April 5, 1960 A. L. DVORSKY 2,931,865

MICROPHONES

Filed Sept. 11, 1959

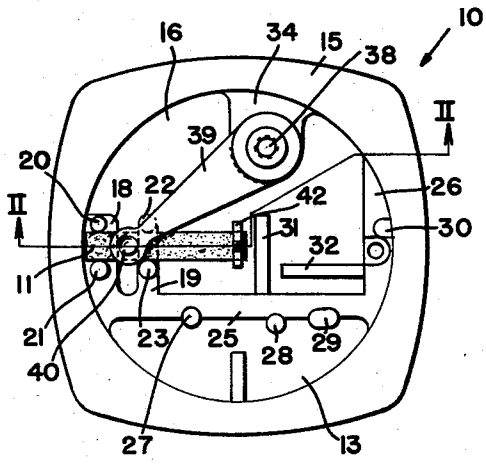


FIG. 1

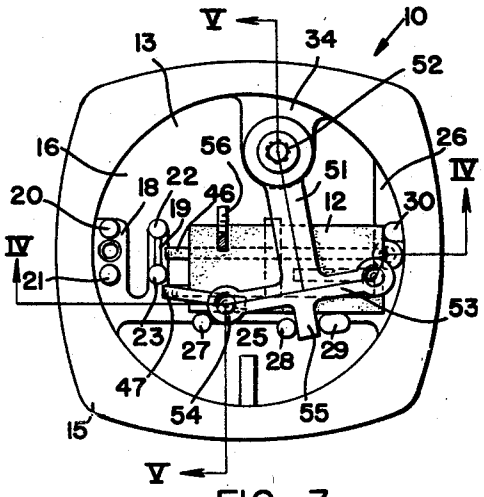


FIG. 3

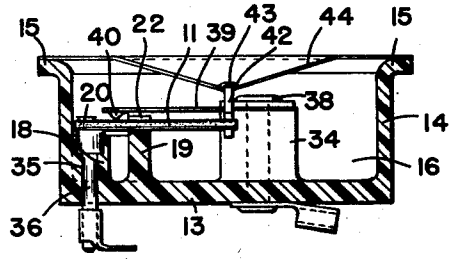


FIG. 2

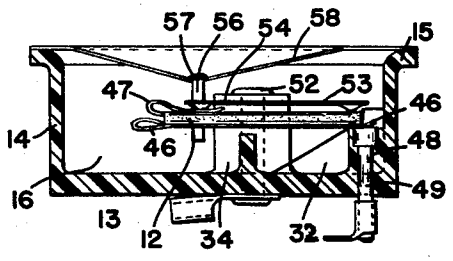


FIG. 4

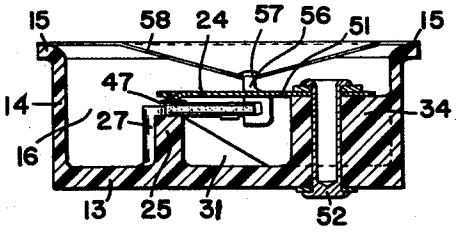


FIG. 5

INVENTOR
ALEXANDER. L. DVORSKY

BY Francis J. Klempay
ATTORNEY

United States Patent Office 2,931,865
Patented Apr. 5, 1960

2,931,865

MICROPHONES

Alexander L. Dvorsky, Conneaut, Ohio, assignor to The Astatic Corporation, Conneaut, Ohio, a corporation of Ohio

Application September 11, 1959, Serial No. 839,414

15 Claims. (Cl. 179—110)

The present invention relates generally to the art of translating and transmitting sound and has to do more particularly with microphones.

Microphones employing piezoelectric transducer elements, such as those fabricated from Rochelle salt or barium titanite ceramic material, for example, are widely used because of their relatively low cost and high efficiency. Such microphones are well adapted for large volume markets, such as public address systems, home recording apparatus, etc.

In the manufacture of such a microphone it is customary to secure the piezoelectric transducer element in the microphone casing by placing and by cementing the same on various small rubber pads. These pads must be accurately located with respect to the microphone casing and the transducer element must then be very accurately positioned on and cemented to the rubber pads. This has entailed the use of many and complicated locating jigs or fixtures and has further required highly skilled technicians to perform the delicate and precise positioning and cementing operations. The accidental application of too little or too much of the cement will materially effect the performance of the finished microphone. Also, the imbrittlement of the cement, in combination with the hardening of the rubber pads, over a period of time will cause the premature failure of some of the microphones constructed and assembled in accordance with the above described prior art practices.

In view of the above, it is the primary or ultimate object of the present invention to provide microphones wherein the transducer elements may be mounted in proper relation without the use of rubber pads, cement, etc.

Another object of the invention is to provide extremely simplified and highly advantageous spring means for holding and clamping the transducer elements of microphones in properly positioned relation in the microphone casings. The provision of such spring means completely eliminates the delicate cementing operations which have characterized prior art assembly methods.

Still another object of the invention is to provide microphones comprising microphone casings which are formed with integral supporting ribs and locating bosses for properly positioning the transducer elements therein.

A further object of the invention is the provision of microphones employing microphone casings having integral locating ribs and bosses therein which are adapted to support and locate either bender or torque type transducer elements. In this manner microphones best adapted for the intended purposes can be fabricated even though the same microphone casings are employed.

Yet a further object of the invention is to provide microphones embodying improved and highly simplified means for effecting the required electrical connections with the electrodes of the transducer elements.

A still further object of the invention is to provide microphones which may be assembled by relatively unskilled labor in a minimum of time without the use of special locating and positioning fixtures or jigs.

The above, as well as other objects and advantages of the invention, will become more readily apparent upon consideration of the following specification and accompanying drawing wherein there are disclosed certain preferred embodiments constructed in accordance with the teachings of the invention.

In the drawing:

Figure 1 is a plan view of a microphone embodying the principals of the present invention wherein the transducer element is of a bender type;

Figure 2 is a sectional view taken along the section line 11—11 of Figure 1;

Figure 3 is a plan view of a microphone employing a torque type transducer element; and

Figures 4 and 5 are sectional views of the microphone shown in Figure 3 taken along the section lines IV—IV and V—V, respectively.

Referring now to the drawing, and initially to Figures 1 and 3 thereof, there are shown a pair of microphones which each embody the same microphone casing, indicated generally by the reference numeral 10. In the microphone shown in Figures 1 and 2 of the drawing a bender type piezoelectric transducer element 11 is employed while in the microphone of Figures 3–5 of the drawing a torque or twister type piezoelectric transducer element 12 is utilized.

The microphone casing 10 comprises a flat bottom surface 13 and an upwardly extending tubular side wall 14 which terminates at its upper extremity in an outwardly directed circumferential flange 15. The arrangement is such that the microphone casing 10 is generally cup-shaped and has a center cavity 16 therein.

Extending upwardly from the flat bottom surface 13 of the microphone casing are a plurality of supporting ribs and locating bosses. These supporting ribs and locating bosses may be conveniently divided into two groups. The first group is used to locate and support a bender type transducer element as shown in Figures 1 and 2 and comprises a pair of vertically extending and spaced parallel ribs 18 and 19 which have the locating bosses 20, 21, 22 and 23 projecting vertically therefrom. The locating bosses 20 and 21 are disposed in spaced relation on the rib 18 while the bosses 22 and 23 are positioned in spaced relation on the supporting rib 19 and are aligned with respect to the locating bosses on the rib 18.

The second group of supporting ribs and locating bosses is employed to properly position and support a torque type transducer element as shown in Figures 3–5 of the drawing. This latter group comprises a pair of vertically extending and normally related supporting ribs 25 and 26 while a series of three locating bosses 27, 28 and 29 project vertically from the supporting rib 25. Also, a locating boss 30 extends above the supporting rib 26. Extending normally with respect to the supporting ribs 25 and 26 are a further pair of ribs 31 and 32, respectively. Each of these last mentioned ribs is tapered downwardly throughout its length as is clearly shown in Figures 4 and 5 of the drawing. The microphone casing also has a large terminal boss 34 adjacent its side wall 14 which is employed in both of the microphones shown in Figures 1 and 3.

Referring more specifically to the embodiment shown in Figures 1 and 2 of the drawing, it will be noted that the transducer element 11 is positioned with its rear end spanning and overlying the ribs 18 and 19 and is nestingly received between the spaced pairs of locating bosses 20—21 and 22—23. The transducer element 11 is preferably of the ceramic type and comprises an active body

of piezoelectric ceramic material which has current conductive electrodes applied to its upper and lower major surface areas. It is, of course, necessary to provide electrical contact with the electrodes on the opposite major surface areas of the transducer element.

The vertically extending rib 18 has a counterbored aperture 35 therein which is positioned between the locating bosses 20 and 21 and which extends through the flat bottom surface 13 of the microphone casing. Inserted within the counterbored aperture 35 is a shouldered and current conductive terminal pin 36 whose top edge extends slightly above the face of the rib 18 whereby the same lies in a plane level with the top surface of the supporting rib 19. It will be observed from Figure 2 of the drawing that the supporting rib 19 is of slightly greater vertical dimension than the rib 18. The rear end of the transducer element 11 is thus supported in a level relation by the supporting rib 19 and the upper face of the shouldered terminal pin 36 that projects vertically above the rib 18. The terminal pin 36 provides a means for effecting electrical contact with the electrode on the lower major surface area of the transducer element.

Resting on the top surface of the terminal boss 34 and secured thereto by a tubular current conducting rivet 38 is an elongated and tapered leaf spring 39 whose forward and dimpled end 40 engages and bears against the upper surface of the transducer element 11 at a point intermediate the ribs 18 and 19. The dimpled end 40 of the leaf spring 39 provides, in effect, a point contact with the upper major surface area of the transducer element. The leaf spring 39 serves to retain the transducer element securely in the position shown in Figures 1 and 2 of the drawing and also serves as a means for effecting electrical contact with the electrode covering the upper major surface area of the transducer element.

The transducer element 11 is mounted in cantilever fashion with the forward and free end thereof projecting inwardly toward the center of the cavity 16 in the microphone casing 10. Attached to the free end of the transducer element 11 is a small and light weight nose piece or coupling member 42 which is fastened by a fillet of cement 43 to the center of a suitably formed acoustical diaphragm 44. The periphery of the acoustical diaphragm 44 is secured, by cementing for example, to the outwardly directed circumferential flange 15 of the microphone casing.

In the operation of the microphone above described, sound waves impinge upon the acoustical diaphragm 44 and the diaphragm is caused to vibrate. Vibrations are transmitted from the diaphragm 44 by the nose piece or coupling member 42 to the transducer element and these vibrations produce alternating bending stresses in the free end of the transducer element 11. The transducer element is characterized by its ability to convert such mechanical forces into proportional electrical signals which are evidenced across the electrodes thereof. These signals are conducted to suitable amplifying equipment, not shown, as is well known in the art. Electrical contact is made with the electrode on the upper major surface area of the transducer element 11 through the current conductive tubular rivet 38 and the leaf spring 39 while contact is provided with the electrode on the lower major surface area of the transducer element by means of the shouldered terminal pin 36.

As indicated above, the embodiment of Figures 3–5 of the drawing employes a torque or twister type transducer element 12. The element 12 operates in response to turning or twisting forces and it is thus necessary to anchor or secure two adjacent and normally disposed side edges while applying the driving force to the freely disposed corner thereof.

The supporting rib 26 is adapted to support one short edge of the transducer element while the supporting rib 25 provides a support for the adjacent elongated edge of the transducer element. The locating bosses 30, 29 and 27 bear against the side edges and align the transducer element 12 in proper position with respect to the microphone casing.

The tapered ribs 31 and 32 provide short inclined planes extending up to the level of the upper surfaces of the supporting ribs 25 and 26. The tapered ribs 31 and 32 serve as assembly aids in raising the transducer element 12 into level relation with respect to the supporting ribs 25 and 26.

The transducer element 12 comprises a body of active piezoelectric material, such as Rochelle salt, for example, which is provided with electrodes on the upper and lower major surfaces thereof. The electrodes and the exposed portions of the body of the transducer element are coated with an insulating lacquer and it is necessary to provide a pair of foil leads 46 and 47 having electrical contact with the electrodes of this transducer element.

The foil lead 46 is folded back on the lower major surface area of the transducer element 12 and is clamped between the same and the supporting rib 26. The rib 26 is provided with a counterbored aperture 48 adjacent the locating boss 30 and received within the aperture 48 is a shouldered and current conductive terminal pin 49. The enlarged upper end of the terminal pin 49 contacts the end of the foil lead 46 while the lower end thereof projects downwardly through the flat bottom surface 13 of the microphone casing.

The other foil lead 47 is folded upwardly over the upper major surface area of the transducer element 12. To secure the transducer element 12 in place, and to simultaneously make contact with the foil lead 47, there is provided a T-shaped leaf spring 51 which has its stem anchored on the terminal boss 34 by means of a headed and current conductive tubular rivet 52. The rivet 52 extends vertically through the terminal boss 34 and the flat bottom surface 13 of the microphone casing as is readily apparent.

The arms 53 and 54 of the leaf spring 51 overlie the supporting ribs 25 and 26 and each terminates in a dimpled end portion which gently but securely bears upon the side edges of the transducer element 12. It will be noted that the dimpled end of the arm 53 contacts the transducer element 12 at a point closely adjacent the terminal pin 49 while the foil lead 47 is clamped beneath the dimpled end of the arm 54. The forward end of the leaf spring 51 has a projection 55 and this projection is adapted to extend between the locating bosses 28 and 29. The arrangement is such that the locating bosses 28 and 29, along with the terminal boss 34 and tubular rivet 52, properly position the leaf spring 51 with respect to the microphone casing and the transducer element 12.

Adjacent the freely disposed corner of the transducer element 12 is a nose piece or coupling member 56 which is connected by a fillet of cement 57 to a properly formed acoustical diaphragm 58. The acoustical diaphragm 58 has its peripheral edge secured to the outwardly directed circumferential flange 15 of the microphone casing.

In the operation of the above described microphone, sound waves impinge against the acoustical diaphragm 58 which causes the nose piece or coupling member 56 to transmit twisting forces to the transducer element 12. The transducer element 12 converts these twisting forces into an electrical output which is conducted to suitable amplifying equipment, not shown. Electrical contact is made with the foil lead 46 by means of a terminal pin 48 while electrical contact is provided with the foil lead 47 through the arm 54 of the leaf spring 51 and the tubular rivet 52.

In the illustrated embodiments of the invention the microphone casing has been shown as fabricated, by molding, for example, from an insulating plastic or other material. In this manner the problem of providing electrical contact with the foil leads or the electrodes of the transducer element is greatly simplified because the current conductive terminal pin and a tubular rivet can be

mounted directly in the insulating microphone casing. However, the present invention also envisions fabricating the microphone casing from a curent conductive metal and this is advantageous where shielding of the transducer element from stray electric fields is required. When a current conductive microphone casing is employed the casing itself may serve as the means for effecting electrical contact with one of the electrodes of the transducer element. Thus, the shouldered terminal pin 36 or 43 may be eliminated and a lead attached to the flat bottom surface of the microphone casing to provide one output terminal. The leaf spring and tubular rivet can still be utilized to provide the other output terminal but it is, of course, necessary to insulate the tubular rivet, by a suitable insulating bushing, for example, from the microphone casing.

The microphone casing disclosed is adapted to mount either a bender or torque type transducer element by providing two groups of supporting ribs and locating bosses. Although this arrangement is preferred since the same microphone casing is adapted for use with both types of transducer elements, it is entirely possible to provide a microphone casing with only one of the groups of supporting ribs and locating bosses. Thus, if only bender type transducer elements are employed, then a microphone casing having only the first group of supporting ribs and locating bosses could be provided.

It should be apparent that the objects initially set forth have been accomplished. Although there has been disclosed certain preferred embodiments of the invention it should be understood that many changes may be made therein without departing from the clear teachings of the invention. Accordingly, reference should be had to the following appended claims in determining the true scope and intent of the invention.

I claim:

1. A microphone which comprises a casing, a pair of adjacent and vertically extending ribs projecting from said casing, a plurality of spaced locating bosses positioned along and extending vertically of said ribs, a piezoelectric transducer element, said transducer element having portions thereof overlying said ribs, said bosses locating ing said transducer element on said ribs, means for retaining said transducer element in position on said ribs, said transducer element having an unsupported portion, an acoustical diaphragm, and means interconnecting said acoustical diaphragm with said unsupported portion of said transducer element.

2. Apparatus according to claim 1 further comprising means to effect electrical contact with the opposite sides of said transducer element, and said last mentioned means comprising said means for retaining.

3. Apparatus according to claim 1 further comprising means to effect electrical contact with the opposite sides of said transducer element, and said last mentioned means comprising current conductive terminal means extending vertically through one of said ribs.

4. Apparatus according to claim 1 further characterized in that said ribs are disposed in spaced parallel relation, each of said ribs having a pair of said locating bosses positioned in spaced relation therealong, and said transducer element spanning said ribs with the side edges thereof being engaged by said bosses.

5. Apparatus according to claim 1 further characterized in that said ribs are disposed in normal relation with respect to each other, said locating bosses being disposed along the lengths of said ribs, said transducer element being generally rectangular, and two normally disposed edges of said transducer element resting on said ribs adjacent said bosses.

6. Apparatus according to claim 1 further characterized in that said means for retaining comprises a pressure applying spring arm, one end of said spring arm engaging said transducer element adjacent said ribs, and the other end of said spring arm being secured to said casing.

7. Apparatus according to claim 6 further comprising means to effect electrical contact with the opposite sides of said transducer element, said pressure applying spring arm being current conductive, and said means to effect electrical contact comprising said pressure applying spring arm.

8. A microphone which comprises a casing, a plurality of adjacent supporting ribs extending vertically from said casing, a piezoelectric transducer element disposed on said ribs, a pressure applying spring arm, said pressure applying spring arm having one portion attached to said casing, said pressure applying spring arm having another portion engaging said transducer element adjacent said ribs for retaining the same in proper position.

9. Apparatus according to claim 8 further comprising means to effect electrical contact with said transducer element, said spring arm being current conductive, and said means to effect electrical connection comprising said spring arm.

10. Apparatus according to claim 8 further characterized in that said another portion of said spring arm comprises a pair of projecting extensions, and said pair of projecting extensions engaging said transducer element at spaced points.

11. Apparatus according to claim 10 further characterized in that said ribs are disposed normally with respect to each other, said transducer element being generally rectangular, two adjacent and normally disposed side edges of said transducer element resting on said ribs, and said pair of extending projections engaging said transducer element along said two adjacent side edges.

12. A microphone which comprises a casing, a pair of adjacent supporting ribs extending vertically from said casing, a transducer element supported on said ribs, means for retaining said transducer element on said pair of ribs, means to effect electrical contact with the opposite sides of said transducer element, and said last mentioned means comprising current conductive means extending vertically through one of said ribs.

13. Apparatus according to claim 12 further characterized in that said means to effect electrical connection further comprises said means for retaining, and said means for retaining comprising a current conductive pressure applying spring member.

14. A microphone which comprises a casing having supporting ribs, a transducer element positioned on said ribs, a pressure applying member securing said transducer element to said ribs, and means for effecting electrical contact with the opposite sides of said transducer element.

15. Apparatus according to claim 14 further comprising a plurality of locating bosses disposed at spaced points along said ribs, and said locating bosses positioning said transducer element on said ribs.

No references cited.