Dec. 11, 1934. J. B. HAWLEY 1,984,018

ART OF AND MEANS FOR MAKING SOUND PRODUCING ARTICLES

Filed July 20, 1931

Fig. 2.

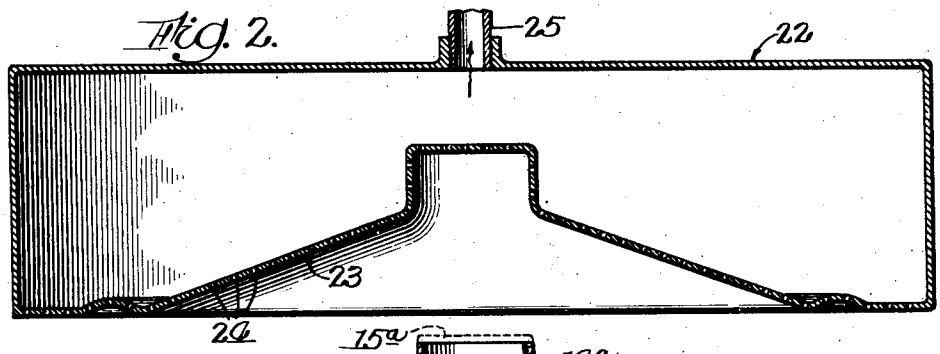



Fig. 4.

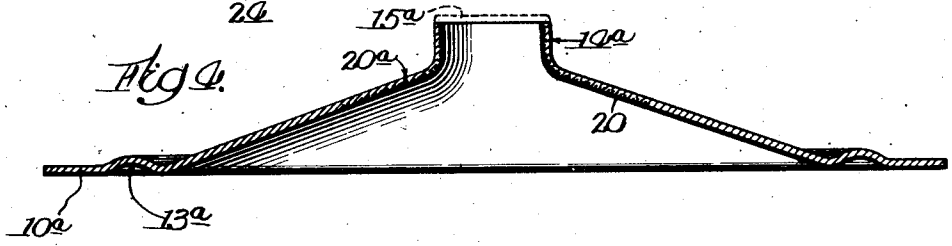



Fig. 3.

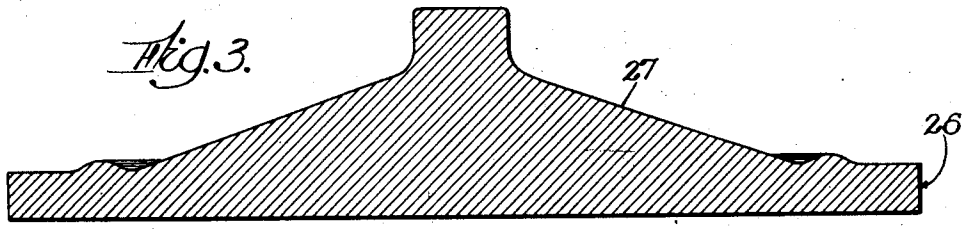
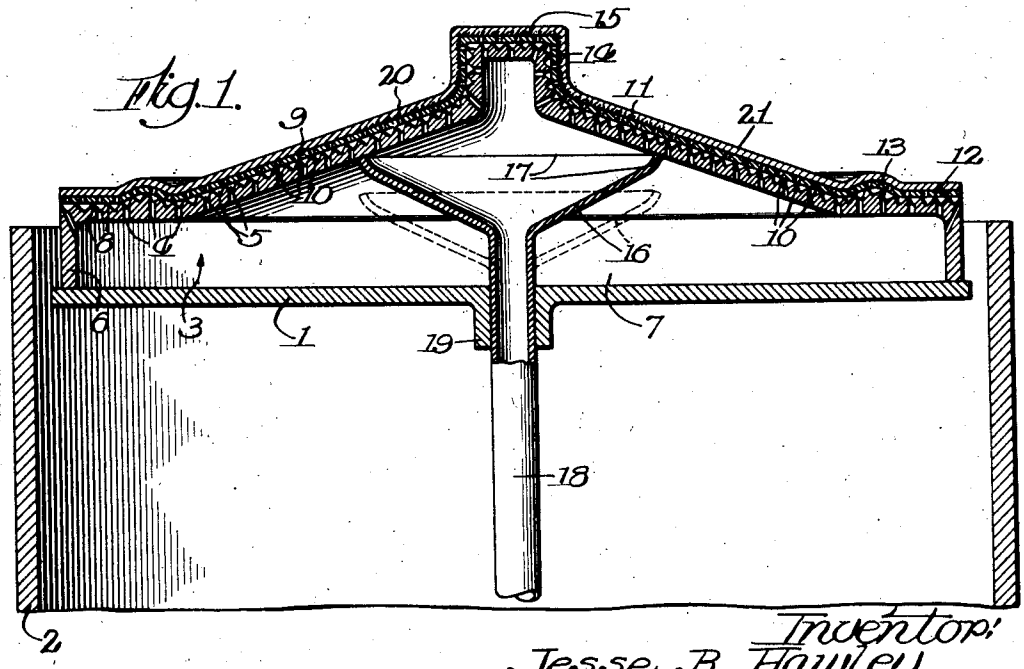



Fig. 1.




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# UNITED STATES PATENT OFFICE

1,984,018

## ART OF AND MEANS FOR MAKING SOUND PRODUCING ARTICLES

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Application July 20, 1931, Serial No. 551,965

7 Claims. (Cl. 92—57)

The present invention relates to the making or producing of sound producing members or the like, particularly those of the fibrous kind.

Among the objects of the invention is to provide a novel sound producing member or article, preferably of the diaphragmatic type. A specific illustrative embodiment of it is shown as conical or conic in form. It is composed of material, preferably moldable, accretable, and integratable fibrous material, having water or moisture proofing characteristics or properties. If the diaphragm be first made of fibrous material, and then, after drying, it be coated and impregnated with proofing substances, the diaphragm becomes loaded, whereby it possesses inertia to free movement of the diaphragm when vibrated to propagate or generate sound. The impregnation is not thorough nor uniform, and some parts of the treated diaphragm will be affected by climatic conditions.

One of the purposes of this invention is to avoid the disadvantages mentioned, by first proofing the material before it is molded, formed, accreted, integrated, and united upon a novel porous former.

Another object of the invention is to provide a novel method or process for making such novel device whereby the device will be light in weight so as to have little inertia and momentum, will be dense and stiff in given parts, such as the vibratile part, will be more rapidly produced by simpler operations and at less expense and cost than heretofore, will be produced on an increased capacity of production, will be dried more quickly, will be more accurately and uniformly made, may be compressed as desired, will have sharper or more distinct features, as angles and the like, will eliminate treatments heretofore necessary to provide stiffness in given parts, as also proofing after article is completed, will be smoother and have a better appearance so that it may be exposed, will be susceptible to decoration for esthetic effects, if desired, and will produce sound with a rendition true to the original sound being reproduced by the diaphragm.

The invention also comprehends, as an object thereof, a novel means or device for carrying out the novel process, and for producing the novel means of this invention.

Other objects, capabilities, advantages, features, and process steps are comprehended by the invention as will later appear and as are inherently possessed thereby.

Referring to the drawing:

Fig. 1 is a transverse sectional view of a molding or forming means for carrying out the invention;

Fig. 2 is a sectional view of a stripping die;

Fig. 3 is a similar view of a drying die; and,

Fig. 4 is a similar view of the blank produced by the invention.

The diaphragm is preferably made from fibrous material, such as pulp. The pulp is usually received in the form of dry sheets, and for the purposes of carrying out the process of this invention, are placed with water in a beater or beater engine, to beat the pulp and to disintegrate and disperse the fibres in the water, and also to shorten and hydrate the fibres to the desired point or extent.

The mixture or batch is then treated to "proof" the fibres. This may be effected in any of several ways. As for example, while continuing the beating of the material in the beater engine, water-proofing wax may be added to the mixture, as in the proportions of about from one to eight per cent of the weight of the dry pulp first placed in the beater. The beating and stirring may continue for a sufficient period of time, such as from about ten to fifteen minutes until the wax has been thoroughly dispersed and mixed, after which powdered alum may be added in a quantity sufficient to set the wax on the fibres. The beating and stirring may continue until the setting has been effected, and then the material, termed "stock", may be stored in a suitable tank or vat for use when molding on the porous formers.

As another example, the proofing may be effected by the same or a similar process, with paper-maker's rosin which may be set with alum as in the case of the wax. The amount of rosin used may be about from one to five per cent of the weight of the dry pulp first placed in the beater.

Proofing may also be effected by the same or a similar process with latex which may also be set with the alum, as above for wax, or rosin.

Also, proofing may be likewise produced, by the same or similar process by mixing in emulsified asphalt and set with the alum, as in the cases of wax, rosin, and latex.

As further examples, proofing may likewise, by a like or a similar process, be effected with starch, or with silicate of soda. Setting with alum is not necessary in these cases.

The latex, asphalt, silicate of soda, and starch vary or change the acoustic properties or characteristics of the diaphragm, and hence they may be varied or even combined two or more of them

in predetermined proportions, so as to obtain the desired acoustic effects in the final article.

The ability of proofing varies in degree from higher to lower in the order of asphalt, wax, latex, rosin and alum, starch, and silicate of soda.

It is to be understood, when desired, any two or more of these proofing substances also may be combined to obtain any degree of proofing with the acoustic property desired in the diaphragm.

The process may be practiced in different ways, and preferably by use of a novel porous former, an illustrative embodiment of which is herein described. This former may rest upon a table 1 supported by suitable means for raising and lowering the table and the members supported thereby, in and out of the bath of a tank 2.

Upon the table 1 is a former member 3 provided with apertures 4 running from grooves 5 formed on the surface of the member 3. The edge or border portion of the member 3 is provided with a flange 6 adapted to rest on the table 1, and hold the body portion of the member 3 spaced above the table 1 so as to define a chamber 7 which may act as a suction chamber.

Upon the ridges 8 of the member 3 is supported a former member 9 of thin material, such as sheet metal, celluloid, rubber, or compositions of various sorts, this member 9 being provided with innumerable apertures, or pores 10 for the passage of the water of the bath.

The members 3 and 9 shown, are shaped or contoured for the making of a diaphragmatic blank of conic type. Accordingly, using member 9 as an example, this member as a conic portion 11, a plano-border portion 12, an undulated juncture portion 13, an apical cylindric portion 14, and a cap 15. The member 3 has correspondingly shaped portions, as shown.

Beneath the member 3 and in the chamber 7 is located a blanking member in the form of suction cup 16 the rim 17 of which is adapted to engage the under surface of the conic portion of the member 3, to blank off a part of the former, as shown in the drawing. The cup has at its bottom a suction and drain duct 18 suitably connected to a suction source (not shown), this duct being slidable in the apertured boss 19 of the table 1, as is clearly shown in the drawing.

In operation, the former and table are lowered in the tank 2 to submerge them in a bath, and with the suction cup in contact with the member 9 and in the position shown in full lines in the drawing, and with the suction effective in the cup 16 and duct 18, a stratum 20 of "proofed" fibrous material is deposited, accreted, integrated, and knitted upon the part of the former above the cup 16. The remainder of the former is thus blanked off. The suction draws the water of the bath through the pores 4, grooves 5, holes 10, and thence through duct 18, the fibres thus being deposited on the member 9 and held matter thereon by the suction.

Completion of the blank by deposit upon the remainder of the former, may be effected from the same bath, or from another bath having a different composition of fibres and proofing material. If from the same bath, the cup is simply lowered, as to a position shown in dotted lines in the drawing, whereupon the suction becomes effective throughout the whole chamber 7, thus causing a deposit, accretion, integration, and knitting of a fibrous stratum 21 over the remainder of the former and over the previously formed stratum 20, and integrating uniting, and knitting therewith, whereby an unitary integral unit or blank is formed, with the apical part thicker than the remainder of the blank, to give stiffness to the vibratile or conic portion of the sound producing member.

If completion is to be effected from another bath, with the suction still acting, the device is raised out of the bath, and then submerged into the other bath, while at the same time the cup is lowered to the dotted line position shown in the drawing, so as to cause the suction to be effective throughout the chamber 7, and a deposition, accretion, integration, and knitting of the stratum 21 over the remainder of the former and the stratum 20, as also an integration, knitting and uniting with the stratum 20 to produce an unitary integral unit or blank, with a thicker and stiffer apical part for the vibratile portion of the sound producing member.

If desired the depositing of the strata may be conversely effected, in which case, when the former is first submerged, the cup will be lowered to the dotted line position in the drawings so that suction is effective throughout the former, to cause the formation of a stratum of accreted and integrated fibrous material over the whole of the former, and then, the cup may be raised to contact the former and thus blank-off a portion of it, whereby a further or other deposit in the form of a stratum may be accreted, integrated, united and knitted with the apical portion of the previously formed stratum. The blank thus obtained may then be treated and operated upon as herein otherwise described.

After thus completing the blank, the device is then raised out of the bath, with the suction still acting to drain off residual water. Then a female suction die or box 22 is placed over the blank, with the suction shut-off or reversed in the chamber 7, and with suction effective in die 22, the blank is stripped from the former 3—9, and engaged with the contoured surface 23 conforming with the shape of the blank, the contoured wall 23 having a number of apertures 24 for the suction of air for engaging and holding the blank with and to the contoured surface 23. The die 22 has connected to it a suction duct 25. Its contoured surface acts as a die to uniformly distinctly shape the wet blanks.

For the purpose of drying the blank, and also for pressing it, a hot male die 26 having a contoured surface 27 conforming to the form of the blank, is pressed against the blank. This die is heated so as to have a temperature of from 500 to 800° F. It is pressed against the blank held in the die 22, if a smooth surfaced blank is desired, but if a fluffy surface condition is preferred, the die is not pressed against the blank but is merely held in contact with it.

The temperature of the die is such as to rapidly convert the water or moisture in the blank into steam, vapor and the like, which are drawn out by the suction in the die 22. When the blank is dry, the die is removed, and the suction in the die 22 reversed to pressure to blow-off the blank.

The blank is then placed in a press having dies to compress and limber the juncture $13^a$ of the blank. Then the top $15^a$ is cut-off to leave the cylindrical portion $14^a$ for the winding thereon of the voice coil. If desired the apical part $20^a$ may be compressed to the same thickness as the remainder of the blank, so that the apical part may be denser and stiffer. This compression may be effected during the drying or after,

as desired. The conical part with the juncture $13^a$ and a portion of the border part $10^a$, constitute the vibratile part of the diaphragm, while the remainder of the border part $10^a$ acts as the supporting portion of the diaphragm.

When drying with the female and male dies, great accuracy and uniformity of shape and form of the final dried unit or blank are obtained, with distinct curves, angles, etc., all of which are uniform for all blanks.

By the above disclosed process and means, there is no need of first drying the blank in a heater or oven, and then die pressing the dried blank, but the drying and die pressing are effected in a step when the blank is made and take the distinct shape and form desired without distortions and strains that occur when die pressing an object in already dried condition. Moreover, the use of a screen or like reticulated former element is avoided, since the former member 9 is of thin sheet material and provided with a very large number of small apertures or pores. This provides for a more uniform and smoother blank which may be thinner and lighter in weight than one made with a screen and having projections which are formed in the comparatively larger holes of the screen.

This invention also eliminates the treatments with chemicals, such as lacquers and the like by way of coating, impregnating and the like with attendant lack of uniformity and thoroughness of treatment. The proofing in that way, that is, after completion of the blank, is eliminated with its disadvantages. Pre-proofing produces a better result than by post-impregnation. Pre-proofing adds much less weight to the diaphragm, and avoids the inertia of the loading material when vibrating the diaphragm. By the present invention the diaphragm is lighter in weight, stiffer at the apical part, and more supple at the juncture and supporting border portion.

While I have herein described and on the drawing shown an illustrative embodiment and mode of using and carrying out the invention, it is to be understood that the invention is not limited thereto but comprehends other means, process steps, modes of operation and treatment, structures, arrangement of parts, details, and features without departing from the spirit of the invention.

Having thus disclosed the invention, I claim:

1. In a process of making sound producing articles, the step of producing a predetermined portion of the article by forming a stratum of fibrous material upon a coextensive portion of a porous former while said former is at rest, and completing the article by forming a stratum of fibrous material upon the entire area of said former including the uncoated area thereof and integrating it upon the first mentioned stratum while the former is at rest.

2. In a process of making sound producing articles from fibrous materials, the step of producing a portion of the article by applying suction to a selected part of the area of a foraminous screen while it is submerged in a pulp bath, and completing the article by applying suction to approximately the entire area of said screen while it is similarly submerged.

3. In a process of making sound producing articles, the step of producing a predetermined portion of the article by forming a stratum of fibrous material upon a coextensive portion of a porous former while said former is at rest, completing the article by forming a stratum of fibrous material upon the entire area of said former including the uncoated area thereof and integrating it upon the first mentioned stratum while the former is at rest, and compacting the integrated strata.

4. In a process of making sound producing articles from fibrous materials, the step of producing a portion of the article by applying suction to a selected part of the area of a foraminous screen while it is submerged in a pulp bath, completing the article by applying suction to approximately the entire area of said screen while it is similarly submerged, and then applying suction to said strata in the opposite direction.

5. In a process of making sound producing articles from fibrous materials, the step of producing a portion of the article by applying suction to a selected part of the area of a foraminous screen while it is submerged in a pulp bath, completing the article by applying suction to approximately the entire area of said screen while it is similarly submerged, drying the body, and applying suction to the body in the opposite direction during the drying stage.

6. A former for making fibrous articles comprising a porous former body having a contoured surface for accretion and integration thereon of fibrous material, and a hollow suction member cooperating with said former body, said member being adjustable toward and from the former body and so constructed and arranged as to effect fractional accretion and integration of fibrous material on said former body in accordance with its position with respect thereto.

7. A former for making fibrous articles comprising a porous former body having a contoured surface for accretion and integration thereon of fibrous material, and a hollow suction member of inverted conical shape cooperating with said former body, said member being adjustable toward and from the former body and so constructed and arranged as to effect fractional accretion and integration of fibrous material on said member in accordance with the position of its open end with respect thereto.

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