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SOUND PICK-UP AND AMPLIFYING
APPARATUS

Marshall L. Lockhart, Des Moines, Iowa

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5 Claims. (Cl. 179—121)

An object of my present invention is to provide a novel sound pick up and amplifying apparatus of simple and inexpensive construction which is an improvement over similar apparatus shown in my co-pending application Serial No. 709,797, filed February 5, 1934, on an "Electro-stethograph".

More particularly it is my object to provide a sound pick up and amplifying apparatus having a simple microphone arrangement provided with means to exclude extraneous sounds, or sounds other than those to be picked up by contact of the microphone with animal tissue or the like, and which is so connected with a vacuum tube of an amplifier that tube noises and noises caused by making electrical connections at certain usual points in an amplifier of the vacuum tube type are eliminated, whereby the outgoing amplified electric current to an audible translation device or a recording device fluctuates in almost exact accordance with frequencies picked up by the microphone and without imposed frequencies caused by tube noises and the like.

A further object is to provide a microphone of the crystal type, such as a piezo cell or crystal pressure type microphone, which is inherently supersensitive and capable of producing potential difference in a conductor without feeding any external electric current to it, the microphone element being enclosed in a heavy casing which has a frequency of vibration much higher than any sound to be picked up by the apparatus and which includes an air column of minimum dimensions so that the diaphragm of the microphone is almost entirely responsive to sounds picked up without any distortion caused by a column of air between the object from which the sound is picked up and the diaphragm.

Still a further object is to provide means for relieving air pressure on the diaphragm when the microphone is made to contact with animal tissue or the like which means is not affected in any way by air currents outside the microphone casing and is not susceptible to variations caused by talking or other sounds outside the microphone casing, nor is it possible to accidentally prevent relief of air pressure on the diaphragm, as by an operator grasping the microphone with a finger or thumb over a pressure relief opening in the casing.

Still a further object is to connect the microphone with a vacuum tube of an amplifier in such manner that tube noises and other undesired frequencies are suppressed, the manner of connection being by a shielded lead having its shield

connected with a tube shield, which in turn is connected with a cathode of the tube and with the ground in the amplifier, the lead having its conductor connected with the grid of the vacuum tube and the microphone and a resistance for stabilizing the frequency at which the microphone operates being shunted across the terminals of the microphone rather than across the cathode and grid of the vacuum tube as ordinarily done, thus preventing, in my apparatus, undesired potential difference in the microphone lead, thereby eliminating any howling or screeching effect in an audible translation device or undesired frequency recording in a recording device connected with the amplifier and caused by a potential difference in the microphone lead.

Still a further object is to provide a modified form of the microphone which is comparatively small and shaped somewhat like the bell of a stethoscope, this form of the invention having a corrugated diaphragm as close to the mouth of the microphone as is feasible for reducing undesired effect of an air column between the object from which sound is to be picked up and the diaphragm.

With these and other objects in view my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawing in which:

Figure 1 is a perspective view of a microphone or sound pick up device embodying my invention.
Figure 2 is a sectional view on the line 2—2 of Figure 1.

Figure 3 is a sectional view on the line 3—3 of Figure 2.

Figure 4 is an enlarged sectional view on the line 4—4 of Figure 3 showing a specific type of lead for the terminals of the microphone.

Figure 5 is an enlarged sectional view on the line 5—5 of Figure 2 showing how the mouth of my microphone contacts with animal tissue or the like to form an effective sound excluding seal therewith.

Figure 6 is a sectional view similar to Figure 2 showing a modified form of the microphone; and

Figure 7 is an electrodiagrammatic view showing the microphone and amplifying apparatus connected with apparatus whereby the picked up and amplified sounds can be heard and/or recorded.

On the accompanying drawing I have used the reference character A to indicate generally the

microphone. It comprises an annular casing 10 having a front wall 12 and a back wall 14 having a screw threaded or other suitable connection with the casing 10. The mouth piece 16 extends from the front wall 12 and is of a bell shape. In its outer end adjacent its periphery, it is provided with an annular groove 18. Inside of the groove 18 is a shallow depression 20 which communicates with a bore 22.

Within the casing 10 is a disc shaped base 24, and an annular ring 26 both formed of insulating material and a piezocrystal or other microphone element 28. A diaphragm 30 has its peripheral edge contacting with the ring 26 and has on its front face a small porous ring or gasket 32. The elements 24, 26, 30 and 32 are all sealed relative to each other by glue or the like and are held as a unit within the casing 10 by a pad of compressible felt or the like 34 and the back wall 14, when in assembled position relative to the casing 10.

The microphone element 28 is preferably of the piezocrystal type now in general use and consisting of a central conductor plate 36 of tin-foil or the like and an outer conductor plate 38 which extend to terminals 36a and 38a, which in turn are wired to terminals 40 and 42 on the back of the base 24. The plates 36 and 38 are separated by crystals 44 of Rochelle salt or the like and which are susceptible to a bending pressure for varying the potential across the terminals 40 and 42. Bending due to pressure is made possible by anchoring the ends of the element 28 to blocks or the like 46 and connecting the center of the element as by a wire 48 to the center of the diaphragm 30.

The connection at the center is preferably made by means of wax 50 applied in a melted state after the parts are assembled so as to eliminate assembly with any strain on the diaphragm and microphone element. As before stated, the elements 24, 26 and 30 are sealed relative to each other and the wax 50 completes the seal so that the microphone element is enclosed in a hermetically sealed container consisting of the diaphragm 30, the ring 26 and the base 24 so that moisture cannot enter and deteriorate the crystal 44. This element, however, forms no part of my present invention; I have simply found it the most satisfactory microphone element for the electrostethograph disclosed in my co-pending application.

For protecting the diaphragm 30 against injury I provide a heavy screen 52 in the bore 22. The casing 10, if made of metal, should be grounded to one of the terminals of the microphone and I provide for such ground in the following manner:

The terminal 42 has connected with it a strip of metal 54 which at its outer end is bent into the form of a circle as indicated at 56 and is a snug fit between the periphery of the base 24 and the casing 10.

A lead B extends into the microphone casing through an opening 58 in the wall thereof. The lead has a conductor 60 surrounded by insulation 62 and a current conducting shield 64. Outside of the lead shield 64 there is a cover 66 preferably of porous material, the purpose of which will hereinafter be described. As shown in Figure 4, the lead is substantially a snug fit in the opening 58.

Within the microphone casing the lead may be secured to the base 24 as by a clip 68 and the conductor 60 of the lead is connected with the

terminal 40 of the microphone while the shield 66 is connected to the terminal 42. A stabilizing resistor 70 is arranged within the microphone casing to shunt the microphone terminals, it preferably being connected directly with them so as to be connected in the circuit as close to the microphone as possible.

In Figure 7, I have shown the microphone thus far described connected with a vacuum tube 72 of an amplifier. The tube is of the triode type, having a cathode 74, a grid 76 and a plate 78. For best results the outside of the tube should be shielded as with a shield 80. The cathode and shield are ordinarily grounded, although if not inherent in the tube used, it should be so connected when the tube is installed in the amplifier to obtain best results.

I have found it quite important to directly connect the conductor of the microphone lead B to the grid cap 82 and the lead shield 64 with the tube shield 80, whereas ordinarily the conductor and lead shield are brought in beneath the shielded base of the amplifier connecting the lead shield with the shielded base to ground it at that point and extending the conductor up to the grid cap. This produces undesirable noises which are eliminated only by a direct drop of the lead B down to the vacuum tube 72 and connection of the lead shield with the tube shield rather than with the ground even though eventually the current from the lead shield reaches the ground, through the tube shield and cathode ground wire.

The amplifier is connected with an ordinary translation device, such as a loud speaker, or a series of head phones and with a recording device such as shown in my co-pending application, so that the sounds picked up can be either heard or recorded, or simultaneously heard and recorded if desired.

In the form of invention shown in Figure 6, many of the parts are similar to those shown in Figure 2 and in such case are given the same reference numeral with the addition of the distinguishing characteristic.

The depression 20 and bore 22 of Figure 2 are eliminated, the diaphragm 30' of Figure 6 being located as close to the outer end of the mouth 16' as possible to minimize the air column between the object with which the microphone contacts and the diaphragm. In Figure 2 it will be noted that the front wall 12 closely follows the contour of the diaphragm 30 to minimize this space.

The diaphragm 30' is preferably corrugated so that disc like portions 30a thereof can vibrate in response to sounds while cylindrical portions 30b thereof are not responsive to vibration but reinforce the diaphragm without detracting from its vibratable area.

The base 24' for the microphone element 28' may be secured in position as by screws 25 and a small vent 31 may be provided in the diaphragm 30' to allow escape of air when the microphone is brought into contact with animal tissue or the like.

In the device shown in Figure 2, escape of air from in front of the diaphragm is permitted because of the porosity of the gasket 32 and the restricted passage afforded between the peripheries of the diaphragm 30 and the base 24, these parts being a snug fit but not an airtight fit.

In operation the microphone, which is especially adapted for picking up heart-sounds, may be adjusted by a physician over the heart of a patient with the bell mouth 16 in contact with

the patient's chest, indicated at C in Figure 5. The annular groove 18 provides a double contact of the mouth at 84 with the patient, which effectively excludes sounds because of making an air tight connection and also by reason of the slight dead air space formed at 86. I have found that even when the mouth of the microphone contacts with hair on the skin an efficient seal can be effected so that extraneous sounds are excluded and only the sounds coming through the skin of the patient affect the microphone element.

Minimizing the air column between the patient and the diaphragm is also quite important as an excessive air column tends to suppress the sound waves before they reach the diaphragm, thus giving a somewhat false and insufficient vibrational magnitude to the diaphragm.

Upon contact of the patient with the microphone, air is compressed between the patient and the diaphragm because of the skin of the patient bulging into the microphone. This must be taken into consideration and has heretofore been taken care of by others by making a vent in the front cover 12. This has considerable objection as extraneous noises can be picked up through this vent while any wind blowing across it will produce an undesired vibration on the diaphragm and it also has the disadvantage of being in an exposed position where it can be closed up by a finger or thumb of the operator or become clogged with dirt, thereby entirely defeating its purpose.

In my microphone construction, an air chamber is provided behind the diaphragm and any air compressed in front of the diaphragm can leak in a restricted manner to this air chamber either past the porous gasket 32 or through the restricted vent 31 in Figure 6. This air chamber can be sealed if found desirable or it can have a slight leak to atmosphere so that the pressure therein can be equalized with respect to atmospheric pressure. Since a lead B is necessary for the microphone, such a leak is readily provided through the opening 58 in the casing for the lead. The lead preferably snugly fits this opening, while if the lead is covered with a fabric material such as shown at 66, the cover forms an effective dust screen as well as permitting restricted leakage of air into or out of the casing 10.

As a further precaution against sound entering the casing and affecting the diaphragm 30 the felt 34 is provided, which acts as a sound deadener and baffling material as well as a filter material to prevent dust entrance. The felt may be in the form of a disc, and this disc may be of other material than felt, such as cotton or the like, compressed into the casing. I have found the felt disc quite satisfactory, however, as it can be compressed by the back 14 to rigidly retain the microphone element and the parts to which it is attached within the casing 10. In

Figure 5 I have omitted any felt packing or the like as the felt is not entirely necessary, although it is preferable.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and purpose of my invention and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope.

I claim as my invention:

1. In a sound pick up apparatus, a microphone including a mouth extending therefrom for contact with animal tissue or the like from which sound is to be picked up, said mouth adjacent its outer periphery having an annular groove, the sides of which contact with said animal tissue or the like and provide a dead air space between said sides.

2. A sound pick up device comprising a casing, a vibratory diaphragm therein adjacent the front thereof, said diaphragm being of corrugated construction, a crystal type microphone element connected therewith and mounted in said casing, a leak from in front of said diaphragm to the portion of said casing behind said diaphragm and a leak to atmosphere from said portion.

3. In a sound pick up apparatus, a microphone including a mouth for contact with an object from which sound is to be picked up, said mouth at its outer end having an annular groove adjacent the periphery thereof for forming a double rimmed seal with such animal tissue or the like and for providing a dead air space between the seals.

4. In a sound pick up apparatus, a microphone including a casing, a mouth thereon for contacting with an object from which sound is to be picked up, a cavity enclosed by said mouth, a diaphragm within said casing, a microphone element connected therewith, a chamber within said casing behind said diaphragm, means for equalizing the pressure in said cavity with the pressure of the atmosphere when said mouth is placed in contact with an object, said means including a leak from said cavity to said chamber and a leak to atmosphere from said chamber, and sound absorbent material between said leak to atmosphere and said diaphragm.

5. In a sound pick up device, a casing, a mouth thereon for contact with animal tissue or the like from which sound is to be picked up, a vibratory diaphragm in said casing adjacent the front thereof and having its periphery connected therewith, a crystal type microphone element mounted in said case and connected with said diaphragm and a leak from the space in front of said diaphragm to the portion of said casing behind said diaphragm.

MARSHALL L. LOCKHART.