

Feb. 6, 1934.

C. CHILOWSKY ET AL
PROCESS FOR THE MANUFACTURE OF DIAPHRAGMS ADAPTED
FOR USE IN PHYSICAL OR LIKE APPARATUS
Filed Dec. 20, 1929

1,945,933

2 Sheets-Sheet, 1

Fig. 1

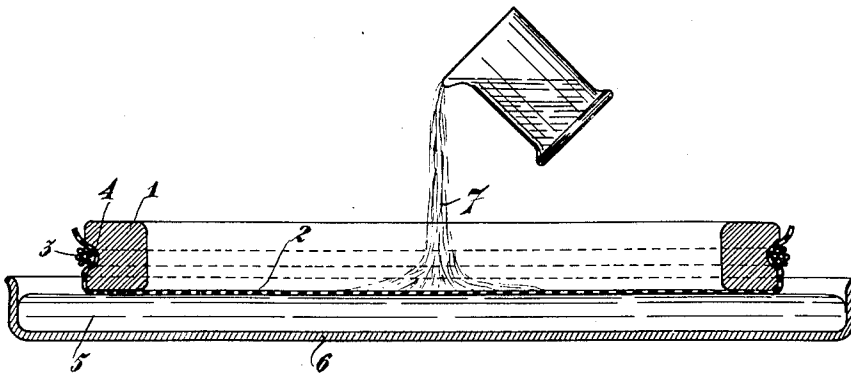


Fig. 2.

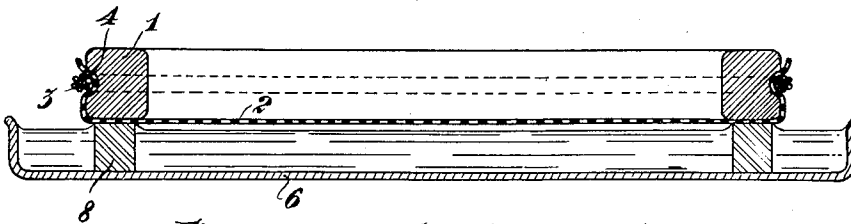


Fig. 3

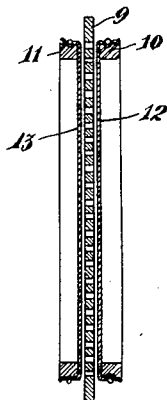


Fig. 4

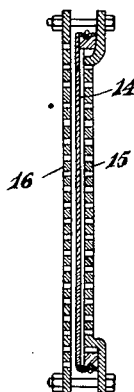
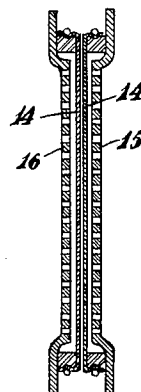


Fig. 5



Inventors:
Constantin Chilowsky & Paul Breton
By Mauro & Lewis
Attorneys.

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Fig. 6

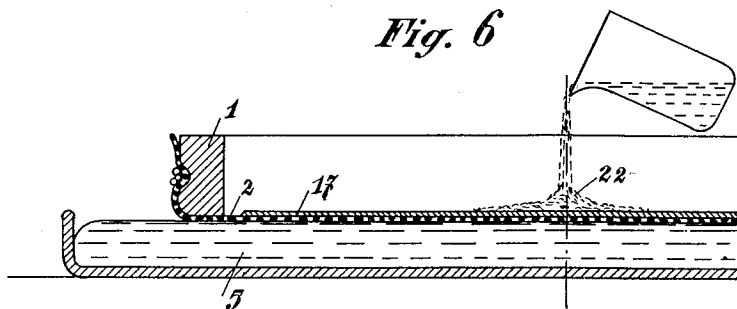


Fig. 7

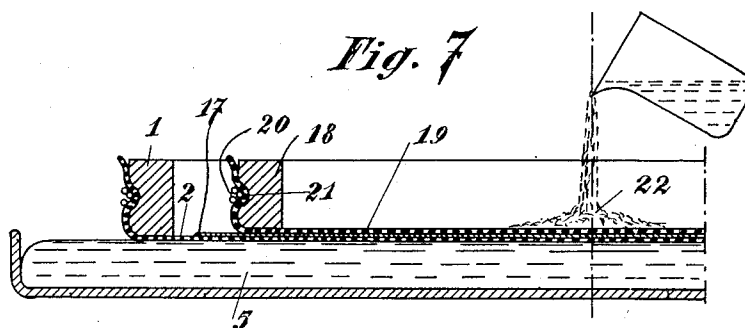
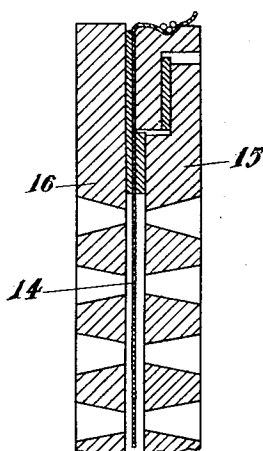


Fig. 8



Inventors:

Constantin Chilowsky + Paul Breton

By *Mauro + Lewis*
Attorneys

UNITED STATES PATENT OFFICE

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PROCESS FOR THE MANUFACTURE OF DIAPHRAGMS ADAPTED FOR USE IN PHYSICAL OR LIKE APPARATUS

Constantin Chilowsky, Paris, and Paul Breton,
Bellevue, FranceApplication December 20, 1929, Serial No. 415,598,
and in France December 28, 1928

8 Claims. (Cl. 18—57)

The present invention relates to the construction of diaphragms which may be employed in acoustic, optical and other apparatus, and are chiefly adapted for use in loud-speaking apparatus. The invention provides for the construction of light diaphragms of all sizes which comprise a suitable backing or stiffening member and have a regular texture and a uniform tension, as well as a great strength against mechanical and electric action, and they are not subject to deformation in the course of time.

The said invention chiefly consists in the construction of such diaphragms by the use of a light backing or reinforcing member which is stretched upon a suitable frame and is disposed above a liquid, and upon which is poured a determined quantity of varnish, paint, collodion or any other liquid adapted to produce a film by the evaporation of the solvent, said backing or reinforcing member being permeable to the varnish, paint, collodion, or like liquid.

Such construction comprises various modifications which will be hereinafter described, relatively to the manufacture of an electrically conducting diaphragm, and chiefly for the obtaining of a diaphragm whose conducting portion is situated within the body of the diaphragm, thus affording a perfectly symmetrical diaphragm in which the said conducting portion is contained within the varnish and is insulated by the latter.

The following description with reference to the accompanying drawings which are given by way of example discloses the manner in which the said invention may be carried into effect.

Figure 1 is a sectional view of a diaphragm which is obtained by the use of a vessel containing mercury.

Figure 2 is a sectional view of a diaphragm which is obtained by the use of any suitable liquid.

Figures 3, 4 and 5 are sectional views showing the use of such diaphragms for loud-speakers of the electrostatic type.

Figure 6 is a sectional view showing the construction of an electrically conducting diaphragm.

Figure 7 is a like view of an analogous construction.

Figure 8 is a sectional view of a loud-speaker of the electrostatic type employing a diaphragm constructed in conformity to the invention.

The construction of a diaphragm in conformity to the invention is effected by the use of a rigid frame 1 upon which is stretched a supporting member or backing 2 of silk muslin, press-point, stretched wires or threads or the like, which is maintained by the binding members 3 in the

groove 4. The whole device is disposed upon the surface of mercury 5 contained in a flat vessel 6. The necessary amount of varnish 7 is poured upon the center of the said frame 1. Since the level of the mercury is quite horizontal, the varnish will spread out in the form of a uniform layer, intimately impregnating and surrounding the said supporting member and also causing it to adhere to its supporting frame. The solution evaporates and leaves a film, and this, in combination with the said backing member, will constitute the diaphragm. The unit consisting of the frame together with its adhering diaphragm is then removed, and the operation can be recommenced with another frame having a backing member stretched thereon or with the same frame provided with another backing member, the diaphragm manufactured as above set forth being first removed, in order to produce a second diaphragm, and so on.

According to the quantity of varnish employed, diaphragms which are more or less light and more or less stretched can be thus obtained.

The said backing member confers upon the diaphragm great mechanical strength without appreciably increasing its weight, and the diaphragm can thus be stretched without danger of tearing.

If an insulating varnish is used, such as a cellulose acetate varnish, the diaphragm may have a high electric resistance, which will be advantageous for certain uses, and chiefly for loud-speakers of the electrostatic type.

In the case in which mercury is not to be employed for any reason, use can be made of any other suitable liquid which will not mingle with the varnish, but in this case certain precautions must be taken in order that the backing member will not be moistened and impregnated with the liquid, and that the frame and backing device will not be immersed in the liquid by its own weight.

The backing member is mounted on its frame as in the preceding case, but the device is not disposed directly upon the liquid as took place with the mercury (Figure 1), and in this event the device (Figure 2) is supported by spacing members 8 (Figure 2) which allow a space between the liquid and the backing whereby the latter will not be moistened; the varnish is then poured upon the central part as in the preceding case.

It is also feasible, to avoid separating the backing member from the surface of the liquid to an excessive degree, to first pour the varnish upon the liquid and allow it to spread upon its sur-

face, and the device consisting of the frame and backing is then placed upon the layer of varnish.

The said diaphragms can be used for example in loud-speaking apparatus of the electrostatic type, and herein we may use a very light silk muslin as the backing, and the varnish consists principally of cellulose acetate dissolved in a suitable solvent, of which several are known. After the said diaphragm has been produced in this manner, it is coated with metal by cementing to it a very thin leaf of metal, or by spraying it with metal by the known pistol apparatus, or by the use of any other process.

For the construction of a loud-speaker of the electrostatic type (Figure 3) consisting of a stationary stiffening member 9 pierced with holes, and of two movable diaphragms 10—11, these latter may be metal-coated on the outside at 12—13, and are maintained at a certain distance from the said stationary backing member by suitable means such as spacing strips, or by keeping the space between the diaphragm under pressure or vacuum.

For the construction of a loud-speaker of the electrostatic type (Figures 4 and 5) consisting of a movable diaphragm 14 disposed between two stationary stiffening members 15 and 16, pierced with holes, the movable diaphragm may be coated with metal on both sides, or may consist of two diaphragms placed together and metal-coated on the two faces in contact. The distance between the said stiffening members and the diaphragm can be adjusted as in the preceding case.

To obtain an electrically conducting diaphragm in which the conducting portion is situated within the substance of the said diaphragm, the following methods can be employed.

It is feasible to proceed as above described, but in the first place the light backing 2 of silk or the like is made conducting by coating it with metal, or by using a backing material which is itself a conductor of electricity, or otherwise, while still proceeding as above mentioned, suitable metallic particles are placed in suspension in the varnish.

We may however proceed as shown in Figure 6, and herein one side of a backing member of the kind represented in Figures 1 to 5 is coated with metal by any suitable process; the said member is placed in contact with the liquid 5 with its metal-coated face exposed upwards and a layer of varnish 22 is poured thereon, which layer evaporates and leaves a film upon the metal-coated surface by which it is protected and also electrically insulated.

Another method may be employed:—

Use is made of a diaphragm constructed according to Figures 1 to 5, and this is coated with metal in the interior of the ring support or frame 1 at 17, either by cementing a very thin leaf of metal, or by the metal straying process, or the like, or a frame 1 can be used upon which is stretched a light backing member of silk muslin, press-point, stretched threads, or the like, this being held at its edge 3 in the groove 4, and the whole is placed upon the surface of the liquid 5, use is then made of a second support 18 (Figure 7) consisting of a rigid frame which may be disposed in the interior of the said frame 1, and upon it is stretched a light backing 19, of silk muslin, press-point, stretched threads or the like, which is held by the binding members 20 in the groove 21. This second support is disposed in the said support 1 and upon the metal-coated surface, then the proper quantity of varnish 22

is poured in at the center of the frame 18. As the level of the liquid is quite horizontal, the varnish will spread regularly, and is thus forms a layer of uniform thickness which impregnates and surrounds the backing member 19 in an intimate manner, and causes it to adhere to the diaphragm and to its supporting frame 18. The solvent of the varnish evaporates, and the backing 1 is cut off around the frame 19, thus obtaining a symmetrical diaphragm forming a unit element together with its frame 18, and in which the metal coating is situated in the interior of the mass.

It is particularly advisable to employ in this process suitable varnishes which will contract on drying, in order to obtain the homogeneity of the diaphragm and a regular tension. Such a varnish may consist of a solution of cellulose acetate in amyl acetate.

According to the quantity of varnish employed, diaphragms which are more or less light and are more or less stretched may be obtained.

Such diaphragms are particularly adapted for use in electrostatic loud-speakers, and chiefly in the case in which they comprise a movable diaphragm 14 disposed between two stationary perforated stiffening members 15 and 16 (Figure 8).

Many specific materials might be named as examples of the varnish, paint or colloid referred to herein as suitable for use in the manufacture of diaphragms according to this invention. Among those materials preference is given to solutions of cellulose acetate and to the general class of cellulose esters, many of which possess in high degree the properties needful for the specified use. Lists of solvents of cellulose esters may be found in any treatise relating to that class of chemical substances (see for example, Worden, Technology of Cellulose Esters, published by D. Van Nostrand, New York). It is to be understood, however, that the invention is not restricted to the use of any particular material or class of materials, but includes all suitable solutions which have the property of forming a film upon evaporation of the solvent.

Obviously, the invention is not limited to the apparatus hereinbefore described, but it comprises all modifications of the aforesaid constructions which are given solely by way of example, as well as all other suitable modifications, comprehended within the scope of the appended claims.

What we claim is:—

1. A process for the manufacture of diaphragms having backing members permeable to fluids, which consists in stretching said backing members in disposing said stretched members above a liquid and at a distance from the surface of said liquid which is less than the desired thickness of said diaphragm, in pouring upon said backing members, in the form of a fluid adapted to coagulate, the substance which is to constitute the diaphragm, and in allowing the said fluid to coagulate, for the purpose set forth.

2. A process for the manufacture of diaphragms having backing members permeable to fluids, which consists in stretching said backing members, in disposing said stretched backing members above a liquid, in maintaining a suitable distance between said backing members and the liquid whereby the said liquid will not moisten the backing members, said distance being less than the desired thickness of the dia-

phragm, in pouring the substance which is to constitute the said diaphragm upon the backing members, in the state of a component of a fluid adapted to evaporate and thus leave the coagulated substance, in allowing the fluid thus poured to dry, for the purpose set forth.

3. A process for the manufacture of cellulose diaphragms having suitable backing members permeable to fluids, which consists in stretching said backing members, in disposing said stretched backing members above a liquid and at a distance therefrom which is less than the desired thickness of said diaphragm, in pouring upon said backing members a cellulose solution comprising a volatile solvent, and in allowing the said solvent to evaporate.

4. A process for the manufacture of diaphragms consisting of cellulose acetate and having backing members, which consists in stretching said backing members permeable to fluids, in disposing said stretched members above a liquid and at a distance therefrom which is less than the desired thickness of said diaphragm, in pouring upon said backing members a solution of cellulose acetate in a volatile solvent thereof, and in allowing the said solvent to evaporate whereby there will remain a stretched backing member imbedded in cellulose acetate varnish.

5. A process for the manufacture of electrically conducting diaphragms having backing members permeable to fluids, which consists in stretching said backing members, in disposing said stretched backing members above a liquid and at a distance therefrom which is less than the desired thickness of said diaphragm, in pouring, in the form of a fluid adapted to coagulate, the substance which is to compose the said diaphragm upon the said backing members, in allowing the said fluid to coagulate, and in coating one face of the resulting diaphragm with a conducting layer.

6. A process for the manufacture of electrically conducting diaphragms having backing members permeable to fluids, which consists in stretching said members, in disposing the stretched backing members above a liquid and

at a distance therefrom which is less than the desired thickness of said diaphragm, in pouring, in the form of a fluid adapted to coagulate, the substance which is to compose the said diaphragm upon said backing members, in allowing the said fluid to coagulate, and in coating one face of the resulting diaphragm with a conducting layer by spraying metal powder upon the said face.

7. A process for the manufacture of electrically conducting diaphragms having backing members permeable to fluids, which consists in stretching said backing members, in disposing said stretched backing members above a liquid and at a distance therefrom which is less than the desired thickness of said diaphragm, in pouring, in the form of a fluid adapted to coagulate, the substance which is to compose the said diaphragm upon said backing members, in allowing the said fluid to coagulate, and in coating one face of the resulting diaphragm with a conducting layer, in disposing said diaphragm upon the liquid in such manner that its exposed face will be the one covered by the conducting metal, and in covering the said conducting part with an insulating layer, for the purpose set forth.

8. A process for the manufacture of electrically conducting diaphragms having backing members permeable to fluids, which consists in stretching said members, in disposing said stretched backing members above a liquid and at a distance therefrom which is less than the desired thickness of said diaphragm, in pouring, in the form of a fluid adapted to coagulate, the substance which is to compose the said diaphragm upon said backing members, in allowing the said fluid to coagulate, and in coating one face of the resulting diaphragm with a conducting layer, in stretching other backing members, in disposing such members above the said conducting layer, in pouring the substance which is to form the remainder of the said diaphragm upon said backing members in the state of a fluid adapted to coagulate, and in allowing said fluid to coagulate, for the purpose set forth.

CONSTANTIN CHILOWSKY.

PAUL BRETON.

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