June 19, 1956 H. F. OLSON ET AL 2,751,441

UNIDIRECTIONAL MICROPHONE

Filed March 2, 1953

Fig. 1.

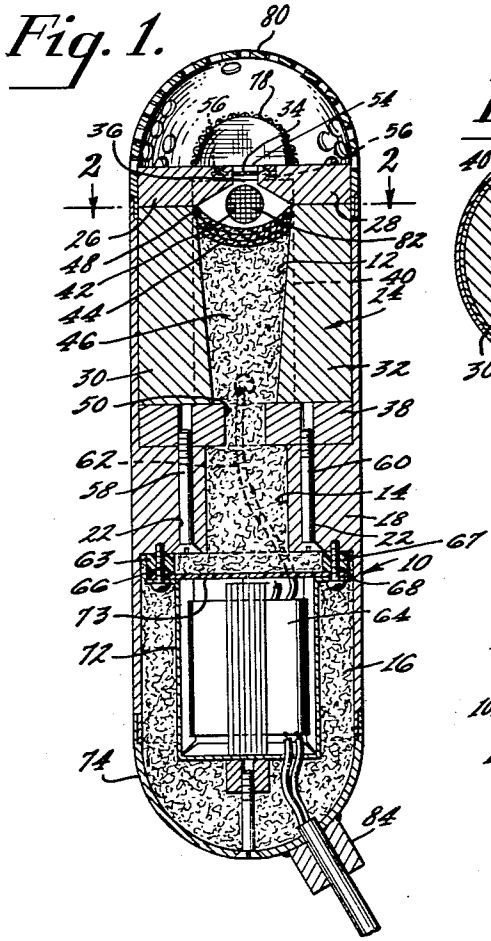


Fig. 2.

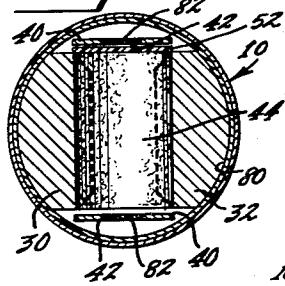
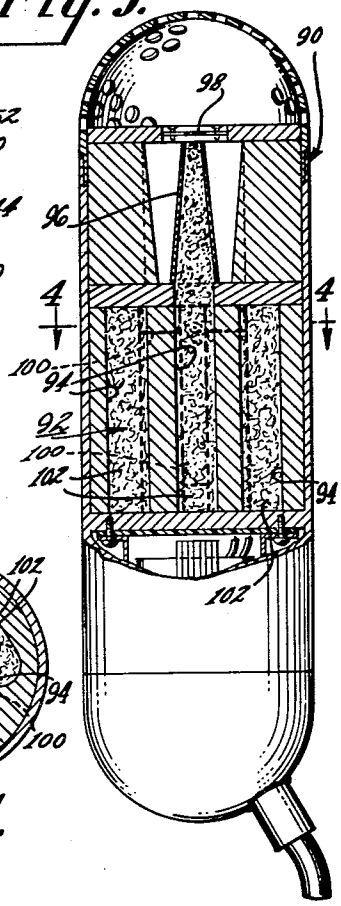


Fig. 3.



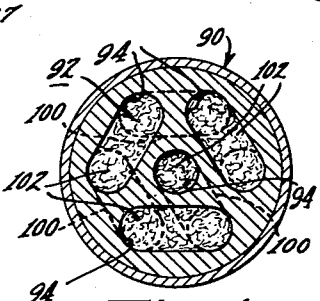


Fig. 4.

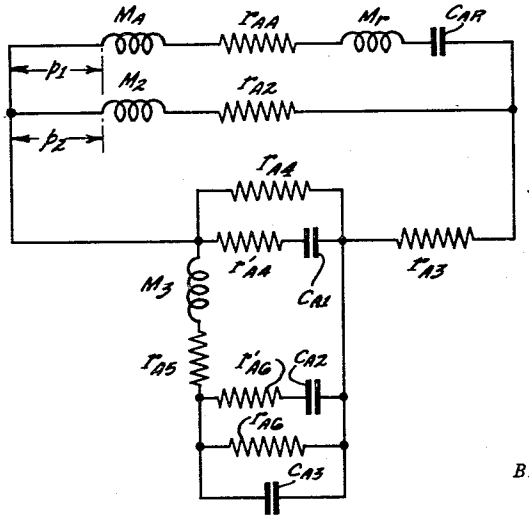


Fig. 5.

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UNIDIRECTIONAL MICROPHONE

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Application March 2, 1953, Serial No. 339,808

6 Claims. (Cl. 179—115.5)

This invention relates to sound translating apparatus, and, more particularly, although not necessarily exclusively, to a universal ribbon-type unidirectional microphone.

The acoustical resistance which is used in the conventional unidirectional microphone consists of a folded tube or pipe which is stuffed with tufts of hair felt. The folded pipe is thus made to be a labyrinth. Such a labyrinth is costly to manufacture because the holes which provide the labyrinth must be accurately drilled very close together. Then the holes must be joined by cutting slots between the holes so that when the top and bottom cover plates of the microphone are placed over the ends, there is a continuous folded pipe. The pipe is then stuffed with tufts of felt. The felt must be finely divided. Furthermore, the amount of felt required to obtain the correct value of acoustical resistance is extremely critical. During the process of manufacture, the felt is weighed. The stuffing is then divided so that the exact proportion is placed in each hole in the labyrinth.

It is, therefore, an object of this invention to provide simplified elements for a unidirectional microphone employing a ribbon as the vibrating element.

It is a further object of the invention to provide a universal low-cost microphone which is small, of lightweight construction and unobtrusive.

It is a still further object of the invention to provide a ribbon microphone with a single resistance substituted for the conventional damped labyrinth.

Still another object of the present invention is to provide a directional microphone with the most universal pattern—the cardioid.

In accordance with the present invention, a lumped acoustical resistance is placed behind the ribbon element of the microphone. Enough space is left so that the two apertures in the ribbon clamps can also feed into the space between the acoustical resistance and the ribbon. The ribbon clamps seal off the volume behind the ribbon except for the apertures in the clamps required to give the desired directional pattern.

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims, the invention itself, however, both as to its organization and method of operation as well as additional objects and advantages thereof, will be best understood from the following description of several embodiments thereof, when read in connection with the accompanying drawing, in which:

Fig. 1 is a view in sectional elevation of a microphone embodying the present invention;

Fig. 2 is a sectional view in plan of the microphone of Fig. 1, the section being taken along the line 2—2 of Fig. 1;

Fig. 3 is a view in section of an earlier type of labyrinth unidirectional microphone;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3; and

Fig. 5 is the electrical analogue of the acoustical circuit involved in the microphone illustrated by Fig. 1.

Referring more particularly to the drawing, there is shown in Fig. 1 a sectional view of a microphone embodying the present invention. The main body or case **10** of the microphone consists of a partially hollow metallic tube or cylinder comprising an upper cavity **12**, a central or middle cavity **14** and a lower cavity **16**, respectively, and including the midsection **18**. The midsection **18** is used as a seat and seal for the sound translating unit **24**. The sound translating unit **24** comprises two pole pieces **26** and **28**, two permanent magnets **30** and **32**, an aluminum ribbon **34**, located in the air gap **36** formed by the pole pieces, and a bottom plate **38**. The magnets **30** and **32** supply the flux to the air gap **36**. The upper cavity **12** lies between the pole pieces. A ribbon clamp **40** is attached to the exposed sides of the magnets **30** and **32** (Fig. 2) to seal the volume in back of the ribbon **34**, except for the apertures **42** in the clamps, which apertures are necessary to give the desired directional pattern. A lumped acoustical resistance, in the form of three layers of felt **44**, is placed in back of the ribbon **34** and is or may be arcuately disposed below the apertures **42**. Each felt layer in the illustrative example is one-sixteenth inch thick. The remaining volume in the upper cavity **12** in back of the ribbon **34** is packed with suitable acoustic damping material **46** such as loosely distributed hair felt, or the like. The felt **44** is cemented or otherwise secured to the area **48** formed by the juncture of the bottom surface of each of the pole pieces **26** and **28** and the two magnets **30** and **32**. The assembled sound translating unit **24** is seated upon and rigidly secured to the upper portion of the midsection **18** and is attached to the midsection through the medium of the bottom plate **38** of a proper diameter and having a large central hole **50** therein to accommodate, among other things, the ribbon leads. Fastening means such as bolts **58** and **60** pass through holes **22** and engage with the plate **38** to perform the securing function. One of the ribbon clamps is insulated from its associated magnet, as by means of a thin fiber strip **52** (Fig. 2). The aluminum ribbon **34** is clamped across the air gap formed by the pole pieces and is secured at each side thereof by means of two machine screws **54** and a top plate **56** at the top of each ribbon clamp, shown in dotted outline in Fig. 1. The large middle cavity or aperture **14** through the center of the midsection **18** and the hole **50** in the bottom plate **38** permits the associated ribbon leads, only one lead **62** of which is shown, to be brought from the ribbon clamps to the transformer **64**. The transformer **64** is provided with a shield comprising clamp member **72** and bottom member **73**. Two screws **66** and **68** and two fiber washers **63** and **67** secure the transformer **64** to the midsection **18**.

The aperture **14** through the midsection **18** gives access to the bottom of the microphone case **10** which increases the volume in back of the ribbon **34** and thus improves the low frequency response. A tapped hole **70** on the transformer clamp **72** provides means for holding the bottom cover **74** of the microphone in place by means of the screw **76**.

A single layer of silk (not shown) is glued over the tips of the pole pieces **26** and **28** to keep dust and chips out of the air gap **36**. A metallic screen **78** may be disposed over the ribbon assembly. A layer of silk is or may be fastened inside the perforated top cover or grill **80**. A wire screen **82** is placed over each of the apertures **42** in the ribbon clamps **40**. A fifty mesh copper screen was used in the illustrative embodiment shown in Fig. 1. A cable from the transformer is brought out through a fitting **84** on the bottom of the microphone case.

Fig. 2 is a view along the line 2—2 of Fig. 1 and shows

the relative disposition of the lumped acoustical resistance provided by the felt 44 behind the ribbon 34.

There is shown in Fig. 3 a labyrinth unidirectional microphone 90 of an earlier type. The relatively complicated labyrinth structure 92 with its alternate drilled out portions 94 and slotted interconnecting portions (not shown) is clearly illustrated. The connecting pipe 96 from the back side of the ribbon element 98 to the center portion of the labyrinth 92 is indicated in the drawing.

Fig. 4 of the drawing shows the alternate drilled out sections 94 and slotted portions 100 as they appear from above along the line 4—4 of Fig. 3. Each of the interconnected pipes and passages must be hand stuffed with the exact proportion of acoustical resistance in the form of felt or ozite tufts 102.

Fig. 5 is the electrical analogue of the acoustical circuit involved in the microphone in the present invention and is thought to be representative of the conditions prevailing in better understanding of the principles involved herein.

In that network,

M_A and r_{AA} are the inertance and acoustical resistance respectively of the air load upon the ribbon 34,

M_R and C_{AR} are the inertance and acoustical capacitance respectively of the ribbon 34,

M_2 and r_{A2} are the inertance and acoustical resistance of the aperture 42,

r_{A3} is the acoustical resistance of the resistive element 44 behind the ribbon 34,

C_{A1}, r_{A4} and r'_{A4} are, respectively, the acoustical capacitance and the series and shunt acoustical resistances of the first or upper cavity 12,

M_3 and r_{A5} are the inertance and acoustical resistance of the aperture 50 connecting the upper and middle cavities 12 and 14, respectively,

C_{A2}, r_{A6}, and r'_{A6} are the acoustical capacitance and the series and shunt acoustical resistances, respectively, of the middle cavity 14,

C_{A3} is the acoustical capacitance of the lower cavity 16,

p_1 is the sound pressure at the front of the ribbon 34,

p_2 is the sound pressure at the apertures 42 in the ribbon clamps 40.

The measured response frequency characteristics of an experimental microphone using the present invention has been shown to be flat within ±3 db from 170 to 11,000 cycles per second. Listening tests have indicated that it gives adequate performance for most applications. The weight of a microphone constructed in accordance with the invention is only 10 ounces.

There has thus been described a universal low-cost microphone which has been developed for such varied uses as public address systems, home recording and any application where an expendable, cheap microphone is desired. The invention involves a ribbon microphone with a single resistance substituted for the conventional damped labyrinth to give a unidirectional characteristic. It is economical to manufacture because the expensive operation of very accurately stuffing the labyrinth is eliminated.

What is claimed is:

1. In a microphone, the combination comprising means defining a magnetic field, a vibratory conductor mounted for vibration in said field, a pair of parallelly disposed magnetic members, means including said magnetic members defining a cavity adjacent said vibratory conductor, and a layer of fibrous material disposed adjacent said conductor to damp said conductor and said cavity.

2. In a unidirectional ribbon microphone, the combination comprising means defining a magnetic field, a vibratory ribbon member mounted for vibration in said field, a pair of parallelly disposed magnetic members, means including said magnetic members defining a cavity adjacent said ribbon, a fibrous layer arcuately disposed adjacent said ribbon to damp said ribbon and said cavity, and means providing a high order of directivity for said microphone.

3. In a unidirectional ribbon microphone including means defining a magnetic field, a ribbon element mounted for vibration in said field, a pair of parallelly disposed magnetic members, means including said magnetic members defining a cavity adjacent said ribbon element, an acoustical resistance further comprising three arcuately disposed layers of felt disposed adjacent said ribbon to damp said ribbon and said cavity, and means providing a high order of directivity for said microphone.

4. In a unidirectional ribbon microphone including means defining a magnetic field, a ribbon element mounted for vibration in said field, a pair of parallelly disposed magnetic members, means including said magnetic members defining a cavity adjacent said ribbon element, the improvement therein, of layers of fibrous material disposed adjacent said ribbon to form an acoustical resistance termination for said ribbon, and a cavity terminating said acoustical resistance, said cavity being filled with acoustical damping material.

5. A unidirectional ribbon type microphone comprising a magnetic field structure generally cylindrical in shape and including a spaced pair of substantially semi-cylindrical magnetic members and a pair of flat substantially semi-circular pole pieces positioned on one end of said magnetic members, said pole pieces defining an elongated air gap, a ribbon clamp disposed at each side of said spaced magnetic members, each ribbon clamp spanning the space between the adjacent sides of said members, said members and said clamps enclosing a cavity, an aperture in each ribbon clamp, a conductive vibratile member supported in said air gap by said ribbon clamps, and an arcuate member providing a lumped acoustical resistance adjacent said conductive vibratile member, said arcuate member lying to the side of each aperture in each ribbon clamp opposite said vibratile member.

6. A unidirectional ribbon type microphone comprising a magnetic field structure generally cylindrical in shape and including a spaced pair of substantially semi-cylindrical magnetic members and a pair of flat substantially semi-circular pole pieces positioned on one end of said magnetic members, said pole pieces defining an elongated air gap, a ribbon clamp disposed at each side of said spaced magnetic members, each ribbon clamp spanning the space between the adjacent sides of said members, said members and said clamps enclosing a cavity, an aperture in each ribbon clamp, a conductive vibratile member supported in said air gap by said ribbon clamps, an arcuate member providing a lumped acoustical resistance adjacent said conductive vibratile member, said arcuate member lying to the side of each aperture in each ribbon clamp opposite said vibratile member, and a filling of acoustical absorbing material in the space between said magnetic members to provide a terminating acoustical resistance located to the side of said arcuate member opposite said vibratile member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,566,094 Olson et al. ---------- Aug. 28, 1951