Nov. 6, 1923. 1,472,830

J. A. HACKER

DIAPHRAGM FOR SOUND CONVEYING INSTRUMENTS

Filed Jan. 3, 1921

Fig. 1.

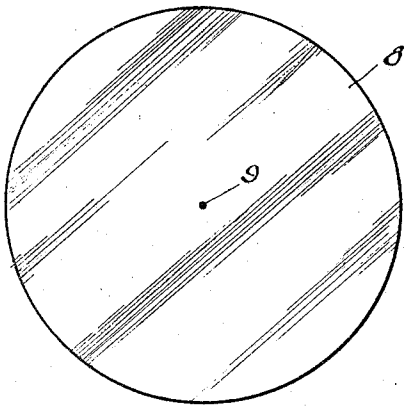

Fig. 2.

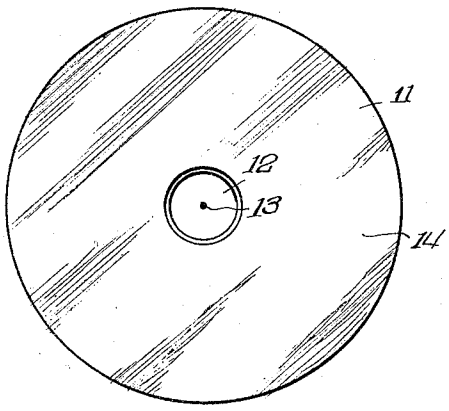

Fig. 5.

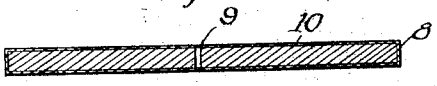

Fig. 6.

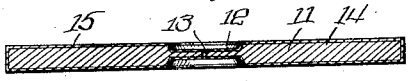

Fig. 3.

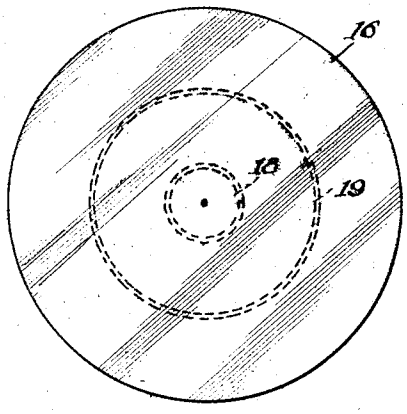

Fig. 4.

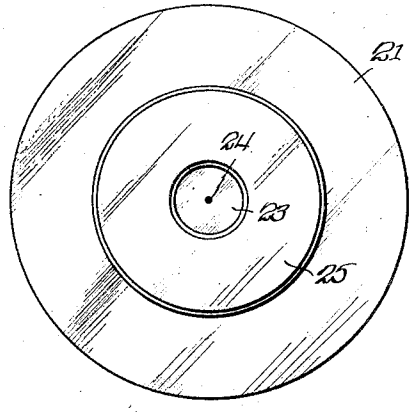

Fig. 7.

Fig. 8.

Inventor:
Josephus A. Hacker

By Jones, Addington, Ames & Seibold Attys

Patented Nov. 6, 1923. 1,472,830

UNITED STATES PATENT OFFICE.

JOSEPHUS A. HACKER, OF CHICAGO, ILLINOIS.

DIAPHRAGM FOR SOUND-CONVEYING INSTRUMENTS.

Application filed January 3, 1921. Serial No. 434,428.

To all whom it may concern:

Be it known that I, JOSEPHUS A. HACKER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Diaphragms for Sound-Conveying Instruments, of which the following in a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention relates to diaphragms for sound-conveying instruments and the process of making these diaphragms, and more particularly to acoustic reproduction diaphragms for talking machines, telephones, dictagraphs, and the like.

One of the objects of this invention resides, therefore, in the production of a diaphragm and the process for producing said diaphragm which will give a fuller tone, greater depth of tone and finer acoustics, and give a true reproduction of either the voice or instruments, and which will at the same time eliminate most of the objectionable features now found in the ordinary commercial metal and mica disc diaphragms. These results are obtained by making the improved diaphragm of a porous or cellular material, preferably fiber, the diaphragm so constructed being thoroughly impregnated and coated with a solution of cellulose. The impregnation and the coating of the diaphragm renders it impervious to moisture and renders it free from the effects of climatic changes. It also produces a diaphragm which gives a truer reproduction and which gives a clear, loud, full and distinct tone and also substantially eliminates all discordant noises, such as scratching, etc. A diaphragm made in accordance with the teachings of this invention will truly reproduce the most delicate sounds with softness and clear and distinct volume.

Another object of the invention resides in the physical shape of the diaphragm thus constructed, whereby a truer reproduction of voice or instruments will be further enhanced.

Other objects of the invention will become apparent from the following description. the accompanying drawings and the appended claims.

For the purpose of description, the accompanying illustrations are included, which show preferred forms of diaphragms, which diaphragms, in order to give the best results, should be constructed and treated as hereinafter described. In the drawings—

Fig. 1 represents a plan disc diaphragm;

Fig. 2 shows a disc diaphragm with a compressed and hardened center;

Fig. 3 shows a disc diaphragm having a depressed and hardened center as well as a depressed and hardened circumferential ring on one face of the disc, the other face of the disc being flat;

Fig. 4 shows a diaphragm having a depressed and hardened center and a circumferential compressed and hardened ring, the compression being applied so as to obtain a depression on either side of the diaphragm; and

Figs. 5, 6, 7 and 8 are transverse sections of the discs illustrated in Figs. 1, 2, 3 and 4, respectively.

The diaphragms shown in the illustrations are preferably made by my improved process. This process may be practiced in a number of ways, the two preferred ways being described in the following.

One manner of practicing this process consists in making a solution of cellulose and then mixing in this solution the material—preferably fiber—from which the diaphragm is to be constructed. The preferred solution of cellulose in which the diaphragm material is impregnated is obtained by dissolving nitro-cellulose in a solvent containing equal parts of alcohol and ether. To this solution a small quantity of acetanilide is added for hardening purposes, as well as a small amount of boracic acid which serves as a fireproofing agent. Obviously, any other suitable form of cellulose, as well as the solvent therefor, could be utilized, and likewise other forms of hardening and fireproofing material could be substituted for the acetanilide and the boracic acid. The solution is preferably prepared by dissolving 1 pound of nitro-cellulose in the alcohol and ether solvent. The amount of solvent necessary will depenl upon the viscosity of the solution which is ultimately desired. When 1 pound of nitro-cellulose is thus dissolved, 1 ounce of acetanilide and 1 ounce of boracic acid are preferably added. The amount of acetanilide and boracic acid may be varied, however, depending upon the degree of hardness which is ultimately desired

and the amount of fireproofing material which it is deemed necessary to include in the solution. The figures given above as to the amounts of the materials used to obtain the cellulose solution may all be varied, the proportions depending upon the desired viscosity of the ultimate solution. In using the impregnating material, it is desirable to use an initial solution which is comparatively light in viscosity and density and to use for the final impregnation a solution of substantially greater density and viscosity. A plurality of solutions of varying densities and viscosities can also be used, the material which is being immersed or impregnated being successively dipped in these various solutions of increasing density and viscosity. The material after each dipping should be thoroughly dried before immersing in the next solution of greater density. The material which is placed in this solution of cellulose must be thoroughly disintegrated before it is placed in the solution, and enough of this material should be added so as to give the mixture the proper density which is desired. Ordinarily the density of this solution should be such as to represent a thick pasty solution. After this mixture has been prepared it is poured into molds of the desired shape and then compressed, so as to obtain a finished article of the shape desired. The compression of this mixture in the molds will result in a finished diaphragm which is thoroughly impregnated with the solution of cellulose and which will have an exterior surface or shell of somewhat glossy appearance composed of the hardened and dried solution of cellulose.

The diaphragms are preferably made in another manner, as, for example, by using a plurality of sheets of the material such as fiber, paper, etc., from which the diaphragm is to be constructed and immersing these sheets in the solution of cellulose. The sheets, after being so immersed, are then stacked one on top of the other until the proper thickness of diaphragm is obtained after which the assembled sheets are given another immersion in the impregnating solution. This solution in which the assembled sheets are impregnated is preferably a solution of substantially greater viscosity and density than the solution used for the impregnation of the individual sheets prior to the time that they are stacked one on top of the other to form the assembled diaphragm. Obviously, as hereinbefore described, the sheets should be thoroughly dried between the immersions; likewise, if desired. instead of subjecting the sheets to but two immersions, they may be subjected to a plurality of immersions in solutions of increasing viscosity and density as hereinbefore set out. The diaphragm constructed of the assembled sheets, the individual sheets of which were individually immersed in a light solution of cellulose, and the assembled sheets of which were immersed in a solution of greater viscosity and density is placed in a mold and compressed to obtain the desired form.

The non-aqueous solution of cellulose in both of these described processes acts as a waterproofing to render the diaphragm impervious to moisture, and also functions as a cement to thoroughly bind together the particles from which the diaphragm is constructed.

In the process of making the diaphragms of sheets. obviously the sheets may be treated to the solution of cellulose by flowing the solution on the sheets or by applying it with a brush, but the immersion process is the preferable one.

In making diaphragms of this character, fiber is the preferable material used, but any porous or cellular material capable of absorbing the solution of cellulose could obviously be used.

Referring to the illustrations, Fig. 1 is a plain disc diaphragm made according to this improved process, and consists of the circular disc 8 fitted with the central hole 9 to receive the arm from the reproduction needle. The disc should be thoroughly impregnated with the solution of cellulose, as above described, and then compressed. Due to this operation the disc will have an exterior glossy surface or shell 10 composed of the dried and hardened non-aqueous solution.

Fig. 2 represents a second form of disc treated in the same manner and comprises the disc 11 having the compressed central portion 12 and the perforation 13 to receive the arm from the reproduction needle. The central compressed portion 12 is considerably harder than the outer portion 14 and thus gives a suitable surface for properly attaching the arm from the reproduction needle. The disc 11 likewise has an outer shell 15 of the compressed and dried solution of cellulose.

Fig. 3 shows another form of diaphragm comprising the disc 16 having a compressed outer ring 17, a compressed center 18 and an intermediate non-compressed ring 19. The central compressed portion is fitted with the perforation 20 to receive the arm from the reproduction needle.

Fig. 4 illustrates another form of diaphragm, similar to the diaphragm illustrated in Fig. 3 with the exception that the depressions shown on but one side of the diaphragm in Fig. 3 are extended to both sides of the diaphragm in Fig. 4. Thus in this figure the disc 21 comprises the compressed circumferential ring 22 and the compressed central ring 23 fitted with the central perforation 24 to receive the arm from the

reproduction needle. Intermediate between these two compressed rings is the ring 25 of less compressed material. The form of diaphragm illustrated in Figs. 4 and 8 in practice has given the best results, although any of the forms illustrated, when treated according to the new process as herein described, give results which are very much superior, in quality of tone and trueness of reproduction, to any of the commercial forms of mica and metallic discs.

Obviously this invention is not limited to the specific embodiment thereof herein illustrated and described, but other forms and variations and other applications are included within its spirit and scope, as set out in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. As a new article of manufacture, an acoustic diaphragm consisting of a cellular material impregnated in a solution of cellulose, said diaphragm having a small portion of greater density than the remainder of the diaphragm.

2. As a new article of manufacture, an acoustic diaphragm comprised of cellular material impregnated in a solution of cellulose, said diaphragm having a depressed central portion harder than the remainder of the diaphragm.

3. As a new article of manufacture, an acoustic diaphragm consisting of a plurality of sheets of material impregnated in a solution of cellulose, said sheets of material being assembled one on top of the other, and the assembled sheets being impregnated in a solution of cellulose of greater viscosity and density than said first mentioned solution, said assembled sheets, after said second impregnation, being compressed in a mold to obtain the desired physical contour of the diaphragm.

In witness whereof I have hereunto subscribed my name.

JOSEPHUS A. HACKER.