Sept. 18, 1945. V. T. PARÉ 2,384,958

METHOD OF AND APPARATUS FOR MAKING FIBROUS ARTICLES

Filed Oct. 14, 1941

Fig. 1.

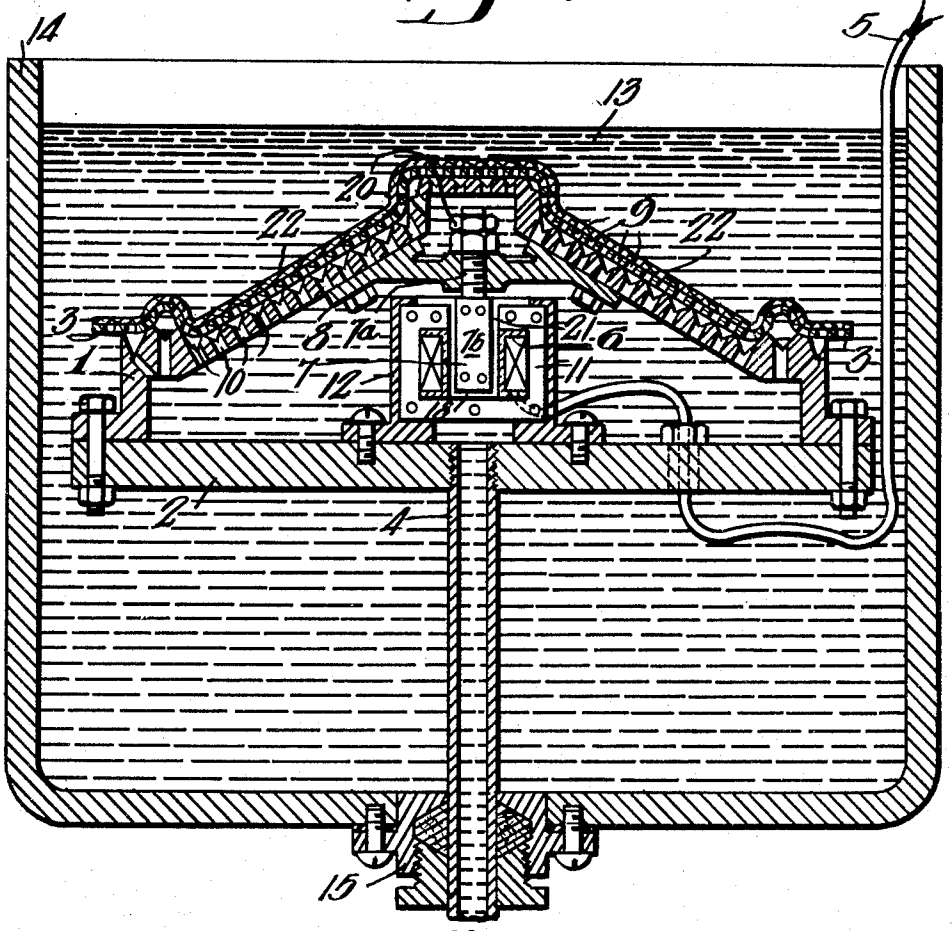


Fig. 2.

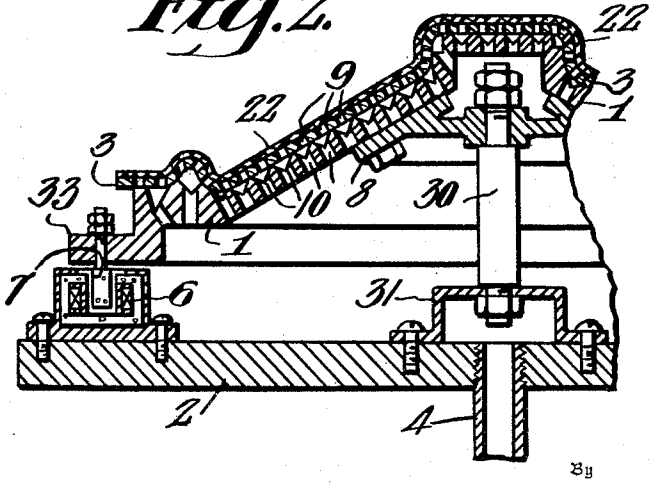


Fig. 3.



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METHOD OF AND APPARATUS FOR MAKING FIBROUS ARTICLES

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4 Claims. (Cl. 92—54)

This invention relates to the process of and apparatus for forming fibrous articles, such as diaphragms for loudspeakers, and more particularly to the type of articles formed through the process of depositing accreted accumulations of fibrous material upon perforated forms from a liquid suspension, the present application being a continuation in part of my copending application Serial No. 161,833, filed August 31, 1937, now Patent No. 2,288,832, granted July 7, 1942.

Heretofore, it has been common practice to mold or felt sound-producing diaphragms of conoid form by the well-known process of causing a layer of fibrous material, such as wood pulp, to become deposited upon the surface of a suitable former. Experience has shown that, aside from various combinations of fibrous material and the additions of various proofing and sizing compounds, accreted layers so formed are all essentially the same in texture. This can easily be shown to be the case because of the simple physical laws involved in the process of felting. In aqueous suspensions of beaten fibrous material, such as wood or rag pulp, the material is held in suspension in water and is caused to be drawn by suction through a suitable perforated form. The individual fibres will naturally settle into a similar general arrangement. For more complete information relative to this type of diaphragm and manufacture, reference is made to Carlisle, et al., 1,901,631, and Hawley, 1,964,018 and 1,872,081.

Sound reproducing diaphragms thus produced require extensive after-treatment to make them suitable for present day standards of reproduction. This treatment may take the form of calendering, embossing or impregnating with various proofing compounds, any or all of which treatments are applied to the dried member to render it more acceptable as a sound radiator.

Because a diaphragm, such as is used in the conventional type of electrodynamic loudspeaker, is called upon to perform in a manner not usually associated with ordinary paper products, it must possess qualities not generally found in ordinary paper.

It is accordingly an object of my invention to provide a novel acoustic diaphragm of the felted type that shall have improved acoustic characteristics and greater strength.

A further object of my invention is to provide a new method or process for producing my improved diaphragm, as well as a novel device for carrying out the method or process.

Other objects and advantages inherent in my invention will appear from the following description of my article, process and device:

In accordance with my invention, I am able to produce a felted layer of accreted fibres that are highly commingled by vibrating the perforated former and/or fibres while depositing the fibres from the liquid suspension. Articles formed in this manner are possessed of greater strength and density because the individual fibres, previously distorted and disarranged by the beating process, are shifted into more compact mutual relationship while being drawn into position. In this manner, they also tend to seek a final position of rest in the accreted layer and a member is thus produced normally free of all stresses.

I have found that a frequency of 60 cycles, or 120 vibrations, per second applied to the former gives good results with ordinary pulps, such as ground wood, rag, kraft or sulphite. However, the frequency may be varied as the article and pulp demand. I have chosen the sound-radiating diaphragm as an embodiment of my invention. However, it is not to be limited to said article, as anyone skilled in the art will readily recognize the fact that it can be advantageously used in the manufacture of other articles.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description of two embodiments thereof, when read in connection with the accompanying drawing in which

Figure 1 is a sectional view of a perforated former for diaphragms showing vibration mechanism constructed in accordance with my present invention,

Figure 2 is a fragmentary sectional view of another arrangement according to my present invention, and

Figure 3 is a fragmentary sectional view of a portion of a frusto-conical diaphragm made in accordance with my invention.

Referring to Fig. 1, a casting 1 of nonferrous metal is drilled and grooved at 1a over its surface to provide free passage for the filtrate from the pulp suspension. A substantial base plate 2 of metal is drilled and tapped for an exit pipe 4. The casting 1 is bolted to the base plate as shown. A strut 6 is secured to the inner surface of the casting former 1, as by bolts, the center boss of the strut 6 being drilled and threaded to adjustably receive a soft steel end 7a of an armature 7,

preferably built up of laminations at portion 7b. A magnetic flux gap is preferably provided at 18 between the end of the armature and the yoke 11, and is adjustable by means of the screw-threaded connection between armature portion 7a and the strut 8. One or more nuts 20 serve to lock the armature in position on the strut. A small clearance is preferably provided at 21 between the armature and upper ends of the yoke.

A solenoid winding structure 6, terminating in the connectors 5, is rigidly mounted within a laminated iron field or yoke 11, in turn clamped rigidly in position by a clamp 12 to the base plate 2.

A perforated former or screen 3 is removably placed in position over the former casting 1 and is provided with small holes throughout its entire surface, some of which are indicated at 9. It is upon the screen 3 that the deposited layer of pulp fibre accumulates to form a diaphragm 22 and from which the diaphragm is removed after being dried.

The complete former is moved downward into the pulp suspension 13, contained in a suitable tank 14, and a suction connection is made through pipe 4 sliding through the stuffing box 15, and thence to a flexible hose 16, which in turn is connected to a vacuum pump.

While I have shown an electromagnetic means of vibrating the former, it is readily understood that vibration of the required frequency and amplitude can be supplied with any one of several well-known mechanical means.

Again referring to Fig. 1, it is evident that when the coil 6 is energized from a source of 60-cycle current, a 120-cycle vibration is imparted to the structure 1. The amplitude of the imparted vibration does not need to be excessive in part 1 and it, in turn, is transferred to the finely perforated metal screen shown at 3. At the instant that suction is applied through the pipe 4, fibres suspended in the liquid 13 are drawn to the surface of part 3, which, because of its violent agitation, causes the fibres to settle down and seek their most natural positions. Because the accretion occurs both by suction and a shifting or shaking process, a superior type of felted product is thus produced.

For improved acoustic fidelity, in certain cases it is preferable to have the smaller base portion of the diaphragm stiffer and denser, as for the better reproduction of higher audio frequencies. With the vibration means attached to the former 1 in the manner shown in Figure 1, the smaller base area will receive a greater amplitude of vibration. The outer portion may be held rigid and maintained free of periodic vibration. The portion of the former 1 which is subjected to vibrations of greatest amplitude will cause the fibres to become most compacted mutually, and vice versa. The result will be a graded diaphragm, as in Nicholson Patent 1,624,357, issued April 12, 1927. In some cases, it may be desired to make the corrugated periphery portion denser than the adjacent portions. This can readily be accomplished by the arrangement shown in Fig. 2 wherein a bolt 30 couples the strut 8 substantially rigidly to a bridge 31 on the base plate 2. The casting 1 may be provided with a peripheral flange 33 to which two or more armatures of suitable vibrating devices may be secured at diametrically opposite sides of, or circumferentially around, the flange 33, only one being shown in Fig. 2 for the sake of simplicity. The arrangement shown in Fig. 2 permits vibrating the peripheral portion of the casting 1 and the former 3 locally, while the central portion thereof is maintained substantially stationary. If desired, the central portion may also be vibrated, as in Fig. 1, and this may be to a greater or lesser extent (that is, with greater or lesser amplitude) than the periphery of the diaphragm.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. In particular, I am aware that diaphragms constructed according to the precepts of my invention may have other forms than the conoidal forms described herein.

My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In the process of forming fibrous articles by accretion upon a former in a liquid suspension of fibres, the steps which comprise causing fibres to be accreted simultaneously on the entire surface of said former, and simultaneously vibrating one portion of said former locally to a greater extent than another portion thereof whereby the fibres accreted on said first named portion are arranged in more compact mutual relationship than are the fibres accreted on said second named portion.

2. In the process of forming fibrous articles by accretion upon a former in a liquid suspension of fibres, the steps which comprise causing said fibres to be accreted simultaneously on the entire surface of said former, maintaining a portion of said former relatively stationary while accreting fibres on said portion, and simultaneously vibrating another portion of said former while accreting fibres on said latter portion whereby the fibres accreted on said latter portion are arranged in more compact mutual relationship than are said first named fibres.

3. In apparatus for forming fibrous articles by accretion of fibres from a liquid suspension thereof, the combination of a tank adapted to receive said liquid, a former within said tank positioned therein to be immersed in said liquid and adapted to have the fibres accreted thereon, and means for simultaneously vibrating one portion of said former locally to a greater extent than another portion thereof.

4. In apparatus for forming fibrous articles by accretion of fibres from a liquid suspension thereof, the combination of a tank adapted to receive said liquid, a former within said tank positioned therein to be immersed in said liquid and adapted to have the fibres accreted thereon, means for vibrating certain portions of said former, and means substantially confining certain other portions thereof against vibration relative to said first named portions.

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