diameter of about 12 mm. or, if desired and possible, a still smaller diameter. What is thus obtained is that the disturbing actions which are occasioned upon the diaphragm by the pressure crests and minima, will occur only when high frequencies are dealt with, say, frequencies of about 6000 cycles per second up to 8000 cycles per second. By this kind of construction the frequency response curve is improved, and the efficiency of the reflector microphone is substantially improved.

Condenser microphones whose diaphragm diameter or diaphragm dimensions are small in contrast to the wave length are known in the earlier art. Reduced dimensions, in the case of these microphones, were mainly chosen for reasons of the so-called "cavity" resonance which is due to the space anteriorly of the diaphragm and which is formed by the tensioning and securing ring of the diaphragm. In these forms of construction the frequency response curve is improved, and the efficiency of the reflector microphone is substantially improved. Condenser microphones whose diaphragm diameter or diaphragm dimensions are small in contrast to the wave length are known in the earlier art. Reduced dimensions, in the case of these microphones, were mainly chosen for reasons of the so-called "cavity" resonance which is due to the space anteriorly of the diaphragm and which is formed by the tensioning and securing ring of the diaphragm. In these forms of construction the frequency response curve is improved, and the efficiency of the reflector microphone is substantially improved. Condenser microphones whose diaphragm diameter or diaphragm dimensions are small in contrast to the wave length are known in the earlier art. Reduced dimensions, in the case of these microphones, were mainly chosen for reasons of the so-called "cavity" resonance which is due to the space anteriorly of the diaphragm and which is formed by the tensioning and securing ring of the diaphragm. In these forms of construction the frequency response curve is improved, and the efficiency of the reflector microphone is substantially improved.

However, the situation is totally dissimilar where reflector microphones are concerned. In fact, the amount or number of sound waves reflected from the reflector onto the microphone in axial direction of the latter is vanishingly small. Nearly all of the sound waves impinge, on the contrary, obliquely upon the surface of the diaphragm so that, with reflector microphones of the customary form of construction and type, the microphone is practically operated only in the presence of different pressure distribution, with the consequence that such defects as have hereinbefore been outlined are caused.

Inasmuch as the reflector microphone of this invention renders particularly the high frequencies under satisfactory conditions, this type will be particularly advantageous in connection

with voice transmission. In voice or speech transmission, one chief desideratum is that the microphone should handle the high frequencies particularly well, on the ground that sibilants contained in speech are of high frequencies. The transmission of consonants and of sibilants, however, is especially essential and important if intelligibility is to be satisfactory.

It has also been found expedient to provide optionally distortion corrector means for the high frequencies in connection with the use of a reflector microphone as here disclosed, for the reason that the frequency response curve of the microphone differs appreciably from known types.

If the reflector microphone is mounted a relatively great distance from the source of the sound, the frequency response curve of the microphone, in a case where the reflector is small compared with the wave length still to be transmitted, will exhibit a uniform shape. The sensitiveness of response or the intensity of the impulses to be transmitted is here comparatively low. Uniform shape of response curve is due to this fact that practically no effect is obtainable with the reflector seeing that the latter is small in contrast to the wave length. In fact, the frequency response of the microphone in this instance is of a kind as if no reflector were present at all.

Now, if the diameter of the reflector grows gradually, reflection of acoustic waves onto the microphone mounted in the focus will occur as soon as the dimensions of this reflector come to be of an order of magnitude equal to the highest frequencies to be transmitted.

As the diameter is still further raised, the effect of the reflector will decline more and more towards the low frequencies. Now, since at the same time the energy striking the reflector grows, it will be found that in the direction of the high frequencies, the sensitiveness of response of the microphone will be found to be higher, that is to say, the higher frequencies will be rendered more intensely or will be more emphasized than the lower frequencies.

If, then, for a definite diameter of the reflector which is practically large compared with the average frequencies to be handled, the distance between the reflector microphone and the source of the sound is more and more reduced, the same frequency response curve of the reflector microphone will be found always as long as the sound waves impinge upon the reflector in a sense parallel to the axis. All that happens is that the intensity of the impulses will gradually grow in proportion as the distance is reduced.

If, then, the sound source is placed at still greater proximity to the reflector microphone, that is, inside a range where striking of the reflector by the sound waves is no longer feasible in a sense parallel to the axis, that is to say, where the sound waves impinge upon the reflector primarily obliquely in reference to the axial direction of the reflector, it will be seen that only a fraction of the sound waves will be reflected towards the focus of the reflector. Especially the high frequencies lose in intensity. Hence, the frequency response curve will exhibit a less pronounced rise or less steepness.

If the acoustic source is placed at direct proximity to the reflector microphone, then the percentage of the sound waves which will be reflected in axial direction of the microphone will be low compared with the sound waves reflected obliquely thereto. The result is the same as

if the reflector were entirely absent. In this instance, the frequency response curve of the microphone will again be entirely uniform and regular, indeed, the characteristic is the same as if the microphone were directly acted upon by acoustic energy.

This invention will best be understood by referring to the accompanying drawing in which

Figure 1 is a plan view of the microphone and reflector,

Figure 2 is a diagram of a microphone arrangement,

Figure 3 shows the frequency response curves.

Now, the annexed drawing shows an embodiment of the reflector microphone of this invention and the application thereof.

Referring to Figure 1, 1 is a reflector in whose focus 2 is mounted a microphone 3. The microphone 3 is accommodated inside a case 4. The face of the case which is turned to the reflector 1 is covered with protection means so as to preclude the risks of accidental touching of the diaphragm surface of the microphone 3. The said case 4 is attached to the reflector 1 or at points adjacent thereto on the reflector casing by means of stay pieces 5, and the latter contain the supply leads 5A for the microphone. The rear face of the reflector 1 is shut by a box shaped housing 6. The space between the reflector 1 and the housing 6 contains the input amplifier 7 or else, if desired or possible, the whole amplifier. The amplifier is set by means of one or more operating knobs 8.

In order to correct the frequency response of the microphone, distortion correcting means 9 may, if desired, be provided, the latter being set by the aid of the operating knob 10. The corrector 9 may be calibrated directly to read in terms of distance between microphone and sound source. On top of the microphone there is provided for this purpose a distance or sighting gauge, the latter consisting of frames 11 and 12, having, for example, a central cross-hair, or the like; these frames may be hinged down as indicated by the dotted lines in order to protect them against damage when transported or handled. The distance gauge serves at the same time to aim the microphone properly in a direction with reference to the acoustic source. The said frames 11 and 12, when placed in operating position, are opened as far as the stops 13 and 14. After the distance has been ascertained, the distortion corrector 9 is adjusted to the actual distance by the aid of the operating knob 10. The distortion corrector means 9, of course, could be operated independently of the distance between the microphone and the source of the sound, if this is deemed necessary.

The whole reflector microphone is preferably suspended in its center of gravity in order that expeditious adjustment may be effected at any time. The mounting arrangement is moreover so designed that the microphone may be adjustable in all directions.

Figure 2 shows an exemplified embodiment of the means adapted to mount the reflector microphone for voice transmission. Upon a platform 15, say, of a speaker, the latter shall be assumed to be positioned at point 16. At a distance ranging between 5 and 10 meters away from the speaker are mounted the reflector microphones 17 and 18, whose axes apparently intersect. The angle thus formed is governed by the pick-up conditions prevailing in a given instance. The point of intersection of the axial lines is roughly

located at the point marked 16 where the speaker is placed. In this arrangement the latter is free to talk without restraint seeing that the solid cone of both microphones encompasses the whole speaker's platform.

Figure 3 shows a number of frequency response graphs of a reflector microphone according to the present disclosure, for different distances from the source of the sound, and different dimensions of the reflector. Graph *a* shows the shape of the frequency response when the reflector is of a diameter that is small in contrast to the wave length of the highest frequencies still to be transmitted, and where the source of the sound energy is a comparatively great distance apart from the reflector. For the lower frequency ranges, curve *b* is of a shape resembling graph *a*; but a certain rise is noticeable in the frequency response curve in the higher frequency ranges, seeing that the dimensions of the reflector are of an order of magnitude of the wave length of the higher frequencies. Curve *c* shows the frequency response where the reflector is still larger, and where the distance from the sound source is likewise great. If, then, the distance between the sound source and the reflector decreases, the intensity of the impulses picked up by the microphone will grow, while the character or shape of the curve is practically the same as before. The curves have been shifted almost parallel to the axis. The frequency response curve is roughly of a form as shown in graph *d*. The reflector has the same diameter as in the case of the microphone exhibiting a frequency response as indicated by graph *c*. As the source of the acoustic energy is placed closer and closer to the microphone, the curve *d* will gradually assume a shape as indicated by graph *e*. The nature of the said curve *e* is totally distinct from the nature of curve *d*, a fact which may be accounted for by the circumstance that the sound waves no longer strike the reflector in directions parallel to the axis. Graph *f* represents the frequency response when the sound source is mounted at direct proximity to the microphone.

What may also be mentioned is that the conditions as hereinbefore outlined hold good also for other kinds of microphone. For instance, in lieu of a condenser microphone there could be employed also a band or ribbon microphone, a carbon microphone, or some other type, provided they are suitably designed so as to be placed in the focus of the reflector.

I claim:

1. A reflector microphone comprising a casing, a reflector mounted within said casing, a microphone mounted in the focus of said reflector by a plurality of supporting braces, said braces having leads contained therein for connecting said microphone with an electrical circuit.

2. A reflector microphone comprising a casing, a reflector mounted in the front of said casing, and a microphone mounted in the focus of said reflector by a plurality of supporting braces, said braces having leads contained therein for connecting said microphone with an electrical circuit.

3. A reflector microphone comprising a casing, a reflector mounted within said casing, a microphone mounted in the focus of said reflector by a plurality of supporting braces, said braces having leads contained therein for connecting said microphone with an electrical circuit, and an amplifier and distortion correcting means within said casing.

4. A reflector microphone comprising a casing, a reflector mounted within said casing, a microphone mounted in the focus of said reflector by a plurality of supporting braces, said braces having leads contained therein for connecting said microphone with an electrical circuit, an amplifier and distortion correcting means within said casing, and external means for adjusting said amplifier and said distortion correcting means.
5. A reflector microphone comprising a casing, a reflector mounted within said casing, a microphone mounted in the focus of said reflector by a plurality of supporting braces, said braces having leads contained therein for connecting said microphone with an external circuit, and a distance

sighting gauge comprising a plurality of frames located externally of said casing in a position above said supporting braces.

6. A reflector microphone comprising a casing, a reflector mounted within said casing, a microphone mounted in the focus of said reflector by a plurality of supporting braces, said braces having leads contained therein for connecting said microphone with an external circuit, and a distance sighting gauge comprising a plurality of folding frames located externally of said casing and hinged thereto in a position above said supporting braces.

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