May 5, 1925. 1,536,116

W. H. MARTIN

SOUND REPRODUCER

Filed April 1, 1924

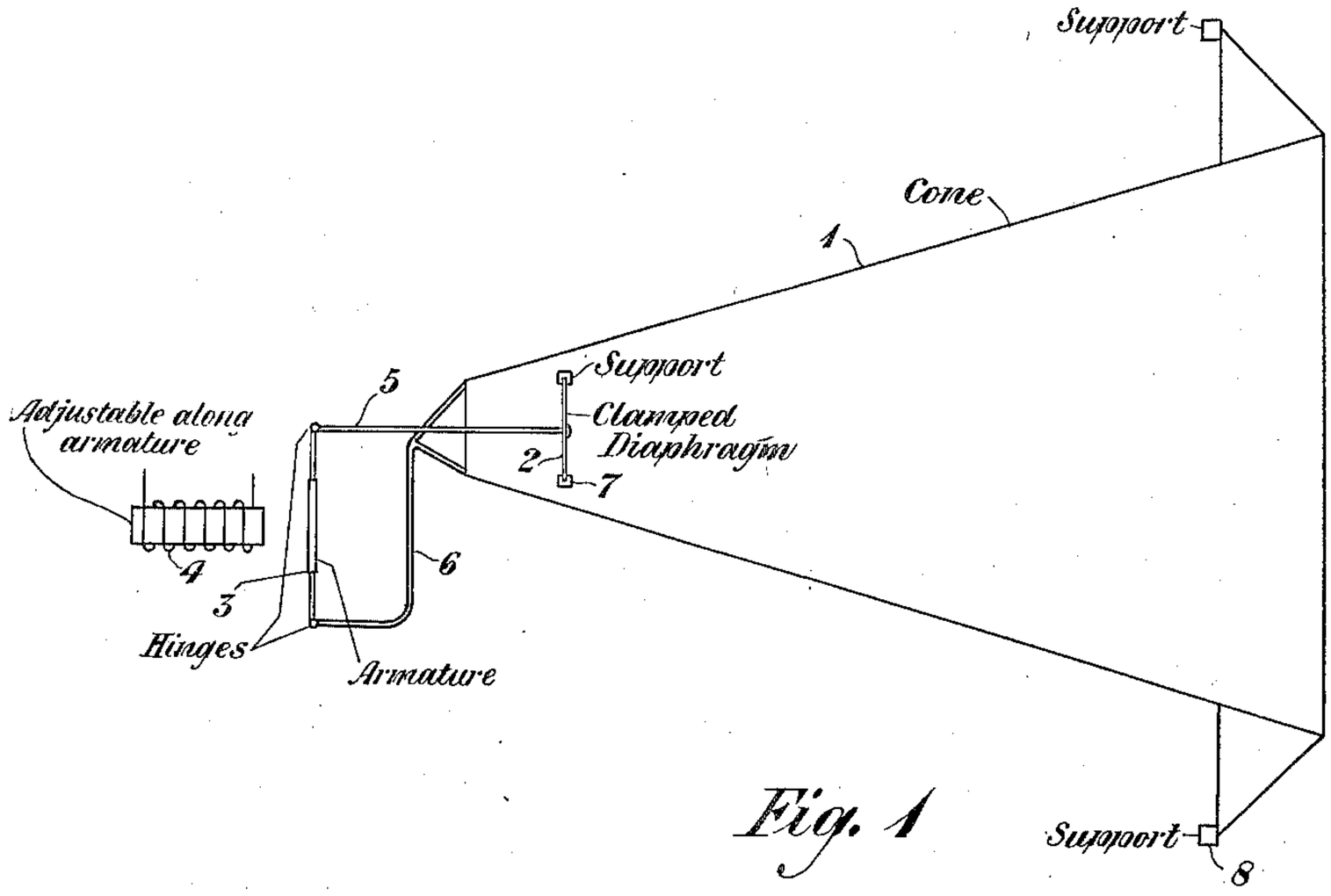

Fig. 1

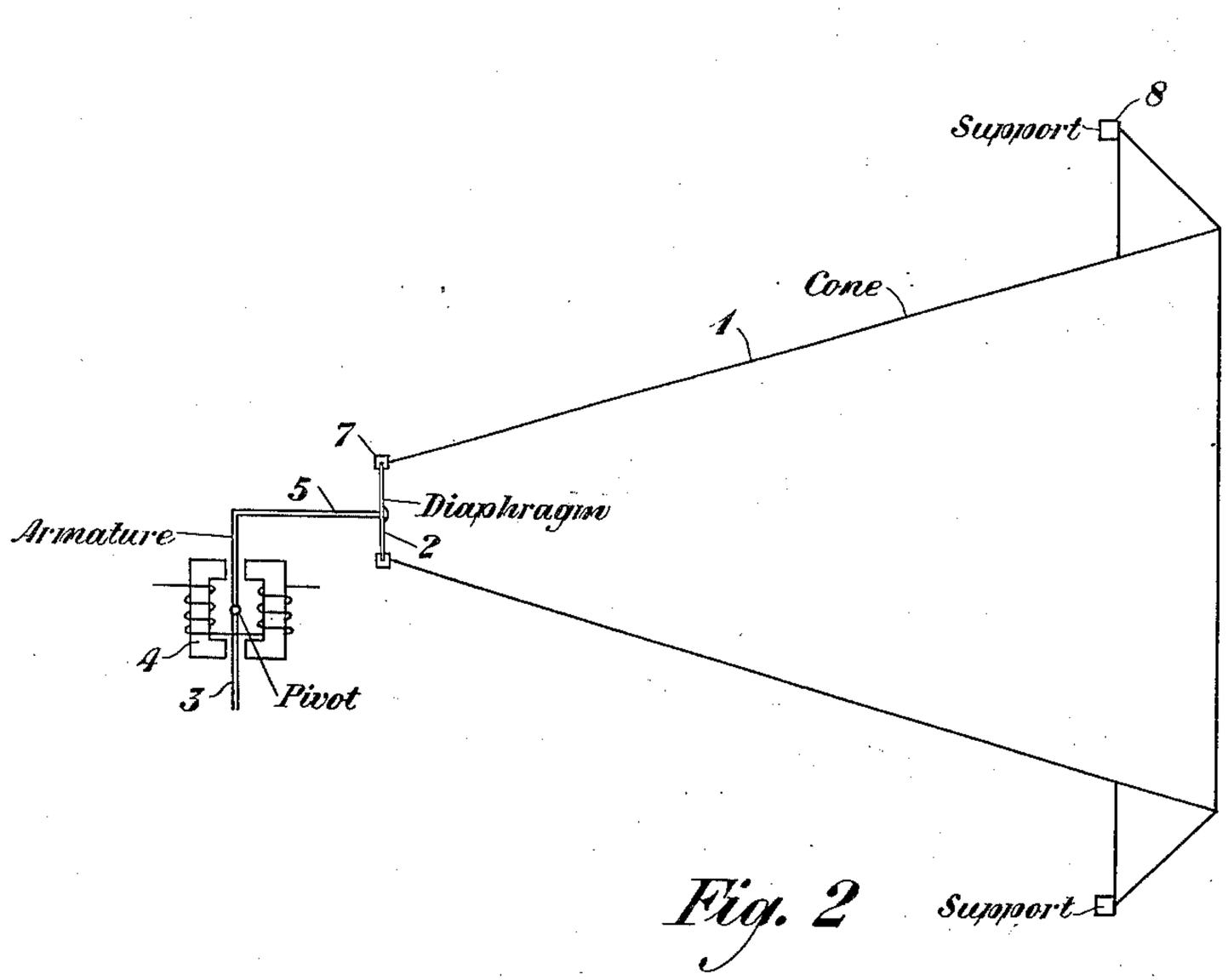

Fig. 2

INVENTOR
W. H. Martin

BY

ATTORNEY

Patented May 5, 1925. 1,536,116

UNITED STATES PATENT OFFICE.

WILLIAM H. MARTIN, OF CHAPPAQUA, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SOUND REPRODUCER.

Application filed April 1, 1924. Serial No. 703,510.

To all whom it may concern:

Be it known that I, WILLIAM H. MARTIN, residing at Chappaqua, in the county of Westchester and State of New York, have invented certain Improvements in Sound Reproducers, of which the following is a specification.

This invention relates to sound reproducers and more particularly to sound reproducers of the type known as loud speakers.

An object of the invention is to provide a loud speaker which will effectively transmit a wide range of frequencies without undue distortion. This object and other objects of the invention are attained by providing a doubly resonant arrangement comprising two diaphragms of different dimensions and different degrees of stiffness. One of these diaphragms may have a natural period corresponding to a low telephonic frequency and the other may have a natural period corresponding to a high telephonic frequency. The two diaphragms are mechanically connected to be operated by a suitable magnetic arrangement. The larger diaphragm is preferably formed in the shape of a cone and is so mounted with respect to the small diaphragm as to act as a horn for the latter.

Further details of the invention will be clear from the following description when read in connection with the accompanying drawing, the two figures of which illustrate schematically two different modifications of the invention.

Referring to Figure 1, a large diaphragm having a conical shape is shown at 1, while 2 designates a small diaphragm. 3 designates a light armature actuated by some form of magnetic system, such as 4. The armature is hinged at one end to a driving member 5, affixed to the small diaphragm 2, while at its other end it is hinged to a member 6, fixedly secured to the small end of the conical shaped diaphragm.

The small diaphragm 2 is mounted upon a support 7 within the conical shaped diaphragm 1 and near the smaller end thereof. Preferably, the diaphragm 2 will be clamped to the support in a well known manner. The conical shaped diaphragm 1 is mounted upon a second fixed support 8 by having its outer end turned back in the form of a truncated cone, the base of which is secured by the support. It will be apparent from the manner in which the two diaphragms are mounted that the diaphragm 1 will act as a horn for the diaphragm 2. It will be readily understood that the small diaphragm, due to its minute mass and relatively great stiffness, can be given a high natural resonance while the large diaphragm, owing to the manner in which it is mounted and because of its greater mass and less stiffness, will have a low natural frequency.

It will be noted that the driving force is applied to the common armature 3. Let us consider what happens when the armature is actuated by a low frequency driving force. The small diaphragm, due to its great stiffness and high natural period, presents a large mechanical impedance to the motion of the armature, while the large diaphragm presents a relatively small one. The result will be that the end of the armature connected to the small diaphragm will remain practically stationary while the end connected to the large diaphragm will vibrate vigorously. On the other hand, when a high frequency driving force actuates the armature the end attached to the large diaphragm will, in effect, form a fulcrum, due to the great mass of the diaphragm, and the small diaphragm will vibrate.

A modified arrangement is shown in Fig. 2. In this form of the invention the large cone 1 is mounted upon its support 8, as described in connection with Fig. 1. The support 7 of the small diaphragm 2, however, is attached to the small end of the conical shaped diaphragm 1 so that the diaphragm 2 forms an integral part of the diaphragm 1. The magnetic arrangement 4 is of the type commonly employed in loud speakers and is provided with an armature 3, which vibrates about its middle point as a pivot. One end of the armature 3 is connected by means of a member 5 to a point near the center of the small diaphragm 2. As in Fig. 1, the conical shaped diaphragm 1 will act as a horn for the small diaphragm 2.

In this case, when the armature is actuated by a low frequency driving force, the small diaphragm, due to its great stiffness and high natural period, will present a large mechanical impedance to the motion

of the armature, while the large diaphragm will present a relatively small mechanical impedance. The result will be that the small diaphragm will tend to move rigidly with the large diaphragm so that the large diaphragm will vibrate vigorously and the small diaphragm will, in effect, move with it as a unitary part thereof. On the other hand, when a high frequency driving force actuates the armature, the large diaphragm will present a large mechanical impedance so that the support 7 of the small diaphragm 2 will vibrate very little. The diaphragm 2 will, therefore, vibrate very vigorously with respect to its support and the large diaphragm 1 will be relatively ineffective.

An efficient doubly resonant loud speaker possesses many advantages which are well known and which need not be referred to at this time. The particular structure shown in Figs. 1 and 2, however, has an inherent advantage, residing in the fact that the actuating energy is automatically delivered to that diaphragm which will most efficiently convert energy of that particular frequency into sound. The arrangement shown in Fig. 1 also has another advantage in that the magnetic device 4 may be adjusted with respect to the armature 3, thus changing the relatively mechanical advantage of the driving arm with respect to the two diaphragms. By means of this adjustment slight changes in the quality can be effected.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a sound reproducer, a diaphragm having a high natural period, a diaphragm having a low natural period, said last mentioned diaphragm being substantially cone shaped and being so related to said first mentioned diaphragm as to constitute a horn therefor, and means to apply a driving force to said diaphragms, said means being so related to the diaphragms that when a low frequency driving force is applied to the system the diaphragm having a high period will offer a large mechanical impedance to the driving force so that the driving force will be most effective upon the diaphragm of low frequency.

2. In a sound reproducer, a diaphragm having a high natural period, a diaphragm having a low natural period, said last mentioned diaphragm being substantially cone shaped and being so related to said first mentioned diaphragm as to constitute a horn therefor, and means to apply a driving force to said diaphragms, said means being so related to the diaphragms that when a low frequency driving force is applied to the system the diaphragm having a high period will offer a large mechanical impedance to the driving force so that the driving force will be most effective upon the diaphragm of low frequency, and when a high frequency driving force is applied to the system the low frequency diaphragm will offer a large impedance to the driving force so that it will be most effective upon the high frequency diaphragm.

3. In a sound reproducer, a small diaphragm having small mass and relatively great stiffness so that its natural period will be high, a large diaphragm having a greater mass and less stiffness so that its natural period will be low, said last mentioned diaphragm being substantially cone shaped and being so related to said first mentioned diaphragm as to constitute a horn therefor, and means to apply a driving force to said diaphragms, said means being so related to the diaphragms that when a low frequency driving force is applied to the system the diaphragm having a high period will offer a large mechanical impedance to the driving force so that the driving force will be most effective upon the diaphragm of low frequency.

4. In a sound reproducer, a small diaphragm having small mass and relatively great stiffness so that its natural period will be high, a large diaphragm having a greater mass and less stiffness so that its natural period will be low, said last mentioned diaphragm being substantially cone shaped and being so related to said first mentioned diaphragm as to constitute a horn therefor, and means to apply a driving force to said diaphragms, said means being so related to the diaphragms that when a low frequency driving force is applied to the system the diaphragm having a high period will offer a large mechanical impedance to the driving force so that it will be most effective upon the high frequency diaphragm.

5. In a sound reproducer, a small diaphragm having small mass and relatively great stiffness so that its natural period will be high, a large diaphragm having a greater mass and less stiffness so that its natural period will be low, said last mentioned diaphragm being substantially cone shaped and being so related to said first mentioned diaphragm as to constitute a horn therefor, means to produce a driving force, and a lever arrangement for applying said force to the diaphragms, said lever arrangement being so related to the diaphragms that when

a low frequency driving force is applied to the system the small diaphragm presents a large mechanical impedance and the driving force will be principally applied to the large diaphragm.

6. In a sound reproducer, a small diaphragm having a small mass and relatively great stiffness so that its natural period will be high, a large diaphragm having a greater mass and less stiffness so that its natural period will be low, said last mentioned diaphragm being substantially cone shaped and being so related to said first mentioned diaphragm as to constitute a horn therefor, means to produce a driving force, and a lever arrangement for applying said force to the diaphragms, said lever arrangement being so related to the diaphragms that when a low frequency driving force is applied to the system the small diaphragm presents a large mechanical impedance and the driving force will be principally applied to the large diaphragm, and when a high frequency driving force is applied to the system the large diaphragm will present a large mechanical impedance so that the driving force will be principally applied to the small diaphragm.

In testimony whereof, I have signed my name to this specification this 31st day of March, 1924.

WILLIAM H. MARTIN.