April 18, 1961 R. WELLS 2,980,183

EXPANDABLE TRANSFER HEAD FOR PULP MOLDING MACHINE

Filed March 9, 1960

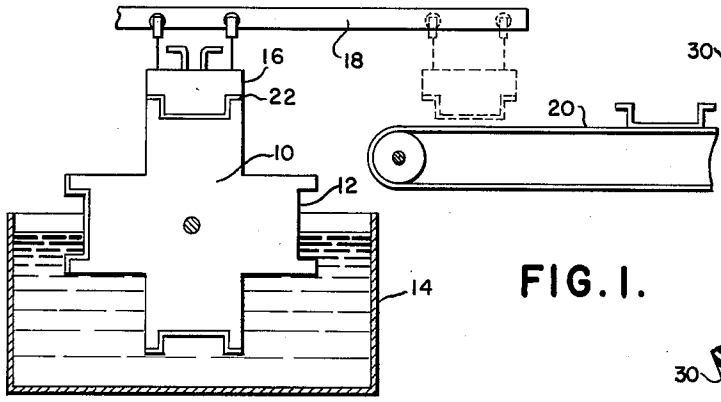

FIG. 1.

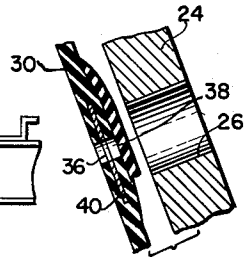

FIG. 4.

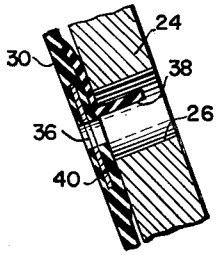

FIG. 5.

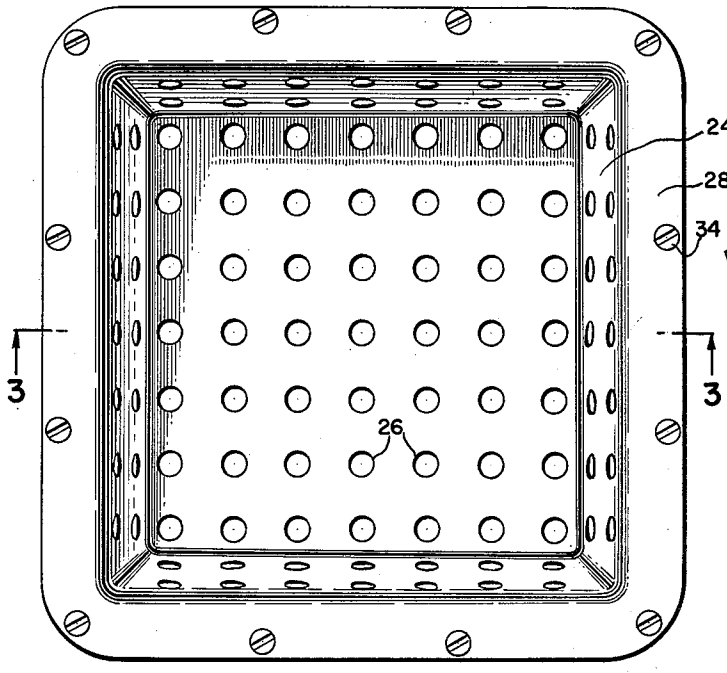

FIG. 2.

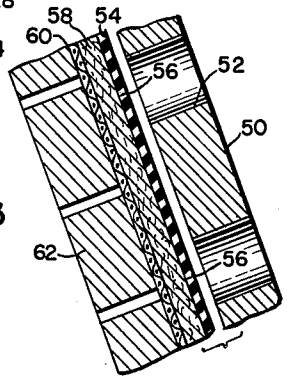

FIG. 6.

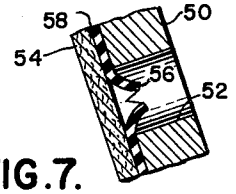

FIG. 7.

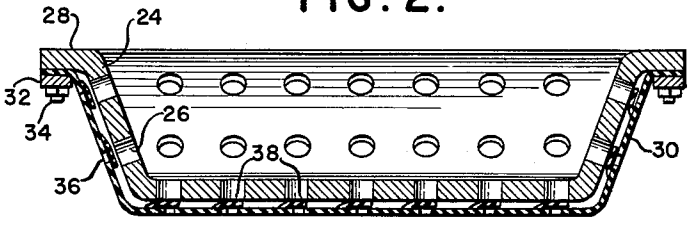

FIG. 3.

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EXPANDABLE TRANSFER HEAD FOR PULP MOLDING MACHINE

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8 Claims. (Cl. 162—416)

This invention relates to transfer heads for pulp molding machines, and more particularly to an expandable combination compression and transfer head for rotary pulp molding machines.

In the mass production of simple, low-unit-cost molded pulp articles, such as plant pots, pie plates, and the like, it is customary to employ rotary molding machines having a plurality of foraminous suction forming molds, which are advanced successively in a circular path through a vat of dilute liquid pulp slurry wherein the pulp articles are formed by suction deposition of pulp fibers onto the molds. The initially formed pulp articles, known as preforms, produced by the accretion of pulp fibers onto the foraminous forming surfaces of the molds in this manner, exhibit a relatively smooth surface on the side thereon formed in contact with the mold surfaces, and the opposite side of the articles formed in contact with the liquid slurry appears at this stage of the production process to possess the relatively coarse surface normally characteristic of molded pulp articles. When it is desired to impart denseness and smoothness to both sides of the molded articles, which may be essential for certain uses of the finished molded articles or for improving the appearance of the articles to enhance their sales appeal, it has been customary to subject the articles to a compression treatment while they are still at the wet preform stage. This treatment has normally been performed by a separate pressure head mounted adjacent to the molding machine, and adapted to compress the articles against the forming molds before the articles are transferred to heated drying apparatus. Following partial or substantially complete drying of the articles, they are sometimes subjected to finishing operations involving additional compression treatments to further densify the articles and highly smoothen the surfaces thereof.

One or more transfer heads are usually provided for successively transferring the wet pulp preforms from the forming molds to the drying apparatus. On some types of molding machines a single reciprocating transfer head may be used, while on many rotary type molding machines a plurality of transfer heads may be mounted on supporting arms radiating from a common shaft rotatable in cooperation with the rotary forming molds at a transfer point elevated above the vat of pulp slurry. Suction is applied internally to the forming molds as they are submerged in and are advanced through the vat of dilute liquid pulp slurry, and this suction is automatically shut off as each of the successive molds emerges above the slurry and approaches the transfer point. A short blast of compressed air is then applied internally to each of the successive molds to blow off the wet pulp preform therefrom, and to transfer the preform over to the cooperating transfer head. At the same time, suction is applied to the transfer head to hold the preform thereon until it is deposited onto a conveyor leading to the drying apparatus.

Conventional transfer heads are designed to engage the pulp preforms with only light contact therebetween,

holding its preforms on the heads by relatively light suction, and said transfer heads are generally incapable of imparting any compression treatment to the preforms. Unlike the pressure heads used for compression treatments which must accurately conform to the contour of the preforms, such transfer heads conform only approximately to the preform contour. Ordinary transfer heads cannot be allowed to fit tightly against the peforms being transferred, because of the danger of scuffing the fibrous surfaces of the preforms during engagement and disengagement thereof, and because some clearance must be allowed for the normal movement of the preform during the pneumatic transfer of each preform from the forming mold over to the transfer head. Another reason for the inability of conventional transfer heads to be used as a compression head, is the fact that most transfer heads are lightly constructed and mounted to facilitate fast movements and changes in direction of movement, which renders them unsuitable for exerting heavy pressures. The provision of a separate heavy pressure head may be feasible in some instances, but on some types of molding machines there is insufficient operating space for the installation of such a separate pressure head. Consequently, a need has existed for a dual-function head capable of effectively performing both the compression and transfer operations on a pulp molding machine.

An object of the present invention is to provide a combination compression and transfer head for pulp molding machines.

Another object of the invention is to provide a dual-function head for effectively performing both the compression and transfer of wet pulp preforms on rotary molding machines.

Still another object of the invention is to provide pulp molding machines with an expandable transfer head, which is capable of expanding into close conformity with the contour of a pulp preform to apply compression thereto, and is also capable of subsequently applying suction to the preform to effect transfer thereof.

In accordance with certain features of the invention, a perforated transfer head is covered by an expandable diaphrgam having a plurality of spaced flap valves registering with the perforations in the transfer head, said valves being adapted to close when internal pressure is applied to the head to expand the diaphragm, and said valves being adapted to open when internal suction is applied to the head during transfer operations.

Other objects and the nature and advantages of the invention will be apparent from the following detailed description of a specific embodiment thereof, when considered in conjunction with the accompanying drawing, wherein:

Fig. 1 is a schematic representation of a rotary pulp molding machine associated with an expandable transfer head embodying the invention;

Fig. 2 is a plan view of a transfer head embodying the invention;

Fig. 3 is a vertical section taken along the line 3—3 of Fig. 2;

Fig. 4 is an enlarged vertical section of a portion of the transfer head, shown in its expanded condition during a compression operation;

Fig. 5 is a view corresponding to Fig. 4, but showing the portion of the transfer head in its unexpanded condition during a transfer operation;

Fig. 6 is a vertical sectional view of a portion of a transfer head representing a second embodiment of the invention, shown in its expanded condition compressing a wet pulp preform against a pulp mold, and

Fig. 7 is a fragmentary view corresponding to Fig. 6, but showing the portion of the transfer head in its un-

expanded condition and transferring a pulp preform thereon.

Referring to Fig. 1, the rotary pulp molding machine illustrated schematically therein comprises a rotary drum 10 having a plurality of foraminous suction molds 12 mounted at equal intervals on its periphery. During rotation of the drum 10 the molds 12 are advanced in a circular path disposed in a vertical plane through a vat 14 containing dilute liquid pulp slurry. The rotation of the drum 10 is intermittent, so that the molds 12 are advanced step-by-step into and through the slurry, and then they are advanced successively into registration with a transfer head 16 embodying the invention. Merely for purposes of illustration, the head 16 is shown as being of the reciprocable type, and it is vertically reciprocable into and out of registration with the successive molds 12. It is also horizontally reciprocable along a track 18 between its position in registration with one of the molds 12 (shown in full lines), and its discharge position (shown in dotted lines) overhanging a conveyor 20 leading to a drying oven (not shown). When the head 16 is first brought into its full line registration position, it is adapted to undergo expansion by the application of internal fluid pressure thereto, thereby applying compression to a wet pulp preform 22 interposed between the head 16 and the mold 12 cooperating therewith. Then this pressure is shut off, and internal suction is applied to the head 16, which suction is continued to hold the preform 22 thereon as it is carried horizontally over to the discharge position overhanging the conveyor 20. Termination of this suction allows each preform to drop onto the conveyor 20, and at this time the head 16 may be reciprocated vertically to bring it down close to the conveyor 20, thereby reducing the distance through which the preforms are dropped to avoid the possibility of damaging the still moist and fragile preforms in dropping them.

In Figs. 2 and 3 there is shown a transfer head embodying the invention, which for purposes of illustration is contoured for use in the production of generally rectangular molded pulp plant pots. This head comprises a contoured metallic plate 24 having a plurality of transverse perforations 26 extending therethrough at uniform intervals over the entire area of its contoured surface, and having a peripheral rectangular rim 28 adapted to be secured to a suitable supporting base (not shown). This base communicates through suitable valved connections with suitable sources of pressure and suction, which are supplied alternately to the interior of the transfer head.

An expandable flexible diaphragm 30 made of a relatively thin sheet material, preferably formed from a natural or synthetic rubber composition, covers the entire outer surface of the contoured metallic plate 24. The diaphragm 30 is secured around its periphery to the rim 28 of the plate 24 by means of a retaining ring 32, which is fastened to the rim 28 by a plurality of bolts 34. A plurality of perforations 36 are formed in the diaphragm 30 in registration and corresponding in number and arrangement with the perforations in the contoured plate 24. Each of the diaphragm perforations 36 is provided with an individual flexible flap valve 38 mounted on the inner surface of the diaphragm 30, and adapted to provide for the unidirectional flow of air or other fluids through the perforations 36.

A single one of the flap valves 38, together with associated adjacent portions of the diaphragm 30 and the perforated contoured plate 24, is depicted in its closed and its open positions in Figures 4 and 5, respectively. The flap valve 38 may be made of a short strip of the same flexible rubber composition sheet material of which the diaphragm 30 is constructed. One end of the flap valve 38 is secured by an adhesive, stitching or other suitable bonding means, to the inner surface of the diaphragm 30 adjacent to one of the perforations 36 therein, and the opposite end of the flap valve is free to flex between the open and closed positions of this valve.

When compressed air or other fluid pressure is applied to the interior of the contoured plate 24, the tendency of the fluid to flow outwardly through the aligned perforations 26 and 36 causes the flap valve 38 to flex into its closed position covering the perforation 36, as shown in Figure 4. In this closed position, the building up of fluid pressure trapped by the closing of all of the flap valves 38 in this manner, causes the diaphragm 30 to expand. In its expanded condition the diaphragm 30 bulges outwardly away from the contoured plate 24, becoming spaced therefrom as shown in Figure 4. The resultant enlargement of the transfer head causes it to conform closely to a wet pulp preform at the transfer point, and at the same time compressive pressure is applied to the preform by the transfer head.

When the expansive fluid pressure applied to the diaphragm 30 is shut off, and suction is then applied thereto, the valves 38 flex to their open position uncovering the perforations 36, and the entire diaphragm 30 contracts until it fits snugly against the outer surface of the contoured plate 24, as shown in Figure 5. Continued application of the suction tends to draw air inwardly through the perforations 36 and thence through the perforations 26, thereby enabling a pulp preform to be held thereagainst for the duration of a transfer operation.

It may be possible to modify some standard suction type transfer heads to convert them into dual-function heads embodying the invention, by the installation of diaphragms, such as the diaphragm 30, and suitable hose connections. In such cases it may be necessary to enlarge the existing perforations corresponding to the perforations 26 in the plate 24, in order to provide sufficient space for the flexing movement of the flap valves 38 as they open and close. Due to the relative thinness and the flexibility of the sheet material of which the diaphragm 30 is made, it may be necessary to provide each perforation 36 therein with a metal washer 40 embedded therein concentric with the perforation 36, to prevent the diaphragm 30 from collapsing into the enlarged perforation 26 when suction is applied. Collapsing of the dia- 30 in this manner might result in the production of undesirable marks on the molded pulp articles. Consideration should also be given to the fact that the washers 40 must be sufficiently small and thin to prevent them from producing marks on the molded pulp articles when the pressure is applied.

Figs. 6 and 7 illustrate a second embodiment of the invention, which is generally the same in structure and in operation as that of the first embodiment, except for the provision of a different type of valve in the flexible diaphragm. A contoured metallic plate 50, which may be generally similar to the plate 24 of Figs. 2 and 3, is provided with a plurality of transverse perforations 52 extending therethrough at uniform intervals over the entire area of its contoured surface. An expandable flexible diaphragm 54 composed of relatively thin rubber sheet material, or the like, covers the entire outer surface of the contoured metallic plate 50 and is secured to the periphery thereof, in the same manner as the diaphragm 30 is mounted. A plurality of short slits 56, which are adapted to function as valves, are formed in the diaphragm 50 registering with and corresponding in number and in arrangement with the perforations 52 in the contoured plate 50.

In Fig. 6 the expandable flexible diaphragm 54 is shown in its expanded condition, wherein it is spaced away from the plate 50, and it is in compressing contact with a wet pulp preform 58, which has been deposited by suction deposition of pulp fibers onto a straining screen 60 covering a standard perforated metallic mold 62. The expansion of the diaphragm 54 is effected by the application of compressed air or other fluid pressure to the interior of the plate 50, in the same manner as has been de-

scribed in connection with the first embodiment of the invention. The valve slits 56 are prevented from opening at this time by the uniform flat contact of the diaphragm 54 with the surface of the pulp preform 58 against which it is urged by the internal fluid pressure. Although the diaphragm 54 stretches slightly as it undergoes expansion, the extent of such stretching is not enough to cause the valve slits 56 to open, so long as these slits are kept closed by the laying up of the diaphragm 54 against the pulp preform 58.

In Fig. 7 the diaphragm 54 is shown in its unexpanded condition, wherein it has contracted and fits snugly against the outer surface of the contoured plate 50. This condition is created when the expansive internal fluid pressure is shut off and internal suction is then applied to the plate 50. Under these conditions there is no supporting surface for those portions of the diaphragm within the area defined by the perforations 52 in the plate 50, and such portions of the diaphragm are freely flexible to be sucked inwardly, thereby causing the valve slits 56 to open. Continued application of the suction causes the wet pliable pulp preform to be held snugly against the diaphragm 54 of the transfer head, as shown in Fig. 7, for the duration of transfer operations.

As an optional incidental feature of the invention, in order to facilitate the release of the pulp preforms from the transfer head at the end of the transfer operation, so that the preforms may be dropped onto the conveyor 20, the diaphragms 30 and 54 of both embodiments of the invention may be provided with a few small transverse leakage holes (not shown). The size of these holes should be such that sufficient fluid can leak through the holes to allow the preform to drop off when the suction is terminated at the completion of the transfer operation, yet the flow of fluid through these holes when the diaphragm is expanded under pressure shall be comparatively insignificant.

Expandable transfer heads embodying the invention are capable of efficiently transferring molded pulp articles in their wet preform stage, and they are also capable of expanding into close conformity with the contour of the articles in applying compressive pressure thereto. The compressive action of such transfer heads greatly improves the surface smoothness of the pulp articles, and at the same time additional excess water is squeezed from the pulp articles. The extraction of more excess water at this stage of the pulp molding process results in higher density in the product, and reduces the work required to effect completion of the drying operation. Beneficial results also become evident by a reduction in the percentage of rejects due to warpage in the molded pulp products, and by facilitating an increased rate of production.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit and scope of the invention, and therefore the invention is not limited to what is shown in the drawing and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. A transfer head for pulp molding machines, comprising a perforated plate contoured approximately to conform to the shape of a molded pulp article to be transferred thereon, said plate being adapted to be connected internally alternately to a source of fluid pressure and a source of suction, and an expandable perforated diaphragm covering the exterior surface of the plate and including a plurality of unidirectional flow valves permitting inward fluid flow through the perforated diaphragm and plate but preventing outward flow therethrough, whereby the diaphragm is expanded when the internal pressure is applied to compress a molded pulp article to be transferred and the diaphragm is collapsed when the suction is applied to hold the article thereon during transfer thereof.

2. A transfer head for pulp molding machines, comprising a contoured plate conforming approximately to the shape of a molded pulp article to be transferred thereon and adapted to be connected internally to a source of fluid pressure and a source of suction, said plate having a plurality of uniformly spaced perforations extending therethrough, an expandable flexible diaphragm covering the exterior surface of the contoured plate, said diaphragm having a plurality of perforations corresponding to and registering with the perforations in the plate, and each of the perforations in the diaphragm having mounted thereon a unidirectional flow valve permitting inward fluid flow but preventing outward flow therethrough, whereby the diaphragm is expanded when the internal pressure is applied to compress a molded pulp article to be transferred and the diaphragm is collapsed when the suction is applied to hold the article thereon during transfer thereof.

3. The transfer head defined by claim 2 wherein the unidirectional flow valve mounted on each of the perforations in the diaphragm is a flexible flap valve.

4. A transfer head for pulp molding machines, comprising a contoured plate conforming approximately to the shape of a molded pulp article to be transferred thereon and adapted to be connected internally to a source of fluid pressure and a source of suction, said plate having a plurality of uniformly spaced perforations extending therethrough, an expandable flexible diaphragm composed of rubber sheet material secured around the periphery of the head and covering the exterior surface of the contoured plate, said diaphragm having a plurality of perforations corresponding to and registering with the perforations in the plate, and a plurality of unidirectional flow valves mounted one for each on the perforations in the diaphragm for permitting inward fluid flow but preventing outward flow therethrough, whereby the diaphragm is expanded when the internal pressure is applied to compress a molded pulp article to be transferred and the diaphragm is collapsed when the suction is applied to hold the article thereon during transfer thereof.

5. The transfer head defined by claim 4 wherein the unidirectional flow valves mounted on the perforations in the diaphragm are flexible flap valves, comprising a strip of rubber sheet material having one end thereof secured to the inner surface of the diaphragm adjacent to one of the perforations therein and having the other end free to flex between open and closed positions over the perforation.

6. The transfer head defined by claim 5 wherein each perforation in the diaphragm is provided with reinforcing means for preventing the adjacent portion of the diaphragm from collapsing into one of the perforations in the contoured plate when the suction is applied thereto.

7. The transfer head defined by claim 6 wherein the reinforcing means is a metal washer embedded in the diaphragm concentric with respect to each perforation therein.

8. The transfer head defined by claim 4 wherein the valves in the diaphragm are short slits formed therein within the area defined by the perforations in the contoured plate.

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