Jan. 13, 1925. 1,522,758

P. THOMAS

TELEPHONE DIAPHRAGM

Filed April 18, 1922

Fig. 1

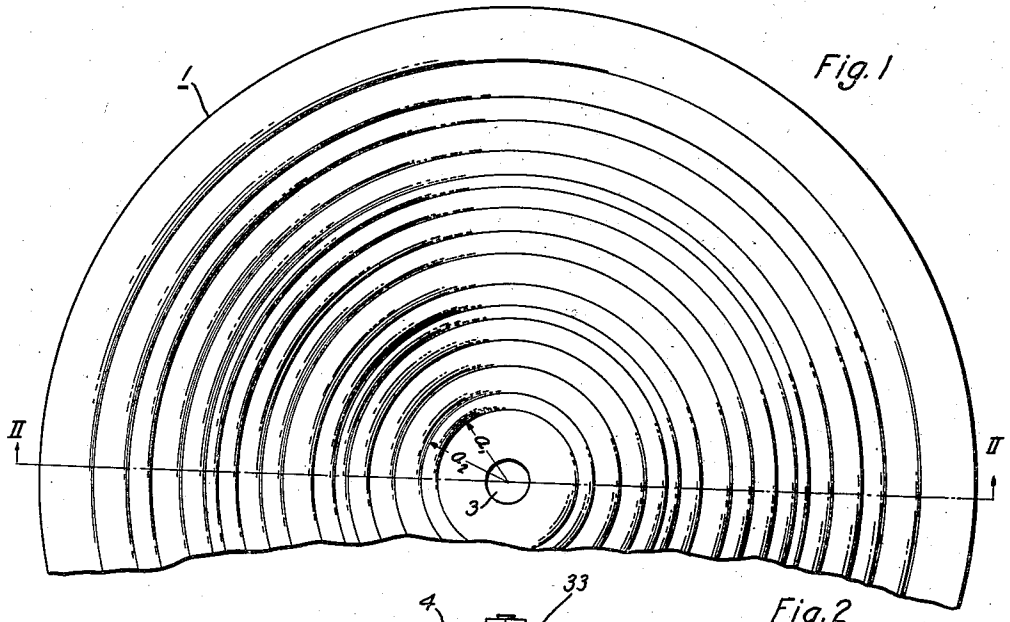


Fig. 2

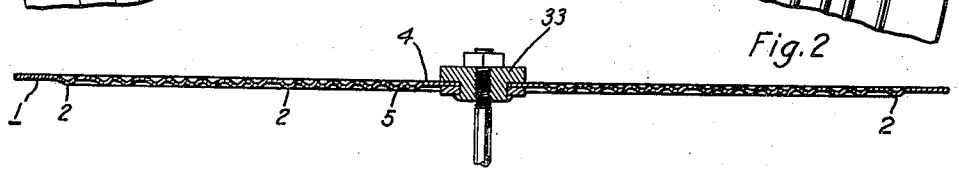
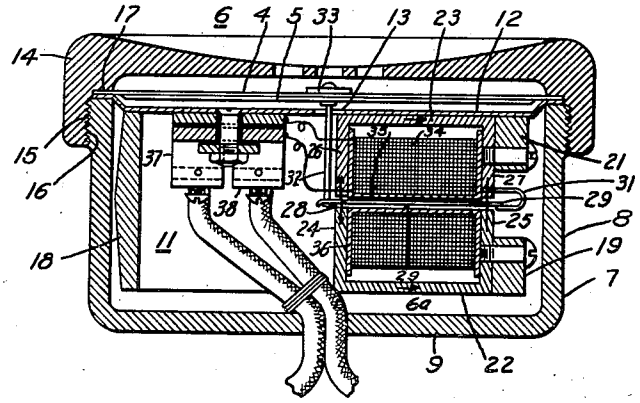


Fig. 3



WITNESSES:

Fred. S. Millard

H. L. Godfrey

INVENTOR

Phillips Thomas

BY

Cooley & Carr

ATTORNEY

Patented Jan. 13, 1925. 1,522,758

UNITED STATES PATENT OFFICE.

PHILLIPS THOMAS, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TELEPHONE DIAPHRAGM.

Application filed April 18, 1922. Serial No. 555,272.

To all whom it may concern:

Be it known that I, PHILLIPS THOMAS, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Telephone Diaphragms, of which the following is a specification.

My invention relates to instruments for recording or reproducing sound waves and particularly to diaphragms common to such devices.

The principal object of my invention is to provide a diaphragm of such design as to admit of the faithful translation of sound waves into corresponding modulated electrical energy, and vice versa, without impairing the quality, tone and quantity of the translated energy.

In the present state of the art, diaphragms, as ordinarily made, consist of a plain circular disk of a desired material, as, for instance, mica, paper or iron, depending upon the specific application.

It is found that such diaphragms have, in addition to the frequency at which the diaphragm as a whole is resonant, other frequencies at which partial resonance occurs. Furthermore, it has been found that if the diaphragm is not a perfect plane, or if there are sections in which there are kinks or wavy places, each of such places will cause partial resonance at some frequency other than the natural frequency of the diaphragm as a whole.

With the diaphragm embodying the above mentioned defects, it is apparent that distortion is introduced, which greatly impairs the usefulness of such transmitters for certain classes of work, as, for instance, the transmission of music by wireless telephony.

According to my invention, I compensate for the distorting effects caused by the fundamental resonant frequency of the diaphragm by employing a diaphragm which has a lower resonant frequency than the lowest note to be employed. Such diaphragms, however, have the disadvantage of having segmental vibration periods which result in the emphasis of certain tones and hence cause distortion.

To overcome the latter defect and others hereinbefore mentioned, I provide the diaphragm with corrugations which are disposed in concentric circles from the center of the diaphragm outwards. Each circle, if no others were present, would cause partial resonance at some frequency. However, by making the radii of the circles of such relative lengths that the numerical expressions thereof are prime to each other and impressing a considerable number on the diaphragm, each corrugation will annul, in a great measure, the tendency to resonance due to the circles on each side thereof. Thus, I am enabled to produce a diaphragm having no resonant frequencies except the one low frequency at which the diaphragm vibrates as a unit.

An advantage of such construction is that it leaves but one resonance point to be corrected instead of a number, as is the case with a plain diaphragm and, in addition, the act of impressing the corrugations on the diaphragm in itself removes, in a great measure, all kinks or irregular portions.

With these and other objects and applications in view, my invention further consists in the combination and in the details of construction and arrangement hereinafter described and claimed and illustrated in the accompanying drawing, wherein:

Figure 1 is an enlarged fragmentary top plan view of a diaphragm embodying my invention;

Fig. 2 is a sectional view taken on the line II—II of Fig. 1;

Fig. 3 is a transverse sectional view of telephone apparatus embodying my invention.

In the drawing is shown a diaphragm 1 comprising a circular disk of resilient material provided with corrugations 2 disposed in concentric circles and having a central point 3 designed to serve as the center of vibration of the disk by the connection of actuating means thereto, as explained more fully hereinafter. The corrugations 2 may be so pressed into the disk 1 as to form a substantially flat surface 4 and raised surface 5. For reasons hereinbefore mentioned, the relation between the radii of the several concentric circles, as indicated by a_1, a_2, etc., in Fig. 1, is the same as that between prime numbers expressed in the same units. It has been found that improved results are obtained by employing corrugations of relatively small dimensions, say approximately 0.012 inch radius.

While the diaphragm 1 is shown as pro-

vided with corrugations 2, it is apparent that a diaphragm having similar non-resonant characteristics may be obtained by employing stiffening or dampening means arranged at distances from the center of vibration which are prime to each other.

In a practical embodiment of my invention, the several radii a_1, a_2, etc., are determined by the following series of prime numbers, 19, 23, 31, 37, 43, 47, 53, 61, 67, etc., which may be expressed as distances with the inch as a unit by multiplying this series by the number .008.

In order to better illustrate my invention, I have shown it embodied in a well known type of telephone receiver 6 but, of course, it is not to be limited to such structure or such specific application.

As shown in Fig. 3, the telephone receiver 6 comprises a casing 7 having a cylindrical wall 8 and a base 9 therefor adapted to form a chamber 11 open at its upper end. A circular cover plate member 12 having a substantially centrally disposed perforation 13 is provided to close the open end of the chamber 11, the edges of said plate member 12 resting upon the upper end of the wall 8 of the casing 7. A cap member 14 of annular shape is provided with a threaded portion 15 for engaging a similar threaded portion 16, which is disposed on the outer surface of the upper end of the wall 8, and with a shoulder portion 17 for engaging the edge of said plate member 12 which is resting upon said wall 8, whereby the cover plate member 12 may be rigidly secured in position.

A substantially circularly bent permanent magnet 18 has it ends or poles 19 and 21 disposed in alinement parallel to the axis of the receiver. The magnet 18 may be supported from the under surface of said cover plate 12 in any approved manner (not shown). A pair of soft iron yoke members 22 and 23 are provided, having polar projections 24, 25 and 26, 27, respectively. The yoke members 22 and 23 are rigidly secured to the ends 19 and 21, respectively, of the permanent magnet 18 in such manner that the polar projections of one magnet are in alinement with the polar projections of the other magnet with an air gap 28 therebetween.

A magnetizable armature member 29 is pivotally mounted in said air gaps 28 at a point 29 midway between said polar projections in any approved manner. One end of the armature member 29, adjacent to the permanent magnet poles 19 and 21, may be connected to the polar projections 27 by means of a spring member 31 to admit of vibratory action of the armature member 29. The other end of the armature member 29 may be rigidly secured, by means of a connecting link 32 and a connector 33, to the midpoint 3 of the diaphragm, which is designed to serve as the center of vibration thereof. The connection link 32 and connector 33 constitute portions of the subject matter of a pending application of A. Nyman, Serial No. 556,856, filed April 27, 1922, and assigned to the Westinghouse Electric & Manufacturing Company. The diaphragm 1 is disposed adjacent to the outer surface of the cover member 12 immediately over the perforation 13 with the flat surface 4 preferably toward the exterior. In view of such construction, it can be seen that vibratory action of the armature member 29 is readily transmitted to the diaphragm 1.

A magnetizing winding 34 is wound upon a tubular core member 35 of a frame 36 which is so mounted between the several polar projections as to produce lines of induction which traverse paths indicated by the arrows 6^a upon the passage of currents through the winding 34 in one direction. When the direction of the currents reverses, the direction of the arrows is correspondingly reversed. The terminals of the winding 34 may be connected to external circuit terminals 37 and 38 which may be carried by the inner side of the cover plate member 12.

When modulating currents corresponding to a signal are caused to traverse the turns of the magnetizing winding 34, the armature member 29 is vibrated in accordance with the varying intensity of such currents, as will be understoood by those versed in the art. The vibration of the armature member 29 is transmitted to the diaphragm 1 and hence causes sound waves.

Among the several advantages of the diaphragm embodying my invention may be mentioned the elimination of so-called side tones, the elimination of distortion when the transmitter is worked hard, and other advantages herein before set forth.

While I have shown but one embodiment of my invention, for the purpose of describing the same and illustrating its principles of operation, it is apparent that various changes and modifications may be made in the nature and in the details of construction without departing from the spirit of my invention. I desire, therefore, that only such limitations shall be imposed thereon as are indicated in the appended claims or demanded by the prior art.

I claim as my invention:

1. A diaphragm comprising a plate provided with damping means spaced from a common point at distances having the same relation as prime numbers, said common point being the center of said plate.

2. A diaphragm comprising a plate provided with a plurality of stiffening portions spaced from a central point at distances prime to each other, said point constituting the center of said plate.

3. A diaphragm comprising a plate provided with indentations disposed in spaced relation from a central point in said plate at distances prime to each other.

4. A diaphragm comprising a plate having a substantially flat operative surface provided with corrugations symmetrically disposed in spaced relation from the center thereof at distances prime to each other.

5. A diaphragm comprising a substantially flat plate provided with a plurality of damping means concentrically disposed and in spaced relation with respect to a common point on said plate at distances prime to each other.

6. A diaphragm comprising a plate provided with stiffening means extending outwardly from the center of vibration of said plate in concentric circles, the radii of which are prime to each other.

7. A diaphragm comprising a plate provided with concentric rings of corrugations, the radii of the several rings with respect to the center of said plate being prime to each other.

8. A diaphragm comprising a disk having a substantially flat operative surface provided with a plurality of concentric rings of shallow indentations extending radially outwardly from the center of vibration of said disk, the radii of certain of said rings being in the same relation as prime numbers.

9. A diaphragm comprising a disk having a low fundamental frequency and provided with a plurality of indentations disposed in concentric circles extending outwardly from the center of said disk, the radii of all of said circles being prime to each other.

10. In a translating device, a casing adapted to form a chamber open at one end, a cover for said chamber having a perforation therein, means for clamping said cover rigidly in position and enclosing a space therebetween, and a mechanically vibratory diaphragm provided with concentric rings of corrugations disposed therein and extending outwardly from the center thereof, the radii of said rings being prime to each other.

11. In a translating device, a casing adapted to form a chamber open at one end, a cover for said chamber having a perforation therein, means for clamping said cover rigidly in position, a diaphragm disposed adjacent the upper side of said cover immediately over said perforation, said diaphragm comprising a disk provided with concentric rings of corrugations extending outwardly from the center thereof, the radii of which are prime to each other, and means for vibrating said diaphragm in accordance with a signal.

12. In a translating device, a casing adapted to form a chamber open at one end, a cover for said chamber having a substantially centrally disposed perforation, means for clamping said cover rigidly in position enclosing a space therebetween, a diaphragm disposed in said space in such manner that the center of vibration thereof is immediately above said perforation, said diaphragm comprising a disk provided with damping means spaced from said center of vibration in the same relation as prime numbers, electrical signal current translating means disposed in said casing and a link adapted to be vibrated by said translating means in accordance with signal currents extending through said perforation and rigidly secured to the center of vibration of said diaphragm.

13. In a translating device, a casing adapted to form a chamber open at one end, a cover for said chamber having a substantially centrally disposed perforation, means for clamping said cover rigidly in position enclosing a space, therebetween, a diaphragm comprising a disk provided with corrugations formed therein in such manner as to provide a substantially flat surface on one side and a raised surface on the opposite side, said diaphragm being so disposed in said space that the flat surface faces the clamping means and the center of vibration is immediately above said perforation, said corrugations being spaced from the center of vibration of said diaphragm in the same relation as prime numbers, electrical signal-current translating means disposed in said casing and a link adapted to be vibrated by said translating means in accordance with signal currents extending through said perforation and rigidly secured to the center of vibration of said diaphragm.

In testimony whereof, I have hereunto subscribed my name this 17th day of April, 1922.

PHILLIPS THOMAS.