April 14, 1931. L. W. SKALA 1,800,573

DIAPHRAGM

Filed Jan. 12, 1929

Fig. 1

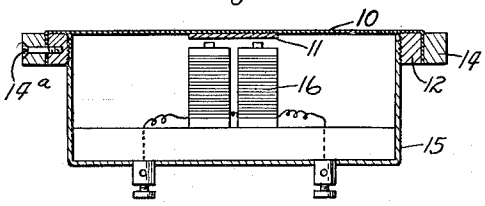


Fig. 3

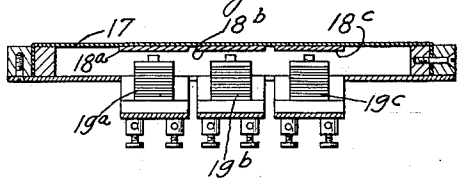


Fig. 2

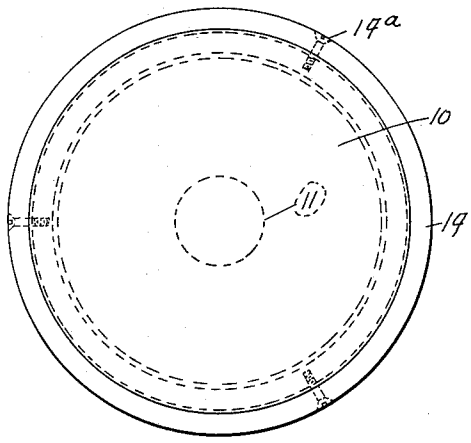


Fig. 4

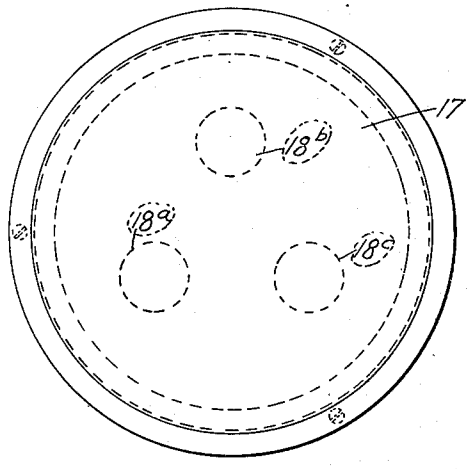
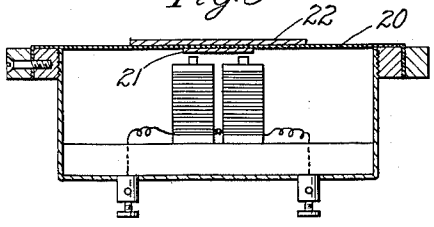


Fig. 5



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UNITED STATES PATENT OFFICE

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DIAPHRAGM

Application filed January 12, 1929. Serial No. 332,088.

The invention relates to diaphragms used in sound reproducing devices such as telephones, radio loud speakers and the like. In the art of mechanically reproducing sound it is of the utmost importance to produce a tone which is a natural one and great strides have been made toward effecting this aim.

The object of the invention is to produce a diaphragm which is capable of producing a tone having the characteristics and qualities of a natural tone.

In order to obtain the results contended for certain conditions must be overcome which play an important part in attaining the desired effect. The diaphragms hitherto employed are not satisfactory because the color or timbre of the produced tone is not natural as metallic diaphragms and parts are used which render the tone artificial and unnatural. If the human ear were possessed of a metallic membrana tympani, the sound produced by a metallic diaphragm would be more pleasant than obtains under present conditions. However, the tone impinging upon organic elements is most natural when originating from organic sources. This is easily demonstrated by a string instrument such as a violin where tones may be produced on organic as well as metal strings. Again in radio loud speakers almost natural tones may be produced where the diaphragms are constructed from organic material such as paper, linen, wood, or the like and the metal parts are limited to a minimum. Inasmuch as the diaphragm is magnetically influenced by the electromagnets, the total elimination of metal for the diaphragm is impossible and explains the fact that the problem of producing a natural tone is still unsolved.

Another factor which renders natural tone production difficult is a chemical one. If pure metal could be utilized precluding any oxidation the timbre of the tone would not be influenced to such a degree as obtains at present where iron diaphragms coated with shellac are used.

Where however, the aluminum and mica diaphragm is used the chemical influence is lessened, but to obtain this advantage a magnetic mechanical sound transferring means has to be utilized with the entailing inefficiency in frequency and intensity of the tone.

A further fact which is important in the problem of natural sound reproduction is the combination effect of an organic and metallic element such as the G string of a violin, where a wire is closely threaded around the organic string and a timbre of tone nearest to that of a human voice is produced.

It therefore constitutes the main object of the invention to produce a diaphragm which will eliminate the disadvantages of the known metallic and non-metallic diaphragms.

Other and equally important objects of the invention will become apparent from a persual of the invention described in the following specification, particularly pointed out in the claims forming a part thereof and illustrated in the accompanying drawing in which

Fig. 1 is a cross section through a diaphragm constructed in accordance with my invention.

Fig. 2 is a top plan view of the parts shown in Fig. 1.

Fig. 3 is a cross section through a modification.

Fig. 4 is a top plan view of the parts shown in Fig. 3 and

Fig. 5 is a detail view of a further modification.

Referring to Fig. 1, 10 designates a membrane preferably made of a sheet of pure parchment but any other organic material such as paper, skin, wood or the like may be used. To the center of the membrane is secured, but not by mechanical means, a

metal plaque or coating 11. The membrane 10 is drawn around a frame 12 and secured thereto by a ring 14. The frame 12 may be made of any suitable non-magnetic metal or any other suitable material such as bakelite, wood or the like. The frame 12 may be adapted to telephone receivers or radio loud speaking units 15 having the electromagnets 16 or to any other sound reproducing device.

The diaphragm is produced by first moistening a sheet of parchment and secured to the frame 12 by the ring 14 held in place by screws 14*a*. The diaphragm is then permitted to become dry and in this condition is taut. Then the metallic center 11 is applied by the known cathode sputtering process (Dr. L. R. Ingersoll J. O. S. A. and R. S. L. Dec. 8, 1923). The parts of the diaphragm not to be covered by the metal deposit is shielded by suitable material such as glass, mica or the like and the diaphragm is suitably cooled during the sputtering process. The cathode is of chemically pure iron or other magnetic material.

The process of cathode sputtering is not described herein as it is well known and is only used as a method for securing a metal plaque or coating to the diaphragm by non-mechanical means. It is understood that I do not limit myself to the sputtering process. The plaque 11 may be produced by depositing the metal by a process using iron or nickel carbonyls ($Fe(CO)_5$ or $Ni(CO)_4$) or any other possible magnetic metal or alloy produced by the carbonyl method.

Attention is called to the fact that the chemical purest metal can be obtained by the aforementioned processes and the thickness of the coating can have any desired dimension.

Upon the plaque being produced it is immediately protected against oxidation by a coating of collodion or other suitable organic or inorganic material. The diaphragm is now ready for use and is mounted in a sound reproducing device in any desired or suitable manner.

The indirect magnetically or mechanically influenced diaphragm will have the same tone properties. However, in this case the metal center or plaque may be of any other non-magnetic metal.

In Figs. 3 and 4 the diaphragm 17 has a plurality of metal plaques 18*a*, 18*b*, 18*c* controlled by a like number of electromagnets 19*a*, 19*b*, 19*c*. This arrangement is especially advantageous for radio loud speakers where not only the natural timbre of the tone but also perspectivity or plasticity is produced.

The electromagnets may be connected in parallel but the series connection is preferred on the theory that sound being heard does not reach simultaneously the two human ears but successively even though the interval is infinitesimally small. Similarly the electromagnets when connected in series will operate successively and thus act with the same time interval as the human ears.

Fig. 5 depicts a further improvement of the diaphragm. As shown the diaphragm 20 is not only provided with a metal plaque 21 on the electromagnetic side, but also contains on the opposite side a thin and elastic film 22 of a non-magnetic metal, preferably precious metal such as gold or silver, although any other kind of metallic film properly shielded against oxidation may be used. The thickness of the film which influences the timbre of the tone may be determined experimentally.

Attention is called to the fact that the diaphragm 10 held by the ring 14 can be placed in more or less tight condition which results in a tuning of the diaphragm entailing a different pitch of the sound produced, such as is practiced with drums to vary or alter the pitch upon striking their diaphragms.

In order to tune the diaphragm 10, the screws 14*a* are loosened and the ring 14 is shifted either upwardly or downwardly to vary the tension of the diaphragm and after such adjustment, the screws are then tightened again. It is, of course, within the scope of the invention to provide other means for effecting adjustment of the tension of the diaphragm.

While the drawing discloses a preferred embodiment of my invention, various changes and alterations may be made within the scope of the invention. I, therefore, do not limit myself to the details of construction or arrangement as shown but claim my invention as broadly as the state of the art permits.

I claim:

1. A diaphragm comprising an organic membrane and a metal armature secured thereto by cathodical impact.

2. A diaphragm comprising an organic membrane and a metal armature of restricted dimension secured thereto by cathodical impact.

3. A diaphragm comprising an organic membrane and a plaque of magnetic metal secured thereto by electrical impact.

4. A diaphragm comprising an organic membrane, a plaque of magnetic metal on one side of said membrane and a film of non-magnetic metal on the other side of said membrane, said plaque and said film being secured by electrical impact.

5. A diaphragm comprising an organic membrane, a metal armature secured thereto by cathodical impact, and means for adjusting the tension of said membrane.

6. A diaphragm comprising an organic membrane, and a plurality of centers secured to said membrane by cathodical impact.

7. A diaphragm comprising an organic

membrane, and a plurality of independent centers secured to said membrane by cathodical impact.

8. A sound reproducing device comprising a diaphragm, a plurality of independent sound reproducing centers secured thereto by cathodical impact, and electro-magnetic means for influencing said members in phase relation.

In witness whereof I affix my signature.

LJUBOMIR W. SKALA.