

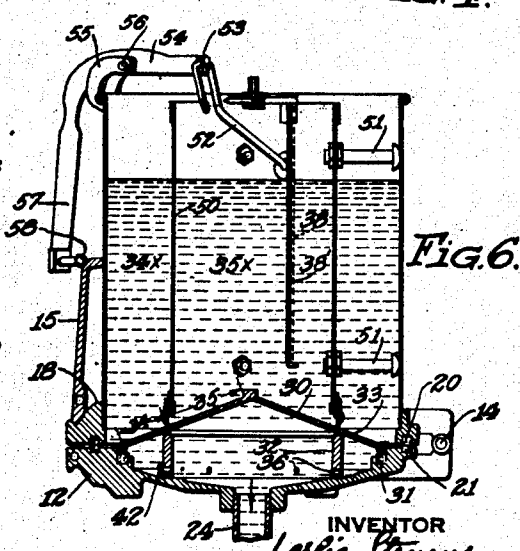
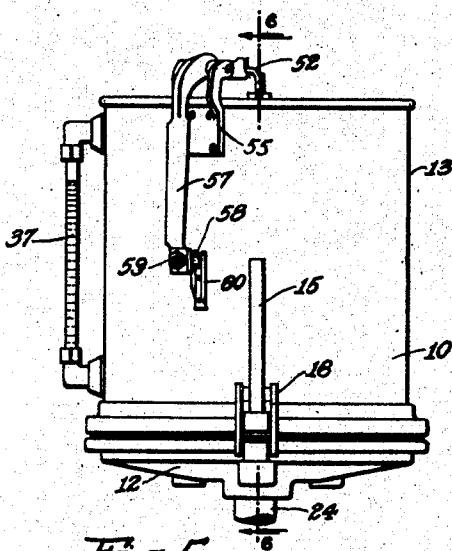
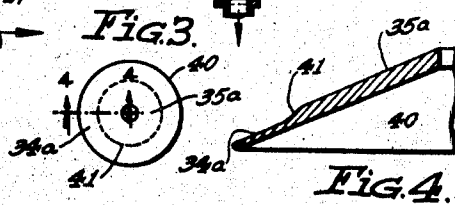
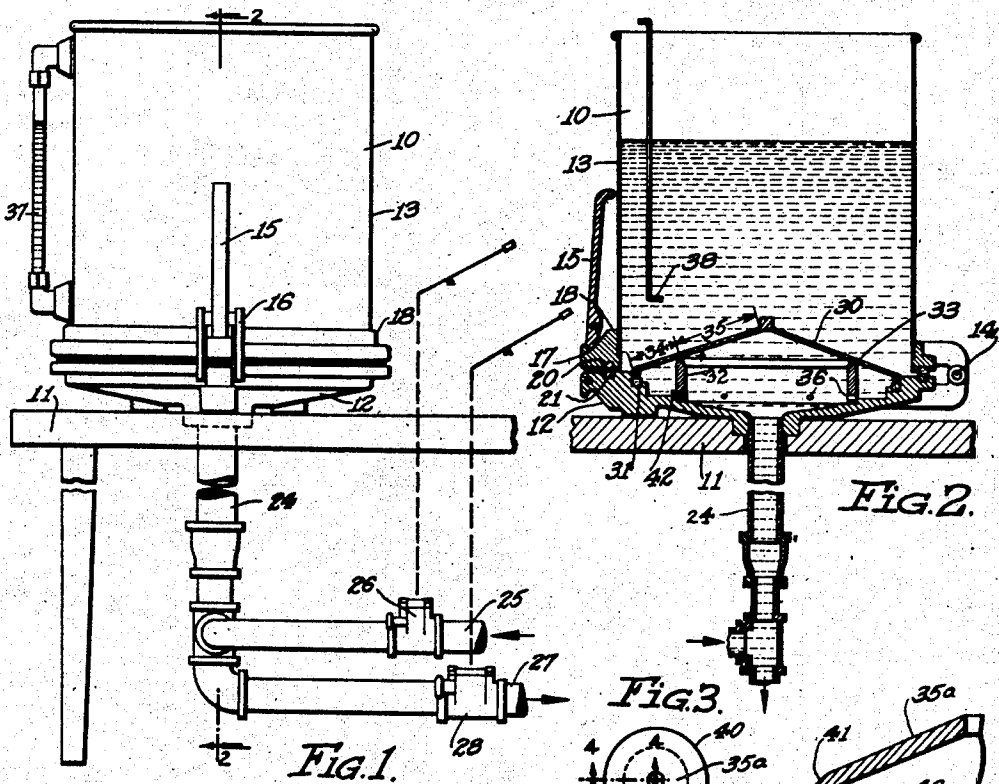
Nov. 12, 1946.

L. STEVENS

2,411,056

MANUFACTURE OF DEPOSITED PAPER PRODUCTS

Filed Sept. 26, 1939



INVENTOR
Leslie Stevens
BY
Lawrence, Brown & Wood
ATTORNEYS

UNITED STATES PATENT OFFICE

2,411,066

MANUFACTURE OF DEPOSITED PAPER PRODUCTS

Leslie Stevens, Glen Ridge, N. J.

Application September 26, 1939, Serial No. 296,555

2 Claims. (Cl. 92-57)

1

This invention relates to the manufacture of paper products by controllably variable fibrous deposition, and especially to the production of loudspeaker diaphragms and the like by the deposition of pulp fibres on a sieve-like form.

The object of this invention is to make paper products such as loud speaker diaphragms in a simple and efficient manner, while at the same time producing diaphragms which are uniformly satisfactory both mechanically and acoustically and which will remain so throughout their lives.

The features of the invention will become apparent from the following description taken in conjunction with the accompanying drawing, in which:

Fig. 1 is an elevational view of an apparatus for depositing cones;

Fig. 2 is a sectional view of the apparatus of Fig. 1, taken along the line 2-2 of Fig. 1;

Fig. 3 is a plan view of a cone deposited by the apparatus of Figs. 1 and 2;

Fig. 4 is an enlarged section of the cone of Fig. 3, taken along the line 4-4 thereof;

Fig. 5 is an elevational view of a modified form of apparatus for depositing cones; and

Fig. 6 is a sectional view of the apparatus of Fig. 5, taken along the line 6-6 thereof.

Referring to Figs. 1 and 2, 10 is a cylindrical container supported upon a table 11, the container being split horizontally near the bottom so as to form a lower portion or base 12 and upper portion 13 which are hinged together at 14. The two sections of the container may be locked together by a latch 15 which is secured by links 16 to the base section 12, the latch fitting within a recess 17 in the ring 18 secured to the upper section.

The ring 18 has a sealing gasket 20 secured therein which engages a similar gasket 21 secured to the base section so as to provide a liquid-tight joint between the two sections when they are locked together.

The center of base section 12 communicates with a pipe 24 which extends downwardly therefrom. This pipe 24 communicates with a water inlet main 25 through the valve 26 and also communicates with an outlet pipe 27 through the valve 28. These valves are manually operated by any suitable mechanism, the mechanism shown in Fig. 1 being diagrammatic only.

Removably mounted in the base section 12 is a conical form 30 containing a multitude of apertures so that it is sieve-like in construction and operation, serving as a screen. The base of the porous form 30 engages a gasket ring 31 mounted in the base section so that there is substantially no leakage around the base of the form.

Mounted on base section 12 and radially within the rim of form 30 is a baffle ring 32 having a relatively sharp upper edge 33. This upper edge

2

of ring 32 engages the under side of form 30 throughout its circumference, so that there is substantially no leakage along such line of engagement. For convenience, the portion of form 30 radially beyond the line of engagement of the baffle ring with the form is termed the rim portion, or zone, and designated 34 while the portion of form 30 radially within such line is termed the central portion, or zone, and designated 35. The baffle ring is provided with a number of holes 36 which afford the only communication between the areas under the rim portion 34 and under the central portion 35, respectively, of the conical form 30.

In the use of the apparatus in carrying out the method of the invention, the container 10 is initially empty with its upper section 13 unlocked and turned back on its hinge. A form 30 is inserted in the apparatus, and the upper section 13 turned forward and locked by the latch 15 to the lower section 12. The parts are now in the position shown in Fig. 2.

Water from the supply main is then introduced into the container by opening valve 26. When the desired water level is attained, as may be determined by observing the gauge glass 37, the valve 26 is closed.

Thereupon a measured quantity of a prepared mixture of pulp and water is poured into the container 10 through the open top thereof and the pulp thoroughly mixed with the water already present in the container. This is conveniently done by agitating the mixture with one or more air jets 38.

The outlet valve 28 is thereupon opened to allow the liquid to drain off. During the draining off period some of the liquid drains through the rim portion 34 of the form while the rest drains through the central portion 35, the drainage starting through the two portions substantially simultaneously.

Since the flow of the liquid through the rim portion 34 is retarded by the baffle ring 32, less liquid drains through the rim portion 34 than through the central portion 35. The pulp, however, does not drain through the form. It is caught and deposited thereon over both the central and rim portions, less pulp being deposited over the rim portion 34 than over the central portion 35 in view of the different amounts of liquid draining through these portions. During this deposition the pulp fibers felt together in heterogeneous directions, thus producing a conical diaphragm which, after drying, has no tendency to warp.

After all the liquid is drawn off, the apparatus is opened up, the form with the diaphragm deposited thereon removed, and the form and diaphragm placed in a suitable drying apparatus. When the diaphragm is dry, it is removed from the form and subjected to such supplementary

operations as are desirable, for example, coating with a stiffening substance, trimming and pressing.

Figs. 3 and 4 show a diaphragm 40 made by this process, before being subjected to such supplementary operation. The rim portion 34a of the diaphragm is substantially thinner than the central portion 35a of the diaphragm, and it will be found that the pulp deposited in each portion 34a or 35a is of substantially uniform thickness throughout that portion. In addition, the junction 41 between these two portions is controllably defined at the radius where the sharp edge 33 of baffle ring 32 engages the conical form 30.

The total weight of the diaphragm is determined by the amount of pulp contained in the pulp mixture poured into container 10, since all such pulp is deposited upon the form. By pouring into the container a measured amount of the mixture from a batch having known and unvaried proportions of pulp and liquid, the weight of the individual diaphragms produced by this method may be kept within narrow tolerances.

The relative weights of the rim portion 34a and the central portion 35a for different diaphragms are determined by the amounts of liquid which pass through the respective portions of the form during the formation of the diaphragms. As these two flows start simultaneously, the relative weights of the two portions are determined by the difference in the rate of flow of these two flows, except for the slight additional deposit on the outer portion after the liquid level has dropped below the upper portion. Thus, by retarding the flow through the rim portion 34, accomplished by reducing the area of the passageways through baffle ring 32 (as by plugging up one or more holes 36, as with the threaded plugs 42), less of the total amount of pulp is deposited upon the rim portion 34 and more is deposited upon the central portion 35. The diaphragm formed when using reduced-area passageways in the baffle ring therefore has a thinner rim portion 34a than the diaphragm formed when using full-area passageways in the baffle ring, other factors remaining the same.

Diaphragms of any desired weight and of any desired comparative thicknesses at the rim and central portions may thus be made by appropriate adjustment of the amount of pulp introduced into the container 10 and of the rate of flow of the liquid through a baffle ring 32.

The line of demarcation or junction 41 between the rim portion 34a and the central portion 35a of the diaphragm is a true circular line of controllable definition concentric with the axis of the diaphragm, thereby enabling the central portion 35a to propagate sound with a minimum of distortion.

The controllable rim portion 34a integral with the central portion 35a enables the diaphragm to be supported at the rim with a widely controllable load upon the sound-emitting portion of the diaphragm, and enables annular corrugations of widely controllable axial flexibility to be formed in the rim. These abilities open up an extremely wide range of acoustical requirements to which diaphragms made by this method may be accurately manufactured.

The manufacture of diaphragms by the foregoing process thus employs a single mixture of pulp and water, molds the entire diaphragm in one operation with the rim area thinner or thicker than the central area, produces a diaphragm with excellent acoustical and mechanical properties

which may be varied as desired, and maintained throughout its life, and produces such diaphragms with consistency. The process is simple and fast and uniformly produces a satisfactory product.

Referring to Figs. 5 and 6, the apparatus there shown is in many respects identical to that shown in Figs. 1 and 2 and corresponding parts are designated similarly as in Figs. 1 and 2.

The apparatus of Figs. 5 and 6 contains an inner cylinder 50 the lower edge of which normally rests upon form 30, the diameter of inner cylinder 50 being substantially the same as that of baffle ring 32. The inner cylinder 50 extends to the top of container 10 and is prevented from moving laterally by the spacing pins 51 secured to inner cylinder 50 and projecting radially outwardly substantially to the inner surface of container 10. A bail 52 is secured to the upper portion of inner cylinder 50, the bail passing through a slot 53 in an arm 54 pivotally mounted on the bracket 55 at the top of container 10. Arm 54 extends past the pivot 56 and is bent downwardly to form a handle 57. A bolt 58 is threaded through the handle at the lower end thereof and is secured in place by a nut 59. The head of the bolt extends toward the container 10 and in the normal position of the parts as shown the head is disengaged from a spring latch 60. However, when the handle 57 is pushed toward the container 10, the head of bolt 58 engages spring latch 60 and the latter serves to hold the handle in the position to which it has been moved. In such position the arm 54 is raised above its normal position, thereby raising inner cylinder 50 a short distance, determined by the adjustment of bolt 58. In the raised position the lower end of inner cylinder 50 does not engage the form 30.

When this apparatus is charged, there is an outer annular body of liquid 34x between inner cylinder 50 and the wall of container 10 and an inner cylindrical body of liquid 35x contained within inner cylinder 50.

In the use of the apparatus of Figs. 5 and 6, the container 10 is initially empty with its upper section 13 unlocked and turned back on its hinge. Inner cylinder 50 moves with the upper section 13.

A form 30 is inserted in the apparatus and the upper section 13 swung forward and locked by the latch 15 to the lower section 12. The handle 57 is pulled outwardly so that the lower end of the inner cylinder rests upon form 30. The parts are now in the position shown in Fig. 6.

Water from the supply main is then introduced into the container by opening the valve communicating with pipe 24. When the desired water level is attained, this valve is closed.

Thereupon a measured quantity of a prepared mixture of pulp and water is poured into the body of liquid 35x and a measured quantity of another prepared mixture of pulp and water differing in constituents or in concentration, or both, from the mixture poured into the body of liquid 35x, is poured into the body of liquid 34x. Thereupon each body of liquid is thoroughly agitated to distribute the pulp in suspension in the liquid, separate air jets being used in the different bodies of liquid, air jet 38 being in the outer body of liquid 34x and air jet 38' being in the inner body of liquid 35x.

The outlet valve communicating with pipe 24 is thereupon opened to allow the liquids to drain off. The outer body of liquid 34x drains through the rim portion 34 of the form while the inner

body of liquid 35x drains through the central portion 35 of the form. The pulp in suspension in the outer body of liquid 34x is thus deposited upon the rim portion 34 and the pulp in suspension in the inner body of liquid 35x is deposited upon the inner portion 35 of the form. These depositing operations over the different portions of the form occur simultaneously but independently of each other, with none of the pulp from one body of liquid intermingling with the pulp of the other body of liquid nor depositing on the other portion of the form.

Near the end of the depositing operation, as determined by observing the gauge glass 37, the handle 57 is pushed inwardly to raise the inner cylinder 50 and maintain it raised, by the latch 60, through the remainder of the depositing period. The two pulp mixtures thus intermingle at the surface of the form beneath the lower end of inner cylinder 50 and as a consequence the deposited fibers at that region are an intermixture of fibers from the two pulps. This intermixture of fibers serves to knit the rim portion 34a of the resulting cone with the central portion 35a thereof.

Baffle ring 32 enables the rate of flow of the outer body of liquid 34x to be adjusted to such a value that the drainage of the outer body of liquid 34x will be completed at substantially the same time as the drainage of the inner body of liquid 35x. As a consequence this eliminates the tendency, when the two bodies of liquid drain in different times, for the slower body of liquid to drain or slop over on to the portion of the form on which the faster body of liquid deposits its pulp. In other words, there is in such cases a tendency toward irregularity in production and an indeterminate, indistinct and non-circular line of demarcation between the rim area 34a and the central area 35a of the resulting cone. These irregularities and uncertainties are eliminated by the use of the baffle ring 32.

After all the liquid is drawn off the apparatus is opened up and the form and diaphragm handled as previously explained in connection with Figs. 1 and 2.

In the general use of this apparatus of Figs. 5 and 6 the two mixtures of pulp are of different ingredients; for example, the pulp for the rim area 34a may be of long, soft, flexible fibers while the pulp for the central area 35a may be of short, hard and stiff fibers, or vice versa, or of any length desired to produce the required acoustic results. The entire diaphragm is molded in one operation to produce an integral diaphragm in which the respective areas are sharply defined by a circular line of demarcation coaxial with the diaphragm and yet felted together in a continuous fibrous unit. Thus the resulting diaphragms have uniformly excellent acoustical and mechanical properties.

The two-mixture apparatus of Figs. 5 and 6 is quickly changed to the single-mixture apparatus of Figs. 1 and 2 by lifting out the inner cylinder 50.

Although, in both the single and double-mixture apparatus, the water is most conveniently introduced into and drawn from the container 10 in the manner shown, the water may be introduced and drained out in different manners, such as by lowering and raising the container, respectively, in a tank of water.

It is to be noted that the apparatus is readily adapted to the manufacture of diaphragms of almost any angle, shape, size and relative construc-

tion, as the apparatus readily accommodates forms of different angles, shapes, and outer limits of perforations, as well as baffle rings of different diameters and heights.

While the invention has been described in connection with the production of a diaphragm for loudspeakers, it is not confined thereto, but is intended to cover the similar controllably variable production of deposited paper products.

I claim:

1. Apparatus for forming one-piece cone-shaped articles having an annular outer section thinner than the center inner section, a vertically sustained cylindrical container having a centrally located drainage opening in the bottom thereof and an annular shoulder in the side wall thereof at a horizontal level above the bottom with a fluid permeable conically shaped former member seated by its periphery on said shoulder, an annular partition member seated on the bottom of said container and concentrically disposed about the said drainage opening, the upper edge of said partition member being knife edged and contacting the under surface of the said former member, said partition member being provided with a plurality of openings therethrough, the number and diameter thereof being selected to provide a determined rate of flow of fluid through the partition member to the drainage opening less than that through the central portion of the former member to the drainage opening, means to fill the cylindrical container to a determined horizontal level with water and to suspend a measured quantity of pulp suspension in the water above the former member and means regulating the rate of flow of said water through the said drainage opening.

2. Apparatus for forming one-piece cone-shaped articles having an annular outer section thinner than the center inner section comprising a vertically sustained cylindrical container having a centrally located drainage opening in the bottom thereof and an annular shoulder in the side wall thereof at a horizontal level above the bottom with a fluid permeable conically shaped former member seated by its periphery on said shoulder, an annular partition member seated on the bottom of said container and concentrically disposed about the said drainage opening, the upper edge of said partition member being knife-edged and contacting the under surface of the said former member, said partition member being provided with a plurality of openings therethrough, the number and diameter thereof being selected to provide a determined rate of flow of fluid through the partition member to the drainage opening less than that through the central portion of the former member to the drainage opening, a cylindrical partition member located centrally within the container above the former member having a diameter approximating that of the annular partition member, the bottom of said cylindrical partition member being provided a knife edge, means to raise and lower the said cylindrical partition member out of and into knife edge contacting position with the upper surface of said former member, means to fill the container with water to a determined horizontal level and to suspend a measured quantity of pulp suspension of different compositions inside and outside the said cylindrical partition member, and means regulating the rate of flow of said water through the drainage opening.

LESLIE STEVENS.