Feb. 10, 1953 J. E. VOLKMANN ET AL 2,627,932

ACOUSTIC FILTER FOR MICROPHONES

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Fig. 1.

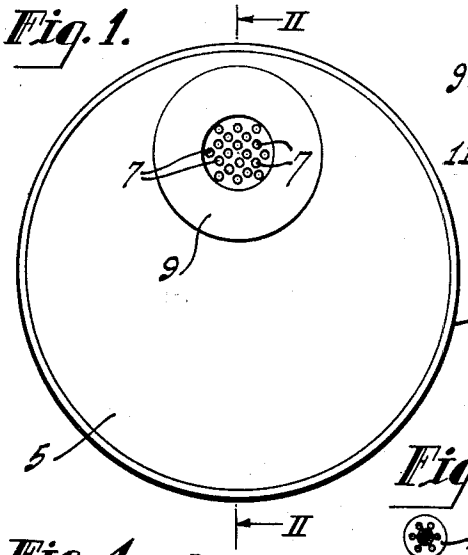


Fig. 2.

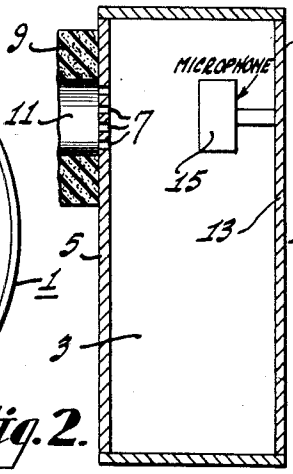


Fig. 3.

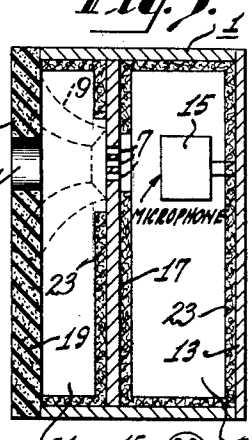
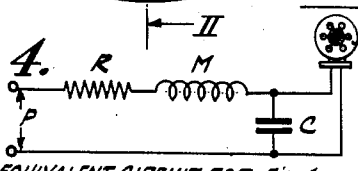
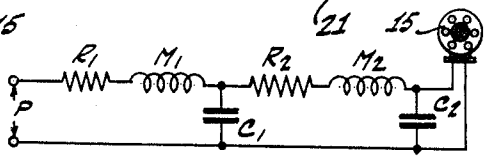


Fig. 4.



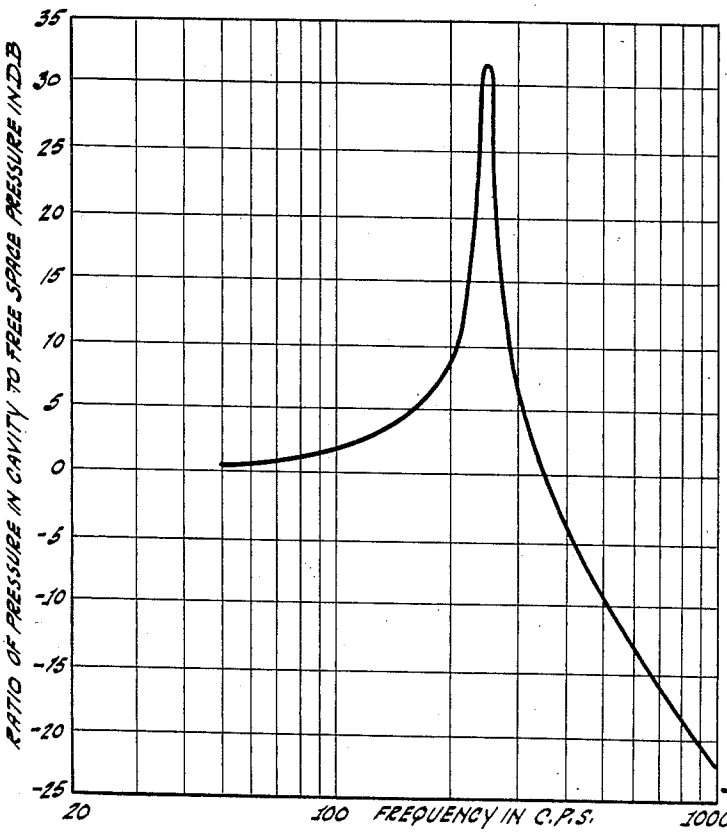
EQUIVALENT CIRCUIT FOR Fig. 1.



EQUIVALENT CIRCUIT FOR Fig. 2.

Fig. 5.

Fig. 6.



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ACOUSTIC FILTER FOR MICROPHONES

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5 Claims. (Cl. 181—34)

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This invention relates to sound translating systems, and more particularly to acoustic filter devices which can be used with microphones to reduce acoustic feedback to and acoustic noise pickup by the microphones.

There are certain places in which microphones are used to pick up sound where surrounding noise is at a high level, as in battleships, airplanes, factories, and the like. In some cases, also, the surroundings are such as to produce acoustic feedback at a high level. Where such conditions are encountered, the signal to noise ratio is correspondingly low, and it becomes difficult to later translate back into clearly discernible acoustic signals the signals that are generated by the microphone.

The primary object of our present invention is to provide an improved sound translating system having a microphone as a component thereof which will not be subject to the aforementioned difficulty.

More particularly, it is an object of our present invention to provide an improved sound translating system by means of which acoustic feedback to and noise pick-up by the microphone will be very greatly reduced so that the signal to noise ratio will be greatly increased and clearly audible signals can be obtained therefrom.

Another object of our present invention is to provide improved acoustic filter devices for use with microphones, which devices can be used with any standard or conventional microphone with great efficiency for the purpose of increasing the signal to noise ratio.

It is also an object of our present invention to provide an improved sound translating system as above set forth which is very simple in construction, economical in cost, and highly efficient in use.

In accordance with one form of our present invention, we provide a casing which has a large cavity therein and which is formed in one wall with one or more openings of suitable dimension which afford communication between the exterior of the casing and the cavity so that sound waves can pass into the cavity. A mouthpiece of sponge rubber or the like having a suitable opening therein is disposed about the aforementioned openings in the casing. Immersed within the cavity opposite and in spaced relation to the aforementioned openings is a microphone of any suitable form or type. The volume of the cavity is large compared to that occupied by the microphone, so that the cavity provides a large acoustic capacitance about the microphone. The openings in the wall of the casing and the cavity therein are so dimensioned that they provide an acoustic filter which discriminates against sounds coming from points appreciably beyond the mouthpiece. Thus, external noises and sounds which are fed back to the system are effectively filtered out and are prevented from reaching the microphone. However, when the mouthpiece is close to the lips of the user, the sound pressure developed by the user is sufficient to cause the sounds emitted by him to readily reach the microphone.

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In another form of sound translating system according to our present invention, the casing may be formed to provide two or more acoustic filters between the mouthpiece and the microphone. Where, for example, a two-stage filter of this type is desired, two cavities may be provided by placing a suitable wall or partition in the cabinet, the partition being formed with one or more suitably dimensioned openings which afford communication between the two cavities. The mouthpiece, which may be of sponge rubber, is so arranged that normally it is spaced from the aforementioned partition. However, when the lips are pressed against the mouthpiece, it can be forced against the partition and around the one or more openings therein to thereby bypass one of the cavities. In this way, one of the filter stages is effectively eliminated. If desired, the cavities in the casing may be lined with acoustic resistance material.

The novel features of our invention, as well as additional objects and advantages thereof, will be understood better from the following description of two embodiments thereof, when read in connection with the accompanying drawing, in which

Figure 1 is a front elevation of one form of sound translating system according to our present invention,

Figure 2 is a central sectional view thereof taken on the line II—II of Fig. 1,

Figure 3 is a similar, sectional view of another form of sound translating system in accordance with our present invention,

Figure 4 is a wiring diagram of an electrical system corresponding to the acoustical system of the form of our invention shown in Figures 1 and 2,

Figure 5 is a wiring diagram of an electrical system corresponding to the acoustical system of the modification of our invention shown in Figure 3, and

Figure 6 is a curve showing the effectiveness

of the form of our invention shown in Figures 1 and 2 as a filter.

Referring more particularly to the drawing, wherein similar reference characters designate corresponding parts throughout, there is shown, in Figures 1 and 2, a casing 1 which may be cylindrical or of any other suitable shape and which encloses a space or acoustic cavity 3. The front wall 5 of the casing 1 may be provided with one or more openings or apertures 7 which afford communication between the exterior of the casing 1 and the cavity 3 for the passage of sound waves into the cavity. An annular pad 9 of sponge rubber or other suitable material which is preferably soft and yieldable and which has a central opening 11 is mounted on the wall 5 about the apertures 7. Thus, the opening 11 constitutes a passage for directing sound waves to the apertures 7.

Mounted on the back wall 13 of the cabinet 1 is a microphone 15. The microphone 15 is preferably disposed opposite and in spaced relation to the apertures or openings 7 and is so arranged that it is immersed in the cavity 3. The volume of the cavity 3 is large compared to the volume of the microphone 15, so that the microphone occupies but a very small space within the cavity 3, and the cavity therefore constitutes a large acoustic capacitance about the microphone.

The cabinet 1 with its large capacitance 3 and its small apertures 7 constitutes an acoustic filter which may be represented by the wiring diagram of Figure 4 in which R represents the acoustic resistance of the apertures 7, M represents the inertance of the air in the apertures 7, and C represents the acoustic capacitance of the air in the cavity 3. By properly dimensioning the cavity 3 and the apertures 7, the acoustic filter may be made to discriminate against sounds coming from points appreciably beyond the mouthpiece 9. The curve of Figure 6 shows the action of a single stage filter such as shown in Figures 1 and 2 in which the cavity 3 has a volume of 100 cubic inches and in which there are eleven, closely grouped holes or apertures 7 each about $\frac{3}{16}$ inch in diameter. It will be seen from this curve that, except for a peak at around 250 C. P. S., this filter is quite effective in discriminating against sounds outside of the casing 1. However, when the mouthpiece 9 is brought up against the lips of the user, the acoustic pressure developed by the mouth on speaking is sufficient to actuate the moving element of the microphone 15.

A device such as described above acts, essentially, as a shield to reduce acoustic feedback and acoustic noise pick-up by the microphone 15. The effectiveness of this shield or acoustic filter in attenuating the voice sounds of a user will be reduced or largely eliminated depending upon how close the mouth is brought up to the mouthpiece 9 and the apertures 7. As stated before, any suitable microphone 15 may be employed, but we prefer to use a microphone of the pressure gradient responsive type, as this type of microphone is especially suitable for obtaining additional noise reduction.

In the form of our invention shown in Figure 3, the casing 1 is provided with a wall or partition 17 in which the apertures 7 are formed. The front wall 19 of the casing 1 may be formed, in this case, of a sponge rubber member 19 which provides the mouthpiece 9 and has the opening 11 therein opposite the apertures 7. The wall 19 is preferably spaced from the partition or wall 17 a distance sufficient to provide a second cavity 21 which may or may not be of the same size as the

cavity 3 but which, in any case, also has a volume that is large and comparable to that of the cavity 3 in which the microphone 15 is immersed. The interior walls of the casing 1 forming the cavities 3, 21 may be lined with acoustic resistance material 23, although this material can be eliminated if not desired.

The device of Figure 3 constitutes a two-stage filter such as is represented by the wiring diagram of Figure 5 in which R_1 represents the acoustic resistance of the opening 11, M_1 represents the acoustic inertance of the air in the opening 11, C_1 represents the capacitance of the air in the cavity 21, R_2 represents the resistance of the apertures 7, M_2 represents inertance of the air in the apertures 7, and C_2 represents the capacitance of the air in the cavity 3. Normally, the wall 19 is spaced from the partition 17, and the device is therefore highly effective in discriminating against sounds outside of the casing 1. When the mouth is placed against the yieldable front wall 19 about the opening 11 and pressure is applied, the portion of the wall 19 immediately around the aperture 11 will be forced inwardly to the dotted line position of Figure 3 and will be brought into engagement with the partition 17 about the apertures 7. In this way, the cavity 21 is by-passed and the cavity 3 with the apertures 7 become alone effective as a one-stage filter similarly to the device of Figures 1 and 2.

From the foregoing description, it will be apparent to those skilled in the art that we have provided an improved sound translating system in which acoustic feedback and acoustic noise pick-up by the microphone is reduced to a minimum. Although we have shown and described two specific forms of our invention, it will, no doubt, be readily appreciated that many other forms, as well as variations in the particular ones described, are possible. We therefore desire that the above description and the forms of our invention shown in the accompanying drawing shall be taken as illustrative and not as limiting.

We claim as our invention:

1. In a sound translating system, the combination of a casing having a wall therein which divides said casing into a pair of cavities, said wall being provided with an opening therein which affords communication between said cavities, a mouthpiece carried by said casing in association with said opening, said mouthpiece affording communication between the exterior of said casing and one of said cavities, and a microphone immersed in the other of said cavities, the volume of said other cavity being large compared to that occupied by said microphone whereby to provide a large acoustic capacitance about said microphone.

2. A sound translating system according to claim 1 wherein the volume of said one cavity is also large compared to that occupied by said microphone.

3. A sound translating system according to claim 1 characterized in that said mouthpiece is of a yieldable material and has an opening opposite said wall opening, said mouthpiece being normally spaced from said wall, and characterized further in that when pressure is applied against said mouthpiece about its said opening by the lips of a user, said mouthpiece is adapted to yield and to be brought into engagement with said wall about its said opening to thereby provide a passage directly between the exterior of

said casing and said wall opening and thus by-pass said one cavity.

4. A sound translating system according to claim 3 characterized in that said openings and said cavities are so dimensioned that when said mouthpiece is in its normal position spaced from said wall, said openings and cavities provide a two-stage acoustic filter which discriminates against sounds coming from points appreciably beyond said mouthpiece, and when said mouthpiece is brought into engagement with said wall to by-pass said one cavity, said passage and wall opening and other cavity provide a single stage acoustic filter which discriminates against sounds coming from points appreciably beyond said mouthpiece.

5. A sound translating system according to claim 1 wherein at least one of said cavities is lined with acoustic resistance material.

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