Jan. 30, 1973 D. F. HIESTAND 3,714,376

SHOCK RESISTANT SEMICONDUCTOR MICROPHONE HAVING MAGNETICALLY OPERATED OVERLOAD MECHANISM

Filed July 26, 1971

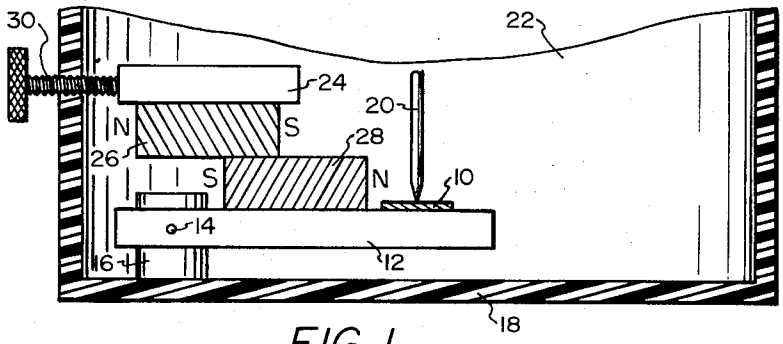


FIG. 1

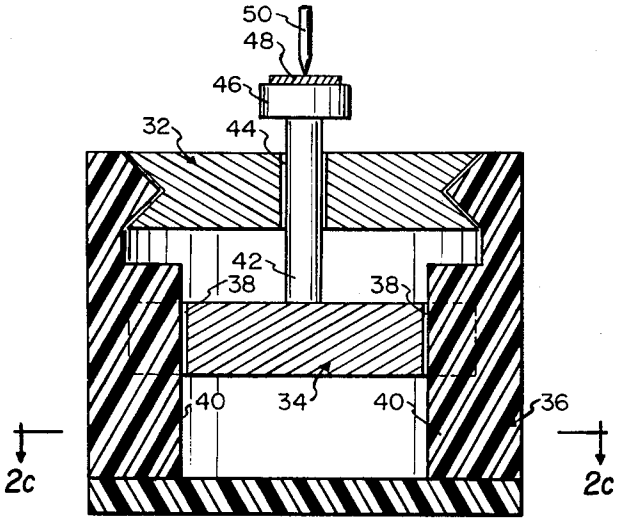


FIG. 2

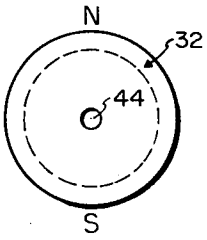


FIG. 2A

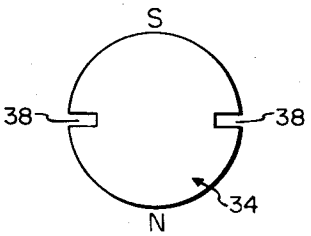


FIG. 2B

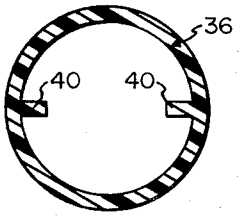


FIG. 2C

INVENTOR
DAVID F. HIESTAND

BY Robert Van Epps
ATTORNEY

United States Patent Office 3,714,376
Patented Jan. 30, 1973

3,714,376

SHOCK RESISTANT SEMICONDUCTOR MICROPHONE HAVING MAGNETICALLY OPERATED OVERLOAD MECHANISM

David F. Hiestand, Lombard, Ill., assignor to GTE Automatic Electric Laboratories Incorporated, Northlake, Ill.

Filed July 26, 1971, Ser. No. 166,175
Int. Cl. H04r 23/00
U.S. Cl. 179—110 B 2 Claims

ABSTRACT OF THE DISCLOSURE

An electroacoustic transducer of the stressed semiconductor type wherein the stressing member or semiconductor is mounted on a first member which is magnetically coupled with a selected breakaway force to a fixed mounting member. Overload stress overcomes the magnetic coupling thereby permitting the stressing member and semiconductor element to separate and thus prevent mechanical damage to the transducer.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates generally to the field of electroacoustic transducers and more particularly to a stressed semiconductor microphone having a magnetic stress overload protection means.

Description of the prior art

The advantages of semiconductor elements as electroacoustic transducers have been recognized for many years. In the typical arrangement a PN junction and a stressing member are mounted in mechanical contact with one another such that acoustic energy varies the stress on the junction and converts the acoustic energy to electrical energy. Generally the semiconductor junction is disposed on a fixed mounting and the stressing member is affixed to a microphone diaphragm, however, the reverse arrangement is also known. The problem which attends the use of the stressed semiconductor microphone has been the fragility of the semiconductor elements which leaves the microphone sensitive to mechanical damage when subjected to rough handling as in the common telephone handset.

Prior to the present invention the shock damage susceptibility of the stressed semiconductor microphone was recognized and attempts were made to alleviate this problem. One such shock-resistant microphone is described in U.S. Patent No. 3,440,363 which issued to H. J. Boll on Apr. 22, 1969. That patent describes a semiconductor microphone of the cantilever type wherein the semiconductor is mounted in a bar member and is indirectly stressed through application of deflection forces to one end of the bar member. The bar member has a double fulcrum and is retained against the fulcrum pivot points by a spring member such that on the application of shock overloads the bar member mechanically pivots at the spring end rather than bending excessively. While the overload protection provided by the apparatus disclosed in the referenced patent may be satisfactory in certain applications it is of a fixed or non-adjustable nature, i.e. the spring force and thus the overload level necessary to call the protective feature into play may not be adjusted to meet varying environmental or handling conditions.

OBJECTS AND SUMMARY OF THE INVENTION

From the foregoing it will be understood that among

the various objectives of the present invention are included:

The provision of a new and novel shock-resistant semiconductor microphone;

The provision of apparatus of the above-described character wherein the level of shock overload protection may be adjusted; and

The provision of apparatus of the above-described character wherein shock overload protection is provided by a variable magnetic coupling between the semiconductor and stressing member of the microphone.

These and other objectives of the present invention are efficiently achieved by mounting either the semiconductor element or the stressing member on a movable member which is magnetically coupled with an adjustable breakaway force to a supporting member. On the application of an overload stress to the microphone the magnetic attraction is overcome and the movable member is permitted to move away from its supporting member thus separating the semiconductor element from the stressing member and precluding physical damage to the semiconductor element.

The foregoing as well as other objects, features and advantages of the present invention will become more apparent from the following detailed description taken in conjunction with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of a first embodiment of a shock-resistant semiconductor microphone constructed in accordance with the principles of the present invention;

FIG. 2 is a schematic cross-sectional view of an alternative embodiment of the present invention;

FIGS. 2A and 2B schematically illustrate a top view of the magnetic elements of the embodiment of FIG. 2; and

FIG. 2C is a schematic top view of the base member of the embodiment of FIG. 2.

DESCRIPTION OF PREFERRED EMBODIMENTS

Turning now to FIG. 1 there is illustrated a shock-resistant semiconductor microphone in accordance with the present invention. A stress-sensitive semiconductor element **10** is mounted on a member **12** which is movable in rotation about a pivot point **14** and mounted on a post **16** affixed to the microphone outer case **18**. A stressing member **20** is affixed to any suitable means for converting acoustic to mechanical energy such as the diaphragm **22** illustrated. A supporting member **24** is disposed above the movable member **12** and has a first permanent magnet **26** fixed thereto. The movable member **12** is provided with a second permanent magnet **28** disposed with its polarity reversed with respect to magnet **26**. The first magnet **26** is axially movable with respect to the second magnet **28** by means of an adjustment screw **30** threaded through the outer case **18**. In this fashion the magnetic attraction between magnets **26** and **28** may be varied such that the level of overload stress necessary to overcome the magnetic coupling may be selected in accordance with the handling to which the microphone may be subjected. When an overload stress above the selected level is placed on the microphone the magnetic coupling is overcome and the movable member **12** rotates downward about the pivot point **14** thus carrying the semiconductor element **10** out of contact with the stressing member **20**. Thus the semiconductor element is efficiently protected from damage by stress overloads.

With reference now to FIGS 2 through 2C there are schematically illustrated several views of an alternative embodiment of the present invention. In this embodiment first and second magnets, **32** and **34** are disposed in a correspondingly shaped outer case **36**. Magnet **32** is

shaped at its circumference to mate with and be longitudinally fixed with respect to the case **36** but free to rotate about the longitudinal axis of the microphone. The second magnet **34** is basically disc shaped but has a peripheral notch or notches **38** formed therein which are adapted to mate with correspondingly shaped members **40** disposed on the interior of the microphone case **36**. Thus the second magnet **34** is longitudinally movable within the case **36** but is constrained in rotation. The second magnet **34** is provided with a centrally disposed post **42** which is adapted to pass through a central aperture **44** in the first magnet **32**. The top of the post **42** is provided with a mounting plate **46** upon which a stress sensitive semiconductor element **48** may be disposed. A stressing member **50** carried by a suitable acoustic-to-mechanical energy conversion means (not shown) contacts the semiconductor element **48** in the usual manner since the magnetic attraction between magnets **32** and **34** tend to maintain this relationship. The degree of magnetic attraction is easily adjusted through rotation of magnet **32** with respect to rotationally constrained magnet **34** to any selected level. When a stress overload in excess of the selected level is applied to the microphone of FIG. 2 the magnetic attraction between magnets **32** and **34** is overcome and magnet **34** bearing the semiconductor element **48** moves axially downward thereby precluding shock induced damage.

It will thus be seen that the applicant has provided an improved shock-resistant semiconductor microphone wherein the objectives set forth hereinabove are efficiently achieved. Since certain changes in the above-described contruction will occur to those skilled in the art without departure from the scope of the invention it is intended that all matter contained in the foregoing description or shown in the various views of the appended drawing shall be interpreted as illustrative and not in a limiting sense.

Having described what is new and novel and desired to secure by Letters Patent, what is claimed is:

1. An improved stressed-semiconductor microphone comprising

a microphone housing,

a first magnetic member axially fixed with respect to said housing, and having an axial aperture disposed therein,

a second magnetic member axially movable with respect to said housing,

a mounting member disposed on said second magnetic member, in axial alignment with and extending through said aperture in said first magnetic member,

a stress-sensitive semiconductor element disposed on said mounting member,

means for applying a variable stress to said semiconductor element in response to the impingement of acoustic energy on said microphone,

the magnetic attraction between said first and second magnetic members being preselected to maintain said semiconductor element in contact with said stress applying means with a preselected breakaway force such that the application of overload stress to said microphone in excess of said preselected breakaway force overcome said magnetic attraction and moves said semiconductor element away from said stress applying means.

2. Apparatus as recited in claim **1** wherein

said first magnetic member is rotatably movable with respect to said housing, and

said second magnetic member is fixed in rotation with respect to said housing,

whereby the magnetic attraction between said first and second magnetic members is adjustable through rotation of said first magnetic member.

References Cited

UNITED STATES PATENTS

3,440,363	4/1969	Boll	317—235 M
3,404,243	10/1968	Krieger et al.	179—110 B

KATHLEEN H. CLAFFY, Primary Examiner

T. L. KUNDERT, Assistant Examiner

U.S. Cl. X.R.

317—235 M