May 6, 1930. C. R. MOORE 1,757,465

ACOUSTIC DEVICE

Filed June 23, 1927

FIG. 1.

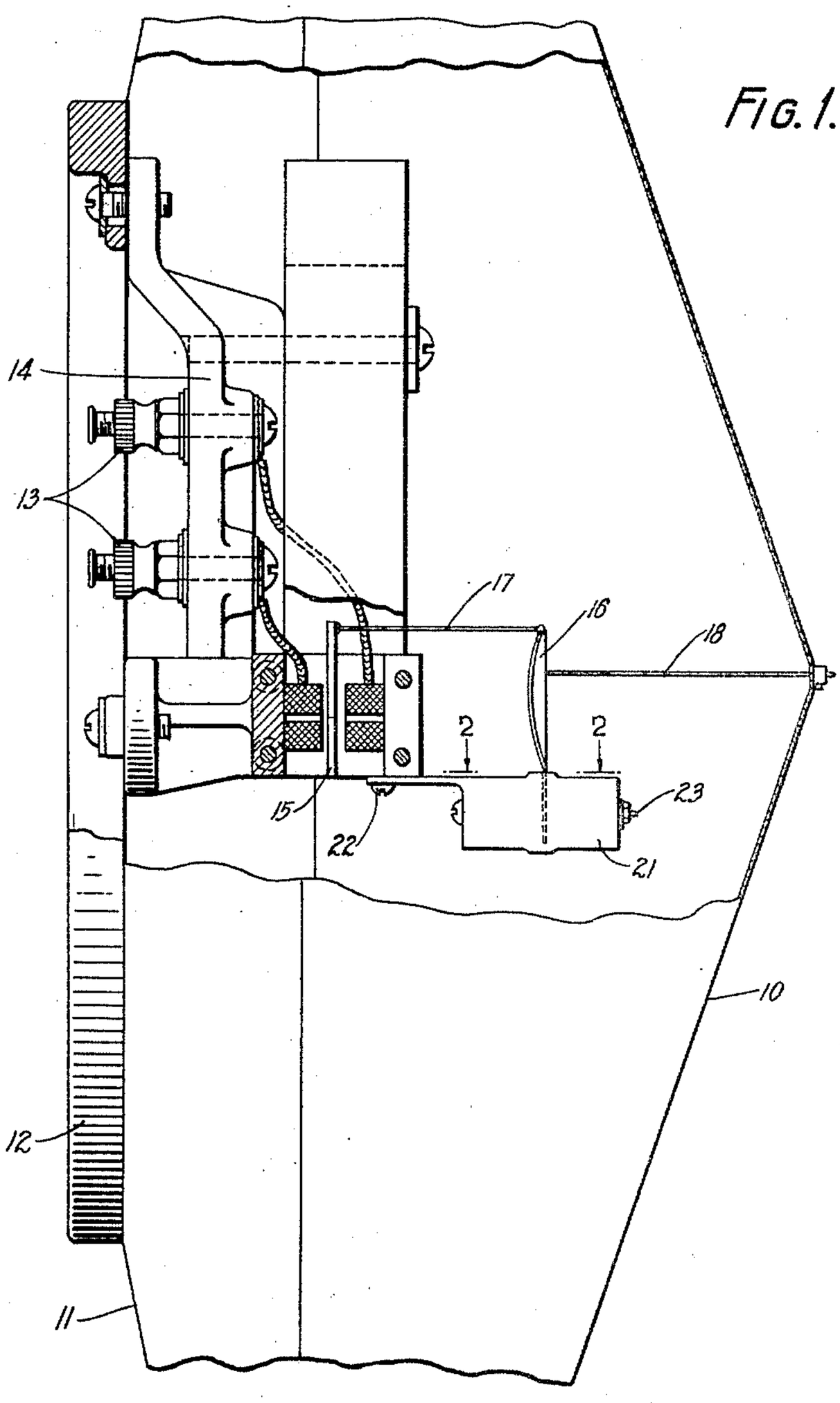
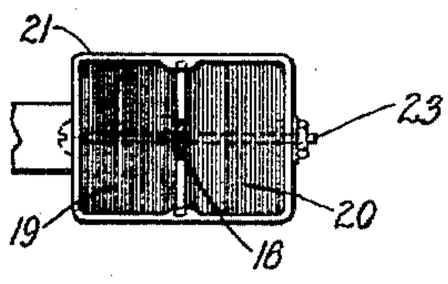



FIG. 2.




INVENTOR
CHARLES R. MOORE
BY Walter C. Kiesel
ATTORNEY

Patented May 6, 1930 1,757,465

# UNITED STATES PATENT OFFICE

CHARLES R. MOORE, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

## ACOUSTIC DEVICE

Application filed June 23, 1927. Serial No. 200,780.

This invention relates to acoustic devices and particularly to means for driving the diaphragm of a direct acting sound radiator.

There is disclosed in U. S. Patent No. 1,704,354 to R. L. Wegel, dated March 5, 1929, a lever system for connecting the armature of an electromagnetic receiver to the diaphragm of a direct acting sound radiator. This lever system comprises a lever arm one end of which is rigidly supported. The armature of the electromagnetic unit is connected to the end of the lever arm opposite its supported end and the diaphragm is connected thereto at a position intermediate its ends.

In accordance with the present invention, a lever system such as that disclosed in the patent referred to above is considerably improved by providing a non-rigid support for the end of the lever arm opposite the end connected to the armature of the driving unit. In a preferred embodiment of the invention the non-rigid lever arm support comprises a plurality of thin aluminum strips or leaves interposed with air films and positioned on opposite sides of a flat end portion of the lever arm. An improvement in the quality of the sound reproduced by a sound radiator results from employing a driving system therefor constructed in accordance with this invention. It is particularly noticeable that the frequency band which the improved sound radiator is capable of reproducing is broadened due to its increased efficiency of reproduction at the lower portion of the frequency range employed in music.

The invention may be readily understood by referring to the following description and the accompanying drawing in which:

Fig. 1 is a side view of a sound radiator having portions broken away to better illustrate the invention; and

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1.

Referring now to the drawing, the sound radiator comprises a diaphragm having conical and frusto-conical portions 10 and 11, respectively, made of paper or other suitable material and joined at their peripheries. The frusto-conical portion 11 is secured to a supporting frame 12 while the apex of the conical portion 10 is driven in accordance with the electrical energy impressed on terminals 13 of the electromagnetic unit 14 which is supported by the frame 12. The armature 15 of the electromagnetic unit 14 is coupled to the diaphragm through a lever arm 16, one end of which is connected to the armature 15 of the electromagnetic unit by a rod 17. One end of a rod 18 is connected to a portion of the lever arm 16 intermediate its ends while the opposite end of the rod 18 is connected to the apex of the conical portion 10 of the diaphragm. The enlarged flat end portion of the lever arm 16 opposite the end to which the rod 17 is connected is yieldably or floatably supported by the damping units 19 and 20 located on opposite sides of the lever arm.

These damping units comprise a plurality of strips of paper or metallic foil, preferably of the order of 0.001 inch thick, packed in the supporting structure 21 which is secured to the electromagnetic unit by the screws 22. These strips are maintained in alignment in the supporting structure by the screw 23 passing through a centrally located opening in the strips. This screw also passes through an opening in the end of the lever arm 16, this opening and also the opening in the strips which comprise the damping units being slightly larger than the diameter of the screw 23. The strips comprising a damping unit are preferably loosely packed so that an air space of about 0.00025 to 0.0005 of an inch in thickness separates the adjacent strips. These strips, moreover, are slightly smaller than the cross sectional area of the supporting structure 21 so that there may be a space of the order of 0.01 inch between the periphery of the sheets and the inner wall of the supporting structure 21.

When a low frequency alternating potential is impressed across the terminals 13 of the electromagnetic unit 14, both ends of the lever arm 16 are displaced due to the resulting vibrational movement of the armature 15. Consequently, the thickness of the air spaces between the adjacent strips of one of the damping units increases while the air spaces between the strips of the other unit corre-

spondingly decrease in thickness. Air is thus forced in and out of these air spaces and, as a result, the motion of the lever 16 is appreciably damped at one end. At somewhat higher frequencies of vibration there is practically no displacement of the end of the lever arm 16 which is positioned between the damping units 19 and 20.

It has been found that as a result of employing this flexible support which permits the displacement of the fulcrum of the lever arm 16 at low frequencies of vibration, the frequency response characteristic of the sound radiator is considerably improved. It is particularly noticeable that the efficiency of the sound radiator is increased at the lower portion of the sound frequency range without impairment of the response at higher frequencies, thus resulting in widening the band of frequencies which the device is capable of radiating efficiently. It is apparent that the ratio of the reproduction efficiency of high and low frequencies, respectively, can be varied by changing the thickness area and number of strips employed in the damping units for supporting the end of the lever arm 16. An advantage realized due to the damping action of the units 19 and 20 is a reduction in the amplitude of the resonance peaks occurring in the frequency response characteristic of the sound radiator and thus an improvement in the quality of the sounds reproduced thereby. By employing a flexible support, the arm is free to move and strains are thus relieved which would normally result from the expansion and contraction of the paper diaphragm due to changes in atmospheric conditions.

What is claimed is:

1. An acoustic device comprising a vibratile member, a driving means for actuating said vibratile member, means to which said vibratile member and said driving means are connected at different positions respectively, and an air damped support for said connecting means located remotely from the positions at which said vibratile member and said driving means are connected.

2. An acoustic device comprising a vibratile member, driving means therefor, a lever to which said vibratile member and said driving means are connected at different positions along its length, respectively, and means yieldable in the directions of movement of said vibratile member for supporting the fulcrum of said lever located at a position remote from the position at which said vibratile member and said driving means are connected.

3. An acoustic device comprising a vibratile member, driving means therefor, a lever to which said driving means is connected near one end and said vibratile member is connected at a position remote from its ends, and floating means for supporting the fulcrum of said lever so that the fulcrum may be displaced when said driving means is operating at a low frequency.

4. An acoustic device comprising a vibratile member and a driving means for actuating said vibratile member, a lever to which said vibratile member and said driving means are connected at different positions along its length, respectively, and a non-rigid support for said lever located remotely from the position at which said vibratile member and said driving means are connected, said support comprising a plurality of loosely mounted thin leaves.

5. An acoustic device comprising a vibratile member and a driving means therefor, a lever to which said driving means is connected near one end and said vibratile member is connected at a position remote from its ends, and supporting means comprising a plurality of thin leaves loosely mounted on opposite sides of said lever near its fulcrum so that the fulcrum may be displaced when said driving means is operating at low frequencies.

6. An acoustic device comprising a diaphragm, an electromagnetic element having an armature for driving said diaphragm, a lever, a plurality of thin leaves loosely positioned on opposite sides of a flat portion of said lever near its fulcrum, and means for connecting said armature and said diaphragm to the lever at different positions, respectively, remote from said fulcrum.

7. An acoustic device comprising a diaphragm, driving means for actuating said diaphragm, means to which said diaphragm and driving means are connected at different positions, respectively, and means variably movable in response to variable frequencies for supporting one end of said connecting means.

8. An acoustic device comprising a diaphragm, driving means for actuating said diaphragm, means to which said diaphragm and driving means are connected at different positions, respectively, and means automatically shifting the fulcrum of said connecting means at high and low frequencies.

9. An acoustic device comprising a diaphragm, driving means for actuating said diaphragm, means to which said diaphragm and driving means are connected at different positions, respectively, and air damping means supporting one end of said connecting means.

In witness whereof, I hereunto subscribe my name this 13th day of June, A. D., 1927.

CHARLES R. MOORE.