April 21, 1925. 1,534,373

H. FISCHER

DIAPHRAGM FOR TELEPHONE RECEIVERS

Filed Oct. 25, 1922

Fig. 1.

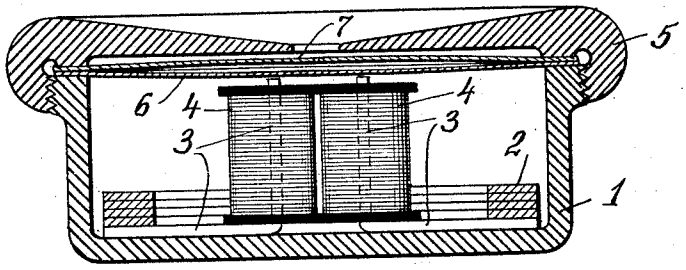


Fig. 2.

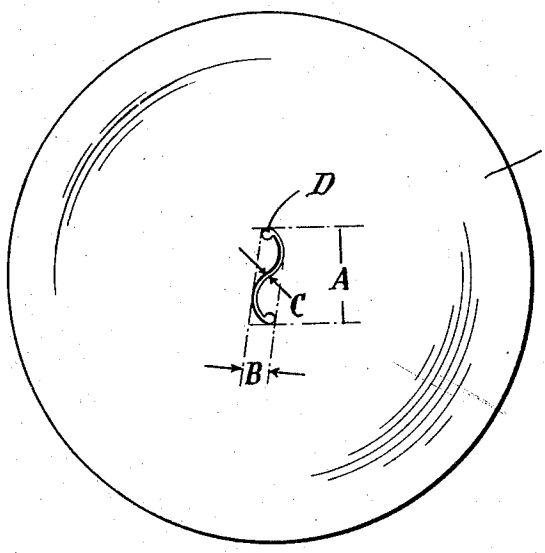
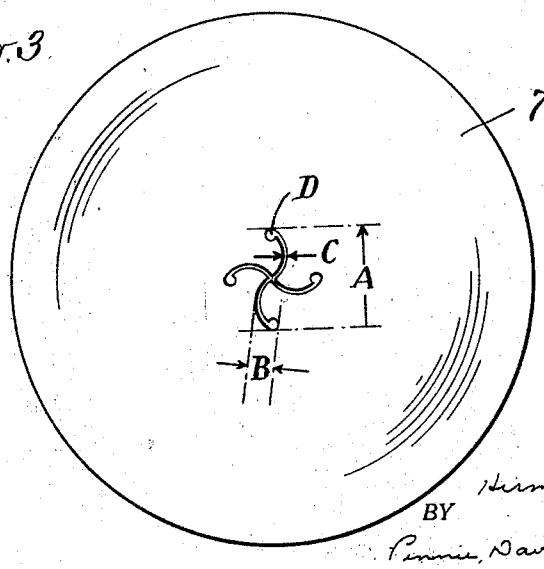


Fig. 3.



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UNITED STATES PATENT OFFICE.

HERMANN FISCHER, OF NEW YORK, N. Y., ASSIGNOR TO C. BRANDES, INC., A CORPORATION OF NEW YORK.

DIAPHRAGM FOR TELEPHONE RECEIVERS.

Application filed October 25, 1922. Serial No. 596,741.

To all whom it may concern:

Be it known that I, HERMANN FISCHER, a citizen of Russia, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Diaphragms for Telephone Receivers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to sound producing diaphragms and more particularly to diaphragms for use in telephone receivers.

The object of the invention is to effect an improvement in telephone receivers by increasing the volume of sound production for a given amount of input energy. In other words, the object is to increase the efficiency of telephone receivers.

As a result of extensive experimental work it has been found that a telephone receiver provided with two superposed or superimposed diaphragms will, under proper conditions, reproduce signals with substantially increased volume. The conditions apparently essential for the best results are—first, that the outer diaphragm, that is the diaphragm farthest from the magnet poles, should be perforated; second, that the diaphragms should be out of contact with each other at their center portions; and third, that they should be tightly clamped together at their peripheries. The first of these conditions is the only one which is absolutely vital to the attainment of improved response in accordance with the invention, while the last two conditions named are merely contributory to further improved response. It should not be presumed, however, that the last two conditions are immaterial. They are in fact quite vital, although relatively less vital than the first.

The invention, therefore, consists broadly in the combination of two superimposed or superposed diaphragms in which one only of the diaphragms is perforated. More specifically it consists of the aforementioned combination modified in that the two diaphragms are out of contact at their center portions, and still more specifically in that the two diaphragms are in intimate contact at their peripheral portions forming an air chamber having a column of air therein of a substantial depth.

It has been found that the outer diaphragm may be perforated in many different ways with varying degrees of improvement resulting. Some of the very best results, however, have been obtained with an outer diaphragm provided with a so-called *f*-hole or with a pair of crossed *f*-holes at the center portion thereof. The *f*-holes referred to are so called on account of their similarity in form to the *f*-holes of a violin and it is thought that the improved response resulting from their use is due to reasons somewhat akin to the reasons for their use in violins.

In my copending application Serial No. 596,629 filed October 24, 1922, there is disclosed a telephone diaphragm provided with an *f*-hole at its center portion. As pointed out therein, the improvement resulting from the provision of an *f*-hole or its equivalent as distinguished from other forms of apertures is that the lower notes of the musical scale are reproduced in more correct proportionate volume with respect to the higher notes than is the case with plain diaphragms such as are ordinarily used in telephone receivers. The reason for the improved response of a diaphragm provided with an *f*-hole is not definitely known, but the most plausible explanation which has been advanced is that the projecting portions of the diaphragm, which are defined by the *f*-hole, have a lower natural frequency than the diaphragm as a whole, and that they therefore respond to magnetic flux variations of lower frequencies with greater amplitude than the diaphragm as a whole, accordingly accentuating the lower notes which are ordinarily greatly attenuated.

The difference in resultant volume of response between the diaphragm provided with a single *f*-hole and one provided with a pair of crossed *f*-holes is very slight but the cumulative results of many tests indicate a slight advantage in favor of the latter. The preferred form of the invention, therefore, includes an outer diaphragm having a pair of crossed *f*-holes at its center portion.

No really plausible and reliable explanation of the operation of the present invention has yet been deduced, and for that reason no such explanation will be undertaken herein. Ample information, however, is

given in the detailed description hereinafter to enable those skilled in the art to practice the invention.

With reference to the accompanying drawing which forms a part of this specification, Fig. 1 is a cross-sectional view of a watchcase type double pole telephone receiver having a pair of superimposed diaphragms in accordance with the invention;

Fig. 2 is a plan view of a diaphragm having an *f*-hole at its center portion; and

Fig. 3 is a plan view of a diaphragm having a pair of crossed *f*-holes at its center portion.

The receiver shown in cross section in Fig. 1 is, in general, of the conventional double pole type comprising a casing 1 in which is mounted a permanent magnet 2 having a pair of polepieces 3, 3 which form cores for the windings 4, 4 and a threaded cap 5.

In addition, however, to the plain diaphragm 6, which is of the usual type, there is provided a second diaphragm 7, which is perforated preferably as shown in either of Figs. 2 or 3. Diaphragm 6 is normally somewhat dished at its center portion by reason of the magnetic attraction of the polepieces 3, 3 which are permanently magnetized, and the diaphragm 7 is preferably, although not necessarily, slightly dished in the opposite direction, that is upwardly, as viewed in Fig. 1. The dishing of the upper diaphragm 7 is to insure a definite separation between the adjacent surfaces of the diaphragms at the center portion, which it has been determined experimentally is essential to the best results.

In certain experiments in which excellent results were obtained the diaphragms were 2⅛″ in diameter, diaphragm 6 was .006″ in thickness, diaphragm 7 was .011″ in thickness, the dimension A of the *f*-hole was approximately 1/32″, dimension B was approximately 3/32″, dimension C was approximately .010″, and the diameter of the end holes D was approximately 1/64″. These dimensions are not at all critical, but are given merely for the purpose of a complete disclosure. It may be said, however, that the best results to date have been obtained with the dimensions stated and that distinctly less satisfactory results were obtained with diaphragms 7 of substantially less and substantially greater thickness than that given.

It is preferable that the peripheral portions of the diaphragms be tightly clamped together as indicated in Fig. 1, and they may advantageously be permanently secured together by soldering, brazing, welding or otherwise.

The increased response resulting from this invention is of such extent as to be distinctly apparent even to inexperienced persons.

It is not desired that the invention be construed as limited to the specific embodiment shown, but only by the scope of the appended claims.

I claim:

1. In a sound producing instrumentality, a pair of superposed diaphragms each contacting with the other at their respective peripheries and forming an air chamber therebetween, at least one of said diaphragms having a narrow aperture therein extending substantially along a diameter of said diaphragm, and means for actuating at least one of said diaphragms for producing sound vibrations.

2. In a sound producing instrumentality, a pair of superimposed diaphragms each contacting with the other at their respective peripheries and forming an air column therebetween, at least one of said diaphragms having an *f* shaped slot therein, and means for actuating at least one of said diaphragms for producing sound vibrations.

3. In a sound producing instrumentality, a pair of superposed diaphragms each contacting with the other at their respective peripheries, at least one of said diaphragms having a diametrically extending slot therein, said diaphragms jointly defining a chamber between their adjacent surfaces, and means for actuating at least one of said diaphragms for producing sound vibrations.

4. In a sound producing instrumentality, a pair of superimposed diaphragms, at least one of said diaphragms having a centrally positioned narrow slot therein, said diaphragms being secured together at their peripheral portions and separated at their center portions to enclose an air column, and means for actuating at least one of said diaphragms for producing sound vibrations.

5. In a sound producing instrumentality, a pair of superimposed diaphragms, at least one of said diaphragms being dished at its center portion so as to form, conjointly with the other of said diaphragms, a chamber enclosing an air column therebetween, at least one of said diaphragms being perforated with a narrow diametrically positioned slot, and means for actuating at least one of said diaphragms for producing sound vibrations.

6. In a sound producing instrumentality, a pair of superimposed diaphragms, one of said diaphragms being of substantially greater thickness than the other and dished at its center portion so as to form, conjointly with said other diaphragm, a chamber therebetween enclosing an air column, said dished diaphragm being perforated by means of an *f* shaped aperture for preventing interference between vibrating portions of said diaphragms, and means for actuating the thinner one of said diaphragms for producing sound vibrations.

7. In a sound producing instrumentality, a pair of superposed diaphragms, one of

said diaphragms being provided with an *f*-hole at its center portion, and means for actuating the other of said diaphragms for producing sound vibrations.

8. In a sound producing instrumentality, a pair of superimposed diaphragms having their respective peripheries in contact with each other, one of said diaphragms being provided with an *f*-hole and dished at its center portion so as to form, conjointly with the other of said diaphragms, a chamber therebetween enclosing an air column, and means for actuating one of said diaphragms for producing sound vibrations.

9. In a sound producing instrumentality, a pair of superimposed diaphragms having their respective peripheries in contact with each other, one of said diaphragms being provided with a pair of crossed *f*-holes and dished at its center portion so as to form, conjointly with the other of said diaphragms, a chamber therebetween enclosing an air column, and means for actuating one of said diaphragms for producing sound vibrations.

10. In a telephone receiver, a pair of superimposed diaphragms having their respective peripheries clamped together, one of said diaphragms being substantially thicker than the other, said thicker diaphragm being perforated at its center portion and dished, the concave side of said thicker diaphragm being adjacent the thinner one of said diaphragms, thereby forming a chamber therebetween enclosing an air column, and an electromagnet for actuating the thinner diaphragm for producing sound vibrations.

In testimony whereof I affix my signature.

HERMANN FISCHER.