June 4, 1940. W. DITSCHE 2,203,428

METHOD OF COUPLING A SOUND GENERATING SYSTEM TO A SOUND GENERATING DIAPHRAGM

Filed Dec. 19, 1935 2 Sheets-Sheet 1

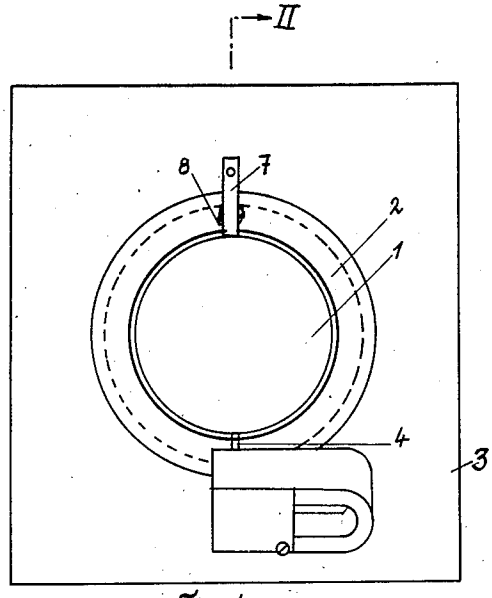

Fig. 1.

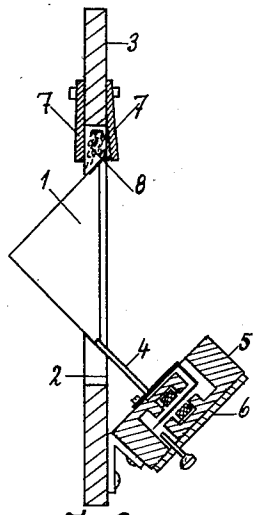

Fig. 2.

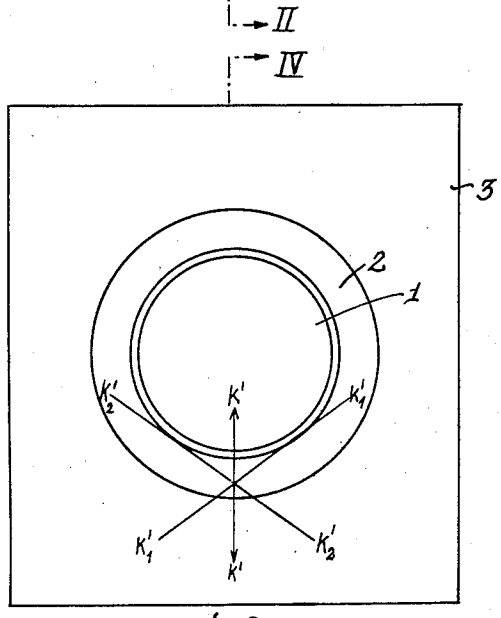

Fig. 3.

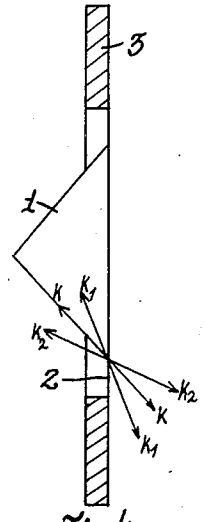

Fig. 4.

INVENTOR
WALTER DITSCHE
BY Richards & Geier
ATTORNEYS

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Filed Dec. 19, 1935 2 Sheets-Sheet 2

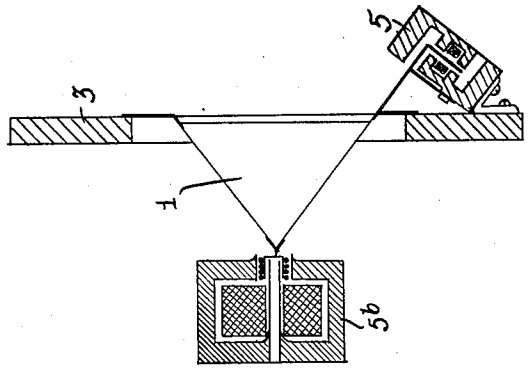

Fig.7.

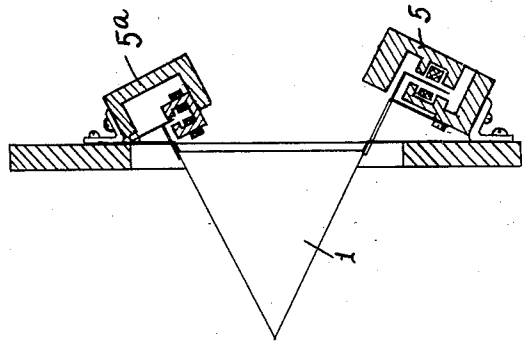

Fig.6.

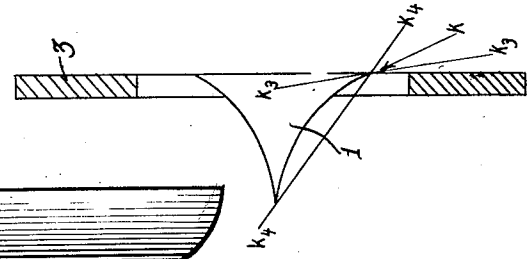

Fig.5.

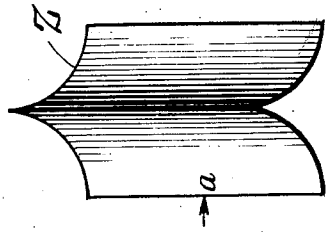

Fig.8

INVENTOR
WALTER DITSCHE
BY Richards & Geier
ATTORNEYS

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METHOD OF COUPLING A SOUND GENERATING SYSTEM TO A SOUND GENERATING DIAPHRAGM

Walter Ditsche, Wesermunde, Germany, assignor of one-half to Leon Ladislaus von Kramolin, Berlin-Kladow, Germany

Application December 19, 1935, Serial No. 55,154
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2 Claims. (Cl. 181—31)

The present invention relates to a method of coupling a sound generating system to a sound generating diaphragm, wherein use in made of a newly discovered phenomenon.

The objects of the present invention will appear from the following detailed description when taken in connection with the accompanying drawings showing by way of example preferred embodiments of the inventive idea.

In the drawings:

Figure 1 shows in font elevation a device constructed in accordance with the principles of the present invention;

Figure 2 is a vertical section through the device shown in Figure 1 along the line 2—2 of Figure 1;

Figure 3 is a diagram similar to Figure 1 and shows the device without the actuating means; it illustrates the distribution of forces acting upon the device;

Figure 4 is a section along the line IV—IV of Figure 3;

Figure 5 shows in vertical section a cone through the use of which particularly favorable results may be obtained;

Figure 6 shows in vertical section a device wherein two transducers are employed; and

Figure 7 shows in vertical section a device wherein central excitation is combined with peripheral excitation.

Figure 8 is a diagram showing a different form of diaphragm.

Similar parts are designated with the same numerals in all the figures.

The discovered phenomenon consists in that if for instance, a standard loud speaker (such as the one shown in the patent to Blattner No. 1,965,405) is excited from the edge instead of the apex, then for certain directions of the exciting forces, effects are obtained which were hitherto unknown. These effects become particularly evident if the cone is truncated up to about halfway, or even further, from the apex and the exciting force is then again caused to act from the periphery. These effects consist in that if the direction of the force is approximately through the virtual apex, i. e., in the direction k—k in Fig. 4, the sound appears surprisingly to come from the centre of the truncated cone, that is, from the virtual apex. This effect becomes more evident if the force be allowed to oscillate about the position k—k of Fig. 4, for example, first in the direction k_1—k_1, then in the direction k—k, then in the direction k_2—k_2 and then back again. In non-linearly tapering cones such as that shown in Fig. 5 of the accompanying drawings the preferred direction described lies between the direction of the tangent to the diaphragm at the point of excitation and the direction from the point of excitation to the apex, i. e., in Fig. 5, between k_3—k_3 and k_4—k_4. In the case of wedge-shaped diaphragms, the direction is perpendicular to the apex edge.

As experiments show, however, the method of excitation indicated also has other considerable advantages; one of them is that, even the highest sounds are surprisingly well reproduced, even on excitation with a normal electro-magnetic actuating unit, because there is no substantial resonance, although, of course, an electro-dynamic or any other actuating unit may be used such as an electrostatic, piezo-electric or other actuating unit. In this case, the sound volume appears to be undiminished. For radiation free from distortion, of course, a suitable size of baffle board or housing is necessary.

The reduction of resonance is remarkable. It must be assumed to be probable that, in view of the good reproduction, the above described localisation of the sound at the cone centre, which is not directly excited per se, is also important.

Experiments show that, notwithstanding the non-central excitation, the suspension of the peripherally excited cones can be effected in the hitherto usual manner, for instance, by means of strips of cloth 2 (Figs. 1 and 2) at the base. If the cone is not truncated, however, the apex may also be resiliently mounted. As further experiments have shown, however, if a peripherally excited system is fixed, for instance, in a baffle board, the latter must not be brought too close, for instance, to a wall at its rear. If this were done the reproduced frequency spectrum would decrease in width to an extent clearly audible. The minimum of the distance can easily be found by experiment and it is advisable to prevent non-observance of this limit by enclosure in a suitable housing. This housing may possibly serve also to accommodate a receiver and low-frequency amplifier.

Various embodiments of the invention are illustrated in the Figs. 1 to 7 of the accompanying drawings, Figs. 1 and 2 show the above described embodiments in elevation and section. The further advantage is clearly apparent, that the exciting movement may be mounted very simply. In the figures, 1 is the cone, 2 a leather or cloth strip or the like to which the cone is attached so as to vibrate freely, 3 a baffle board, 4 the driving pin of an electro-magnetic transducer

5, 6. 8 is a padding made of wool and cotton, which preferably produces a braking effect at the point situated opposite the driving point. The cotton and wool padding is held by the metal clamps 7. In view of this braking effect, if the system resistance is to be adjusted to the amplified tube circuit, i. e., the generating circuit which supplies the system with the energy which is to be transformed into sound, the low pitched sounds are clearly audibly amplified without any audible weakening of the high pitched sounds occurring. Instead of the cotton and wool padding 8 for braking purposes as shown in Figure 2, a further transducer 5a may be provided, as is shown by way of example in Fig. 6, which illustrates a device similar in other respects to that shown in Fig. 2.

Care should be taken in regard to the phase of the second transducer with respect to the first. In this case, it is preferable to allot to the two transducers different resonance levels (i. e., low sounds for one transducer, high sounds for another transducer). In general, several transducers may be arranged at the periphery of the diaphragm or, alternatively, central excitation may be combined with peripheral excitation as is shown in Fig. 7, illustrating a device comprising two transducers 5 and 5b. The force direction in which the transducer acts is to correspond approximately to the direction shown in the figures hitherto described, but departures from this direction in two vertical planes are also possible, as is illustrated in Figure 3 by the limiting directions k_1'—k_1' and k_2'—k_2', and in Fig. 4, by the limiting directions k_1—k_1, and k_2—k_2. Particularly favourable results are also furnished by a cone constructed in the fashion of Fig. 5, limiting force directions of the transducer being indicated by the directions k_3—k_3 and k_4—$_4$ shown in the drawings. The individual possibilities discussed here may, of course, be combined together, for example, the actuating units of Figure 7 may be combined with several peripheral actuating units shown in Figure 6.

Excitation approximately in the direction of the tangent to the diaphragm may also be of advantage, for instance, for the excitation of a quarter-cylindrical surface from the longitudinal edge, particularly if the excitation proceeds from both longitudinal edges. This latter case, however, may also be regarded again as a wedge, the width of the opening of which does not increase linearly. Figure 8 shows a diaphragm Z consisting of two quarter-cylindrical surfaces, one surface of which is shown actuated approximately in the direction of the tangent to the longitudinal edge as indicated at *a*.

I claim:

1. A device having a sound generating diaphragm, means transmitting an exciting force from a sound generating system to the sound generating diaphragm, and sound-absorbing flexible means from which said diaphragm is suspended, said device being characterized in that said diaphragm in shape is a geometrical figure having a base and side surfaces which converge toward one single point and in that the first-mentioned means are connected to an edge constituting a part of the base of said diaphragm and transmit said force along one of said side surfaces toward said point, the second-mentioned means being also connected to said base.

2. A device having a sound generating diaphragm, means transmitting an exciting force from a sound generating system to the sound generating diaphragm, and a sound-proof support for said means and said diaphragm, said device being characterized in that said diaphragm in shape is a geometrical figure having a base and side surfaces which converge toward one single point and in that the first-mentioned means are connected to an edge constituting a part of the base of said diaphragm and transmit said force along one of said side surfaces toward said point.

WALTER DITSCHE.