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Schenkel

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[54] **METHOD OF MANUFACTURING A DEVICE FOR CONVERTING ELECTRIC OSCILLATIONS INTO ACOUSTIC VIBRATIONS AND VICE VERSA**

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[51] **Int. Cl.** **H04r 31/00**

[58] **Field of Search** ..... 29/594; 179/114 R, 115 R

[56] **References Cited**

UNITED STATES PATENTS

1,815,194	7/1931	Duncan	179/114 R
2,820,107	1/1958	Knauert	179/115 R
3,491,436	1/1970	Carlson	29/594

FOREIGN PATENTS OR APPLICATIONS

248,118	1/1948	Switzerland	174/115 R
564,701	1/1924	France	179/115 R
277,066	8/1951	Switzerland	179/114 R
932,276	7/1963	Great Britain	179/115 R
680,259	4/1930	France	179/115 R

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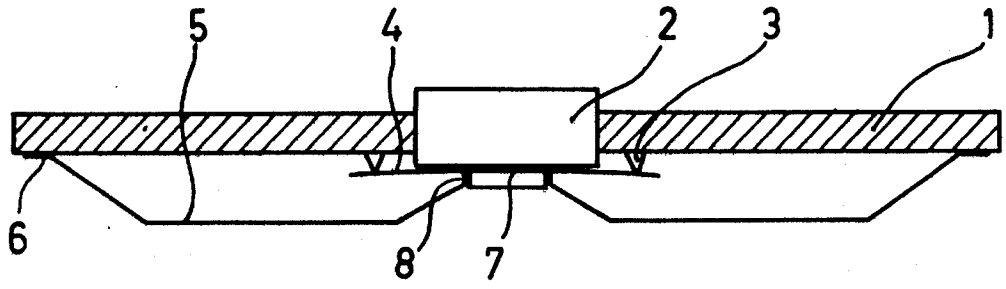
[57] **ABSTRACT**

A method of manufacturing a device for converting electric oscillations into acoustic vibrations and vice versa, preferably a microphone, in which method first the drive system is rigidly secured to a support and then the magnetic and non-magnetic diaphragms are mounted in place, the latter diaphragm being secured to an axial cylindrical guide member. The guide member may form part of the magnetic diaphragm or be the rim of the support. In the first case the guide member is in the form of a disk or a pin.

13 Claims, 3 Drawing Figures



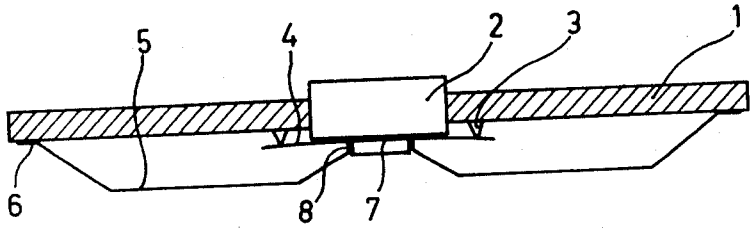


Fig.1

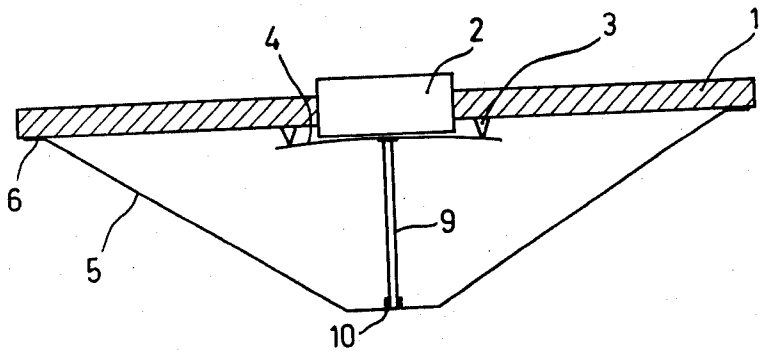


Fig.2

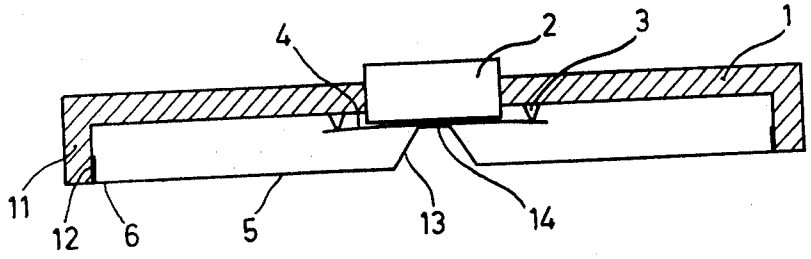


Fig.3

METHOD OF MANUFACTURING A DEVICE FOR CONVERTING ELECTRIC OSCILLATIONS INTO ACOUSTIC VIBRATIONS AND VICE VERSA

The invention relates to a method of manufacturing a device for converting electric oscillations into acoustic vibrations and vice versa and provided with a non-magnetic diaphragm which is joined both to the magnetic diaphragm of an electromagnetic drive system and to a support.

Such a device in the form of a microphone is described in Austrian Pat. No. 271,592.

Manufacture of this known microphone starts from an assembly comprising the support and the non-magnetic diaphragm, the drive system being arranged so as to be freely movable in a hole in the support and being secured thereto after free alignment. Although in this method the influence of the tolerances of the various components is greatly reduced in manufacture by mass-production methods, it has been found that in many devices there is a certain amount of initial tension in the non-magnetic diaphragm. As used herein, the term "diaphragm" refers to a thin flexible plate capable of vibrating in accordance with sound waves and with sufficient amplitude to produce a useful electric signal in a winding of the electro-magnetic drive system.

The invention is characterized in that first the drive system is rigidly secured to the support so as to form an integral unit and subsequently at least part of the non-magnetic diaphragm is disposed in an axial cylindrical guide member with a certain amount of clearance and then is secured to this guide member.

A large number of investigations have shown that this method enables microphones to be manufactured in which the troublesome initial tension in the non-magnetic diaphragm is eliminated at least substantially.

A modified embodiment of the method according to the invention is characterized in that before the non-magnetic diaphragm is mounted in place, the magnetic diaphragm provided with the guide member is placed on a supporting rim on the assembly.

Another modified embodiment of the method according to the invention is characterized in that before the non-magnetic diaphragm is mounted in place it is joined to the magnetic diaphragm to form a rigid integral unit, while during the mounting of the non-magnetic diaphragm the magnetic diaphragm is placed on a supporting rim on the assembly.

The non-magnetic diaphragm is preferably joined to the guide member by means of an adhesive, for example, a glue.

The method according to the invention enables a device for converting electric oscillations into acoustic vibrations and vice versa, for example, a microphone, to be manufactured which is provided with a magnetic diaphragm and a non-magnetic diaphragm which are secured to one another. The non-magnetic diaphragm is secured in a guide member with a certain amount of clearance and also connected to an assembly comprising a support and a drive system co-operating with the magnetic diaphragm.

The guide member may be provided on the assembly at different locations.

In an embodiment of a device according to the invention the guide member is a cylindrical projection on that surface of the magnetic diaphragm which is more remote from the drive system, the guide being surrounded by an annular rim of the non-magnetic diaphragm.

The said projection may take the form of a pin or of a disk.

Another embodiment of a device according to the invention is characterized in that the guide member is the inner surface of a projecting rim of the support which surrounds the annular outer rim of the non-magnetic diaphragm.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

FIG. 1 shows a microphone which is manufactured by the method according to the invention and in which the non-magnetic diaphragm is directly secured to a disk-shaped guide member provided on the magnetic diaphragm,

FIG. 2 is a modified embodiment of such a microphone in which the guide member takes the form of a pin, and

FIG. 3 shows a microphone which is manufactured by the method according to the invention and in which the non-magnetic diaphragm is directly secured to the rim of the support.

The figures are schematic cross-sectional views of microphone cartridges intended to be built into telephone handsets. They are drawn to about twice the actual size.

The microphones shown in the figures have a support **1** in which a magnetic drive system **2** is secured so that the two components form an integral unit.

The support **1** is provided with a supporting rim **3** on which rests a magnetic diaphragm **4.**

The magnetic diaphragm is made of sheet steel and co-operates magnetically with the poles (not shown) of the magnetic circuit of the drive system. The magnetic diaphragm **4** is joined to a non-magnetic diaphragm **5** which is made of aluminium and has an edge **6** secured to the support **1.**

In the microphone shown in FIG. **1** the magnetic diaphragm **4** is provided on its concave surface — that is the surface remote from the drive system **2** — with a disk-shaped projection **7** which serves as a guide member for, and fits with a certain amount of clearance in, a cylindrical rim **8** of the non-magnetic diaphragm **5.**

In the microphone shown in FIG. **2** the magnetic diaphragm is connected to a tubular central portion **10** of the non-magnetic diaphragm **5** by means of a pin **9.** In this microphone the non-magnetic diaphragm **5** takes the form of a truncated cone.

The microphone shown in FIG. **3** has a support **1** provided with a bent-over rim **11** to the inner surface of which a rim **12,** which is also bent over but in the opposite direction, of a plane non-magnetic diaphragm **5** is secured. A central portion **13** of the non-magnetic diaphragm **5** projects towards the drive system **2** and has a flat portion **14** which is rigidly secured to the magnetic diaphragm **4.** The joints between the support **1** and the rims **6** (FIG. **2**) and **12** (FIG. **3**) of the non-magnetic diaphragm **5** are glued joints.

In the embodiment shown in FIG. **1** the components **7** and **8,** and in that shown in FIG. **2** the components **9** and **10,** are joined to one another by glue.

The joints between the pin **9** and the magnetic diaphragm **4** (FIG. **2**) and between the flat central portion **14** and the magnetic diaphragm **4** (FIG. **3**) are rigid spot-welded joints.

The microphones are assembled in the following manner. In all the embodiments manufacture starts from an assembly which comprises the support **1** to which the drive system **2** is rigidly secured. In the embodiments shown in FIGS. **1** and **2** the magnetic diaphragm **4** is then placed on the supporting rim **3.** Then the non-magnetic diaphragm **5** is placed on the magnetic diaphragm **4** and the support **1.** The cylindrical rim **8** is slipped on the disk-shaped projection **7** (FIG. **1**), as is the rim **10** on the pin **9** (FIG. **2**). After the rim **6** has been glued to the support **1** the joints **7–8** or **9–10** respectively is made by gluing.

The microphone shown in FIG. **3** is assembled in a slightly different manner. The magnetic diaphragm **4** at its centre is rigidly connected to the conical central portion **14** of the non-magnetic diaphragm **4.**

The resulting assembly is slipped in the rim **11** of the support **1,** which rim serves as a guide member, until the magnetic diaphragm **4** abuts the supporting rim **3.** Then the bent-over rim **12** is glued to the inner surface of the rim **11.**

What is claimed is:

1. A method of fabricating an electromagnetic sound transducer device provided with a non-magnetic vibratory diaphragm member joined to a magnetic diaphragm of an electromagnetic drive system for transmitting vibrations therebetween and to a support member, comprising the steps of first rigidly securing the drive system to the support member so as to form an integral assembly unit, subsequently placing at least part of the non-magnetic diaphragm member in axial alignment with an axial cylindrical guide member so that one of said aligned member is disposed with a certain amount of clearance in the other aligned member, and then securing said non-magnetic diaphragm to the guide member.

2. A method as claimed in claim **1** wherein said guide member is secured to the magnetic diaphragm and comprising the further step of placing the magnetic diaphragm on a supporting rim on the assembly unit before the non-magnetic diaphragm is placed in alignment with the guide member.

3. A method as claimed in claim **1** comprising the further step of adhering the outer periphery of the non-magnetic diaphragm to the support member prior to the step of securing said non-magnetic diaphragm to the guide member and subsequent to the step wherein said non-magnetic diaphragm is placed in alignment with the guide member.

4. A method as claimed in claim **3** wherein said non-magnetic diaphragm is secured to the guide member in coaxial alignment therewith by means of an adhesive material.

5. A method as claimed in claim **1** wherein the assembly unit includes a supporting rim and comprising the further step of joining the non-magnetic diaphragm to the magnetic diaphragm to form an integral unit before the non-magnetic diaphragm is placed in alignment with the guide member.

6. A method as claimed in claim **5** wherein the step of securing the non-magnetic diaphragm to the guide member comprises the step of adhering the outer periphery of the non-magnetic diaphragm to the support member.

7. A method as claimed in claim **5** wherein the non-magnetic diaphragm is formed with an annular peripheral rim and the support member is formed with an annular peripheral rim that serves as the guide member and wherein the step of securing the non-magnetic diaphragm to the guide member comprises the step of adhering the outer rim of the non-magnetic diaphragm to the inside surface of the rim of the support member.

8. A method of fabricating an electromagnetic sound transducer having a non-magnetic vibratory diaphragm member joined to a magnetic diaphragm of an electromagnetic drive system comprising the steps of securing the drive system to a support member so as to form an integral unit, placing the non-magnetic diaphragm member in axial alignment with an axially extending guide member so that one of said aligned members is disposed at least partly within the other aligned member with a given clearance therebetween sufficient to substantially eliminate the formation of any initial tension in the non-magnetic diaphragm, and fastening the non-magnetic diaphragm to the guide member.

9. A method as claimed in claim **8** comprising the further step of securing the guide member to the magnetic diaphragm before said alignment step, and adhering the outer periphery of the non-magnetic diaphragm to the support member prior to the step of securing said non-magnetic diaphragm to the guide member and subsequent to the step wherein said non-magnetic diaphragm is placed in alignment with the guide member.

10. A method as claimed in claim **8** comprising the further step of securing the non-magnetic diaphragm to the magnetic diaphragm to form a second integral unit before the non-magnetic diaphragm is placed in alignment with the guide member and wherein the step of securing the non-magnetic diaphragm to the guide member comprises the step of adhering the outer periphery of the non-magnetic diaphragm to an annular rim on the support member.

11. A method as claimed in claim **8** further comprising the step of securing the outer periphery of the non-magnetic diaphragm to the support member subsequent to the alignment step and prior to the fastening step.

12. A method as claimed in claim **8** further comprising the steps of securing the guide member to the magnetic diaphragm before said alignment step, next mounting the magnetic diaphragm in cooperative relationship to the drive system, and securing the outer periphery of the non-magnetic diaphragm to the support member between the alignment step and the fastening step.

13. A method as claimed in claim **10** wherein the alignment step comprises the step of inserting the second integral unit within the rim on the support member until the magnetic diaphragm abuts a part of the support member.

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