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MEANS FOR DAMPING VIBRATORY STRUCTURES OF VIBRATION APPARATUS

Filed Oct. 22, 1923

Fig. 1.

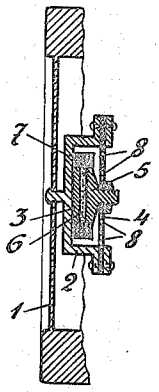


Fig. 2.

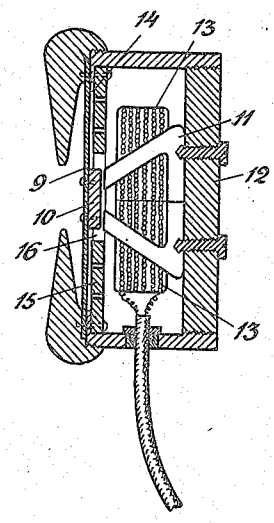
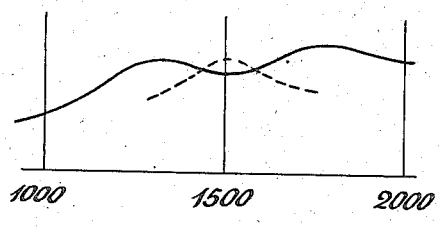


Fig. 3.



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UNITED STATES PATENT OFFICE.

HEINRICH HECHT, HUGO LICHTE, AND BERNHARD NIELSEN, OF KIEL, GERMANY, ASSIGNORS TO SIGNAL GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, OF KIEL, GERMANY.

MEANS FOR DAMPING VIBRATORY STRUCTURES OF VIBRATION APPARATUS.

Application filed October 22, 1923. Serial No. 670,017.

To all whom it may concern:

Be it known that we, HEINRICH HECHT, HUGO LICHTE, and BERNHARD NIELSEN, citizens of the German Republic, and residing at Kiel, Germany, Province of Schleswig-Holstein, State of Prussia, have invented certain new and useful Improvements in Means for Damping Vibratory Structures of Vibration Apparatus, of which the following is a specification.

It has been proposed to damp the motions of vibratory structures of acoustic apparatus by causing the size of chambers filled with fluid and adjacent to said structures to be altered by the vibratory motions of these structures and allowing the fluid in the chambers to flow through narrow openings in their walls. The consumption of energy required for the damping effect is caused by the passage of the fluid medium through the said openings.

It has also been proposed to make these chambers very low or flat in order to increase the damping effect.

In practical apparatus it has been found that to obtain a good damping effect these chambers have to be so very flat or shallow that their construction is very difficult.

In accordance with the invention these chambers, instead of being made so extremely shallow, are tuned to the frequency of the vibratory structures to be damped. The degree and nature of the effect thus accomplished is the same. The tuning results in the medium flowing through the narrow openings as violently as if very shallow chambers were employed.

The invention is illustrated in the drawing in which—

Fig. 1 is a cross section of a sound receiver fitted with a microphone and a tuned damping chamber,

Fig. 2 is a section of an electromagnetic sound apparatus (telephone receiver) with a tuned damping chamber which may be used both for sending and receiving, and

Fig. 3 is a graph showing the frequencies of resonance of an apparatus according to the invention.

The apparatus of Fig. 1 is provided with a diaphragm sound radiator to which is attached a microphone comprising a casing 2, an electrode 3 connected thereto, a freely vibrating electrode 5 connected through the elastic member or diaphragm 4 to the casing 2. Disposed between the electrodes in a known manner is a filling of carbon 6 which is prevented from falling out by a soft packing ring 7. The damping chamber is formed by the space in the casing 2 closed by the diaphragm 4. There are small openings 8 in the diaphragm 4. These openings and the damping chamber itself are of such size as to result in the damping chamber being tuned to the frequency of the vibratory structure (microphone) so that the chamber acts as a resonator and when the structure is excited at the frequency of resonance a correspondingly strong damping effect is produced by the volume of air that passes through the small openings 8.

In Fig. 2 the vibratory structure itself is composed of a diaphragm (sound radiator) 9 with an armature 10. Opposite the armature is a permanent magnet 11 fixed to the back 12 of the casing which envelops the apparatus. The coils 13 receive or deliver alternating current. The subject of this invention consists more particularly in the narrow space 14 located at one side by the inner surface of the diaphragm, bounded at the other side by the rigid wall 15, and containing air. The fluid passage in which the damping action takes place is the circular air gap 16 between the armature 10 and the inner edge of the wall or plate 15 which has the shape of a disk with a central hole. The damping chamber 14 is tuned to the frequency of the diaphragm 9 with its armature 10.

In telephones intended for the reproduction of articulate speech the two different vibratory structures or units consisting of the diaphragm and the damping chamber respectively are preferably both tuned to a frequency of 1500 cycles and coupled together in such a manner that the resulting frequencies of resonance after coupling lie between 1000 and 1500 cycles on the one hand and between 1500 and 2000 cycles on the other hand. This is represented by the graph in Fig. 3. In this graph the abscissæ denote frequencies and the ordinates the amplitudes or loudness of the apparatus shown in Fig. 2. The dotted curve whose crest lies at 1500 represents the resonance

curve of each vibratory structure or unit by itself, while the solid curve is the resonance curve of the apparatus with its vibratory structures coupled together.

A characteristic feature of the apparatus of Fig. 1 is the arrangement of the damping chamber itself. The chamber employed as such is not a separate additional space provided especially for damping purposes, but instead is a chamber that develops in any case in constructing the apparatus. This type in itself is of technical importance because it leads to a simple and cheap instrument. Of course, the chamber has to be tuned to accord with the invention.

The damping openings may be arranged at any parts of the walls of the damping chamber. They form in their entirety the opening of the resonator which the damping chamber constitutes. By altering their number and size this resonator can be tuned. Obviously they are best arranged at or near the parts of the vibratory structure (Fig. 2) where the vibrations are of the greatest amplitude.

Of course a damping chamber of this kind also acts upon such vibratory structures as are coupled to it so as to increase their damping factor and this action is the stronger the closer the coupling is. The fact is well known in the theory of coupled vibratory elements. In the apparatus of Fig. 1 there are three vibratory units or bodies to deal with, the one being formed by damping chamber itself, the second by the masses and elastic members of the microphone or electro-magnet, and the third by the diaphragm. If the three units or bodies are all coupled together extremely closely the damping action of the damping chamber is distributed approximately uniformly among the three units or bodies, particularly if they are all tuned to the same natural rate of vibration.

The scope of the invention is not limited to sound apparatus as used for example in telephony, wire or wireless telegraphy, and sound transmission through air and under water etc., but includes all kinds of vibrators for all manner of technical uses. It can therefore also produce excellent results in vibratory apparatus for balancing phases in alternating current supply systems, apparatus in which vibratory structures are used for testing materials and in similar machines.

We claim:—

1. In acoustic apparatus, a vibratory structure, and a chamber containing fluid which latter is adapted to be acted upon by said vibratory structure and having an opening in its wall through which the fluid may pass when the vibratory structure is excited, said chamber being tuned to the frequency of the vibratory structure and being of such size and shape as to effect the desired damping of said vibratory structure.

2. In acoustic apparatus, a vibratory structure, and a chamber containing fluid abutting thereon and having an opening in its wall through which the fluid may pass when the vibratory structure is excited, said chamber being tuned to the frequency of the vibratory structure and being of such size and shape as to effect the desired damping of said vibratory structure.

3. In acoustic apparatus, a vibratory diaphragm, and a chamber containing fluid abutting thereon and having an opening in its wall through which the fluid may pass when the vibratory diaphragm is excited, said chamber being tuned to the frequency of the vibratory diaphragm and being of such size and shape as to effect the desired damping of said vibratory diaphragm.

4. In acoustic apparatus, a casing having an aperture, a vibratory diaphragm closing said aperture, and a chamber containing fluid abutting on said vibratory diaphragm and having an opening in its wall through which the fluid may pass when the vibratory diaphragm is excited, said chamber being tuned to the frequency of the vibratory diaphragm and being of such size and shape as to effect the desired damping of said vibratory diaphragm.

5. In acoustic apparatus, a casing having an aperture, a vibratory diaphragm closing said aperture, a rigid plate mounted in said casing in such relation to said vibratory diaphragm as to form a chamber therebetween adapted to contain fluid, said rigid plate having an aperture through which the fluid may pass when the vibratory diaphragm is excited, and said chamber being tuned to the frequency of the vibratory diaphragm and being of such size and shape as to effect the desired damping of said vibratory diaphragm.

6. In acoustic apparatus, a vibratory structure having points executing different amplitudes of movement, and a chamber containing fluid abutting thereon and having an opening in its wall through which the fluid may pass when the vibratory structure is excited, said opening being located adjacent a point of the vibratory structure having relatively great amplitude of movement, and said chamber being tuned to the frequency of the vibratory structure and being of such size and shape as to effect the desired damping of said vibratory structure.

7. In a vibration apparatus; an electromagnet; a primary vibratory unit consisting of a diaphragm with an armature attached thereto located in the field of the magnet; a rigid plate with an opening in it

adjacent the said armature; and a secondary vibratory unit consisting of fluid located in a space between the rigid plate and the diaphragm and in a gap between the armature and the edge of the said opening, the two vibratory units being each tuned to a frequency 1500.

8. In a vibration apparatus; an electromagnet; a primary vibratory unit consisting of a diaphragm with an armature attached thereto located in the field of the magnet; a rigid plate with an opening in it adjacent the said armature; and a secondary vibratory unit consisting of fluid located in a space between the rigid plate and the diaphragm and in a gap between the armature and the edge of the said opening, the two vibratory units being each tuned to a frequency 1500 and coupled so that two frequencies of resonance are obtained the one lying between 1000 and 1500, and the other between 1500 and 2000.

In testimony whereof we affix our signatures in presence of two witnesses.

HEINRICH HECHT.
HUGO LICHTE.
BERNHARD NIELSEN.

Witnesses:
EMIL LÜTT,
OTTO DOHM.