

Oct. 22, 1929.

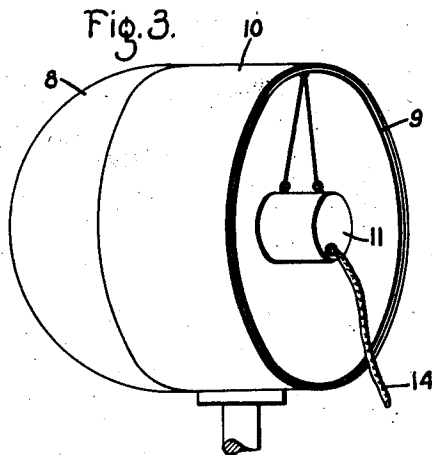
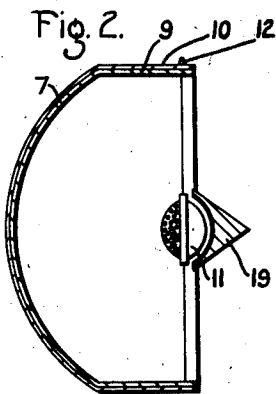
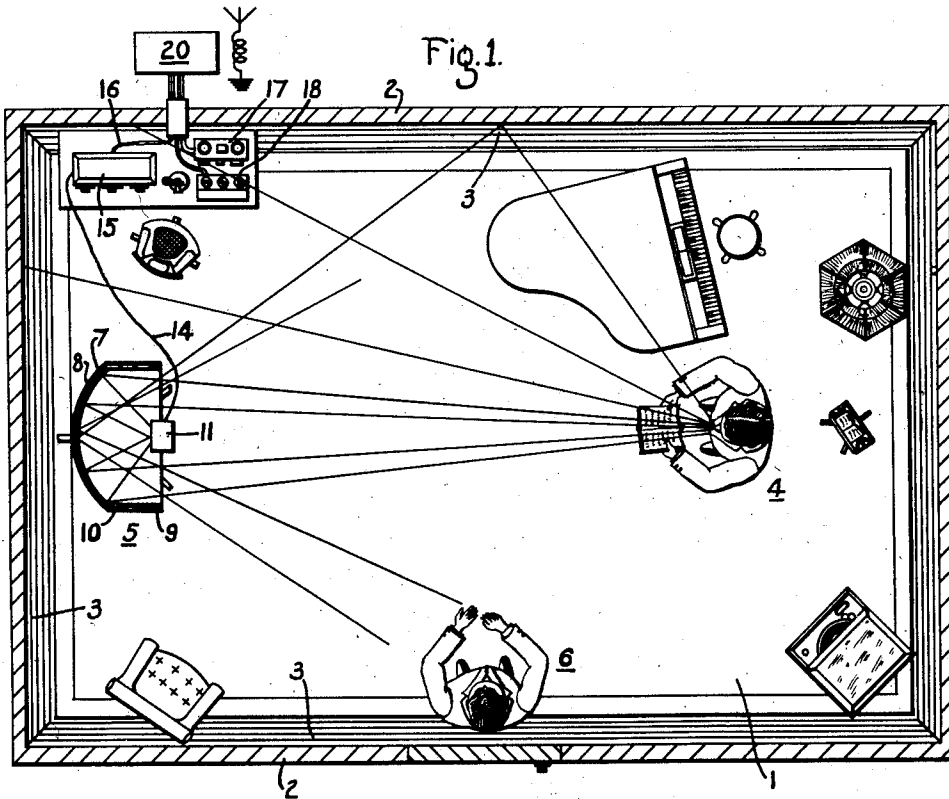
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1,732,722

DIRECTIVE RECEPTION MICROPHONE

Filed Jan. 2, 1924

2 Sheets-Sheet 1



WITNESSES:

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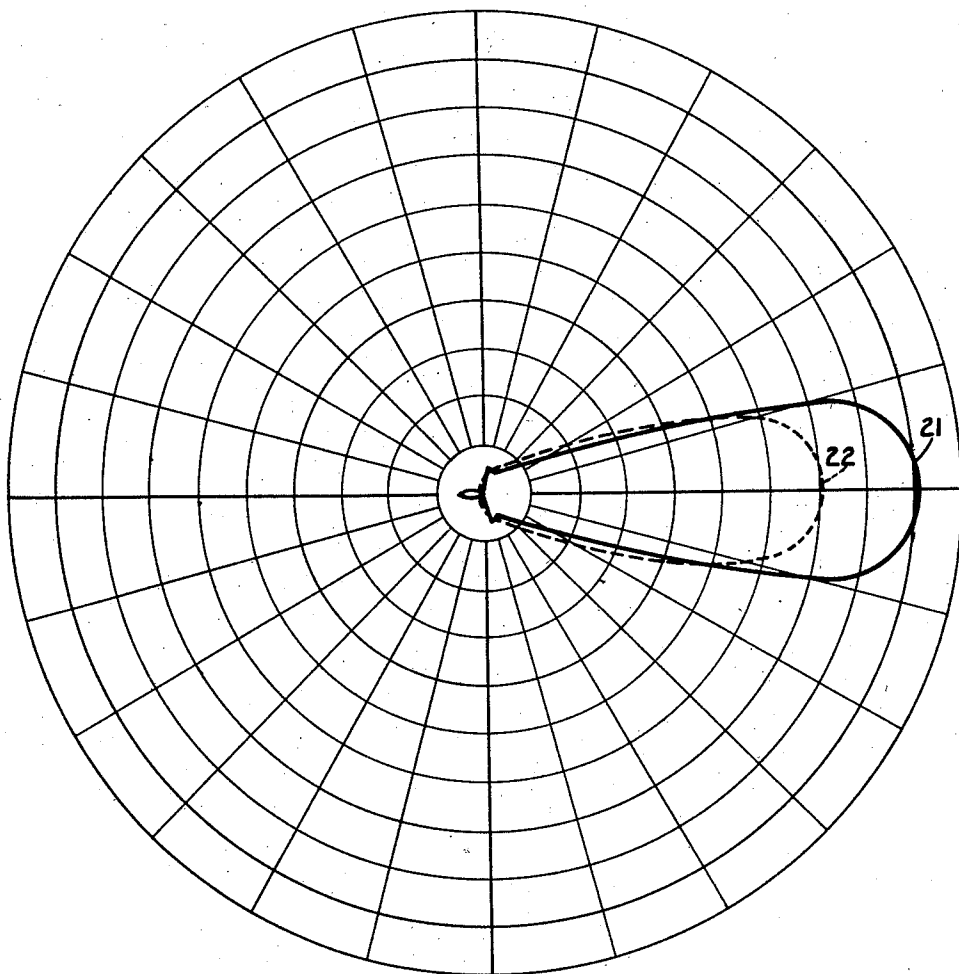
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FIG. 4.



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DIRECTIVE-RECEPTION MICROPHONE

Application filed January 2, 1924. Serial No. 683,910.

My invention relates to apparatus for the translation of sound into vibratory electric currents.

Broadly speaking, the object of my invention is to construct a device for converting sound vibrations into electrical vibrations, which device shall respond to the sound from a certain source more readily than to other sounds.

More specifically, the object of my invention is to provide reflecting and shielding means in connection with a microphone and an attached electrical system which shall accept only sound from a predetermined source and which shall simultaneously reject echoes, extraneous noises, and reflected sound, thereby giving a much more accurate copy of the original sound waves in a telephone receiver connected to the same electrical system.

A further object of my invention is to provide means incorporated in this sound-selective sound-responsive means whereby the area of space occupied by the source from which sound is accepted can be controlled.

In the development of the prior art of telephony, most of the microphones constructed have been of the type of the simple telephone transmitter suitable for the reception of the voice from a speaker close to the transmitter. Relatively few microphones have been constructed which are suitable for other sounds than speech, or sensitive to sound from a greater distance than a few inches. Because of the lack of such devices, the reception of sound from a group of musical instruments, a singer, or a public speaker, and its conversion into vibratory electric currents suitable for such purposes as that of modulating a radio sending apparatus, has been found difficult.

Because of this lack, the first broadcasting of music by a radio-sending apparatus was done from a sound "pick-up" secured by an ordinary telephone transmitter constructed according to the prior art. These transmitters were developed for telephonic conversation and have a small mouthpiece for the collection of the sound of a speaker's voice. They were not found to be satisfactory for this service. It was found difficult to get

sufficient response from such a microphone when it was placed more than a short distance from the source of sound. In instances where it was desired to collect sound from a speaker, at a public function, the microphone could not be placed within a few inches of the speaker's face, but was required to be hidden. This frequently necessitated placing the microphone a number of feet away from the speaker. Under these conditions, difficulty was experienced in getting sufficient response of the microphone to the speaker's voice, and difficulty was also experienced with echoes and extraneous noises which not infrequently covered the speaker's voice to such an extent as to make it almost unintelligible.

In the reception of sound by a microphone, it is necessary to distinguish between two types of sound. The sound emanating directly from the source may be called the primary sound, and the echoes and extraneous sounds including applause and the usual sounds of an audience may be called secondary sound. The purpose of my invention, as before stated, is to obtain maximum response of a microphone to primary sound and a minimum response to secondary sounds.

Other objects and structural details of my invention will be apparent from the following description when read in connection with the accompanying drawings, in which like reference numerals designate corresponding parts and wherein:

Figure 1 is a diagrammatic view, partly in section, of my device as applied to the "pick-up" of sound from a speaker or soloist.

Fig. 2 is a view showing my invention in section with auxiliary shielding means.

Fig. 3 is a view in perspective of my device, and

Fig. 4 is a polar coordinate curve showing the distribution of sensitivity of response to sounds emanating from sources in various positions.

Fig. 1 shows a chamber 1 having walls 2. These walls may have distributed about them reflecting areas 3 capable of developing echoes when sound is produced in the chamber. A soloist or speaker 4 is indicated

as producing sound which is received by the device 5 of my invention. An auditor 6 is indicated as applauding.

The device 5 of my invention comprises a parabolic reflector 7, also shown in Fig. 2. The reflector 7 is coated upon its convex surface with a covering of felt, or other fabric, 8, which serves as deadening material to absorb sound impinging upon its rear surface. A cylindrical shield 9, which is attached to the edge of the reflector 7, is provided as additional shielding means, also covered with felt or other deadening material 10. A microphone 11 is supported substantially at the focus of the reflector 7 by adjustable supporting means 12 comprising a lock nut adjustably movable in a slot in the shielding means 9 and 10.

Conductors 14 are connected to the microphone 11 and to an amplifier 15 which, in turn, is connected by conductors 16 to a radio broadcasting station 20. Signalling and indicating devices 17 and 18 are likewise connected to the various signalling and indicating devices in the chamber and in the broadcasting station.

In Fig 2, additional shielding means 19 are shown whereby direct sound waves are prevented from influencing the microphone 11. These shielding means are felt and metal deadening and reflecting devices so shaped as to diffuse the reflected energy.

In the operation of my invention, primary sound from the source 4 enters the aperture of the reflector 7, strikes its reflecting surface and is concentrated by reflection upon the sensitive element of the microphone 11. In this way, an optimum amount of sound energy is impressed upon microphone 11 from source 4, even though a substantial distance may intervene between the source and the microphone.

The vibratory current of the microphone 11 is then conducted to amplifier 15 from which the amplified vibratory current is conducted to broadcasting apparatus 20 by which it is converted into modulated radio-frequency energy and radiated into space.

The increase in sound energy received by microphone 11 is substantially in the ratio of the projected area of reflector 7 to the projected area of the opening into microphone 11.

By this means, I am able to impress upon microphone 11, when placed at a distance from the source, an amount of sound energy equivalent to what would be impressed upon the microphone alone at a very much shorter distance. I am thereby enabled to get a satisfactory response of the microphone without the necessity of placing it close to the sound source.

The greater response of the microphone makes less amplification of the vibratory currents necessary to produce satisfactory

modulation of the radio sending energy and a stage of amplification in the amplifier 15 may therefore be omitted.

My invention further reduces the influence of secondary sounds upon the microphone. The presence of reflector 7 and its backing of felt 8 damps out sound vibrations radiated or reflected from positions behind the device. The shield 9 and its felt covering 10 surrounding the microphone 11 and the reflector 7 also damp out vibrations from positions at the side of microphone 11. All response to sound emanating from positions to the rear of a plane through the microphone, perpendicular to the line between source and microphone, is thereby substantially prevented.

Sounds emanating from positions in front of said plane and not in the axis of reflector also fail to reach the microphone. Sound which has originated at the desired source and been reflected from a reflecting area, such as shown at 3, may enter reflector 7 through the opening between shield 9 and microphone 11. Such reflected sound, however, strikes the reflector 7 at such an angle as to be reflected out past the microphone 11 and thereby returned to the room and absorbed. As will be obvious, such sound is not reflected into microphone 11 and therefore does not affect it. Likewise, sounds originating from a secondary source, such as an applauding spectator 6, similarly enter the reflector and are reflected out past the microphone 11.

When the microphone 11 is so placed that its sound-responsive element, which may be the center of its diaphragm, is positioned substantially at the focus of reflector 7, sound is received from substantially a point source only, which point source may be quite accurately predetermined. If, however, the microphone 11 is moved away from the focus of the reflector 7, the area of the space from which sound may be received is greatly broadened. The microphone 11 may be moved either nearer to, or farther from, the reflector 7, but I have found it preferable to move it away from the reflector 7.

By thus changing the position of the microphone 11, it is possible, by my invention, to collect the sound from substantially a single point source, such as the voice of a soloist, or by the same device, to collect sound from a number of sources, such as several singers, a quartet, a singer and instruments, or several instruments.

By my invention, as described, I am able to construct a microphone assembly having a directive sensitivity of the character shown in Fig. 4 in which curve 21 shows the change in response of the microphone 11 to change in position of source of sounds having a vibration frequency of 4000 vibrations per second, and curve 22 shows the change in re-

sponse with change in position to vibrations having a frequency of 120 per second, when the microphone is combined with reflector 7 and the shielding and deadening means described. Because of the greater sharpness of reflection of sounds of short wave length, higher pitched sounds are found to be received with a somewhat greater efficiency and sharpness of directive effect than low pitched sounds, as shown by the curves. These curves show the sharp selectivity of my device for sounds in a particular position with respect to the median line of the reflector and microphone combination of my invention.

By means of this invention, I am able to secure augmented response of a microphone to primary sounds and substantial reduction of response to secondary sounds, thereby greatly improving the ratio of response to primary sounds as compared to response to secondary sounds.

While I have shown only one embodiment of my invention in the accompanying drawings, it is capable of various changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be imposed thereon as are indicated in the prior art or in the appended claims.

I claim as my invention:

1. A directive reception microphone comprising a parabolic sound reflector, a sound-responsive element mounted substantially at the focus thereof, a cylindrical shield surrounding said microphone, and a felt covering upon the exterior of said reflector and said shield.

2. A directive reception microphone comprising a sound-responsive element and a plurality of surrounding sound-reflective and sound-absorbent elements, one of said reflective elements being adapted to reflect sound from a given source only into said sound-responsive element, said sound-absorbent elements being adapted to absorb sound from other sources.

3. The combination with a sound-responsive system comprising a microphone, of means for excluding extraneous sound from said system, while accepting sound from a desired source, said means comprising a curved reflector, said microphone being placed substantially at the focus of said reflector, a relatively small shielding device placed between said microphone and said desired source, a plurality of cylindrical shields surrounding said microphone for reflecting extraneous sounds, and a felt backing for said shields for absorbing extraneous sounds.

4. In a sound pick-up process, the method of increasing the ratio of primary sound to secondary sound which consists in reflecting a beam of primary sound to a concentrated point and simultaneously reflecting away and shielding out secondary sounds.

5. A directive reception microphone comprising a parabolic sound reflector, a sound-responsive element mounted adjustably at the focus thereof, a cylindrical shield surrounding said microphone, and a felt covering upon the exterior of said reflector and said shield.

6. A system for converting sound waves into electrical manifestations comprising a sound-reception device constituted by a parabolic sound-reflector, a telephone transmitter at substantially the focus of said reflector, a cylindrical shield surrounding said telephone transmitter, sound-absorbent means upon the exterior of said reflector and said shield, a chamber wherein a source of sound may be positioned, said sound-reception device being so aligned with the position at which said sound-source is to be disposed that the telephone transmitter is intermediate said position and said reflector, and a relatively small shielding device mounted in front of and adjacent to said telephone transmitter, whereby said transmitter is subjected predominately to sounds coming from a source at said position.

7. A directive sound-reception system comprising a curved sound-reflector, a sound-sensitive device disposed substantially at the focus of said reflector, and a relatively small shielding device mounted in front of and adjacent to said sound-sensitive device, whereby said device is mainly influenced by sound waves that are focused thereon by said reflector.

In testimony whereof, I have hereunto subscribed my name this 8th day of December, 1923.

C. W. HORN.