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PULP MOLDING APPARATUS

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2 Sheets-Sheet 1

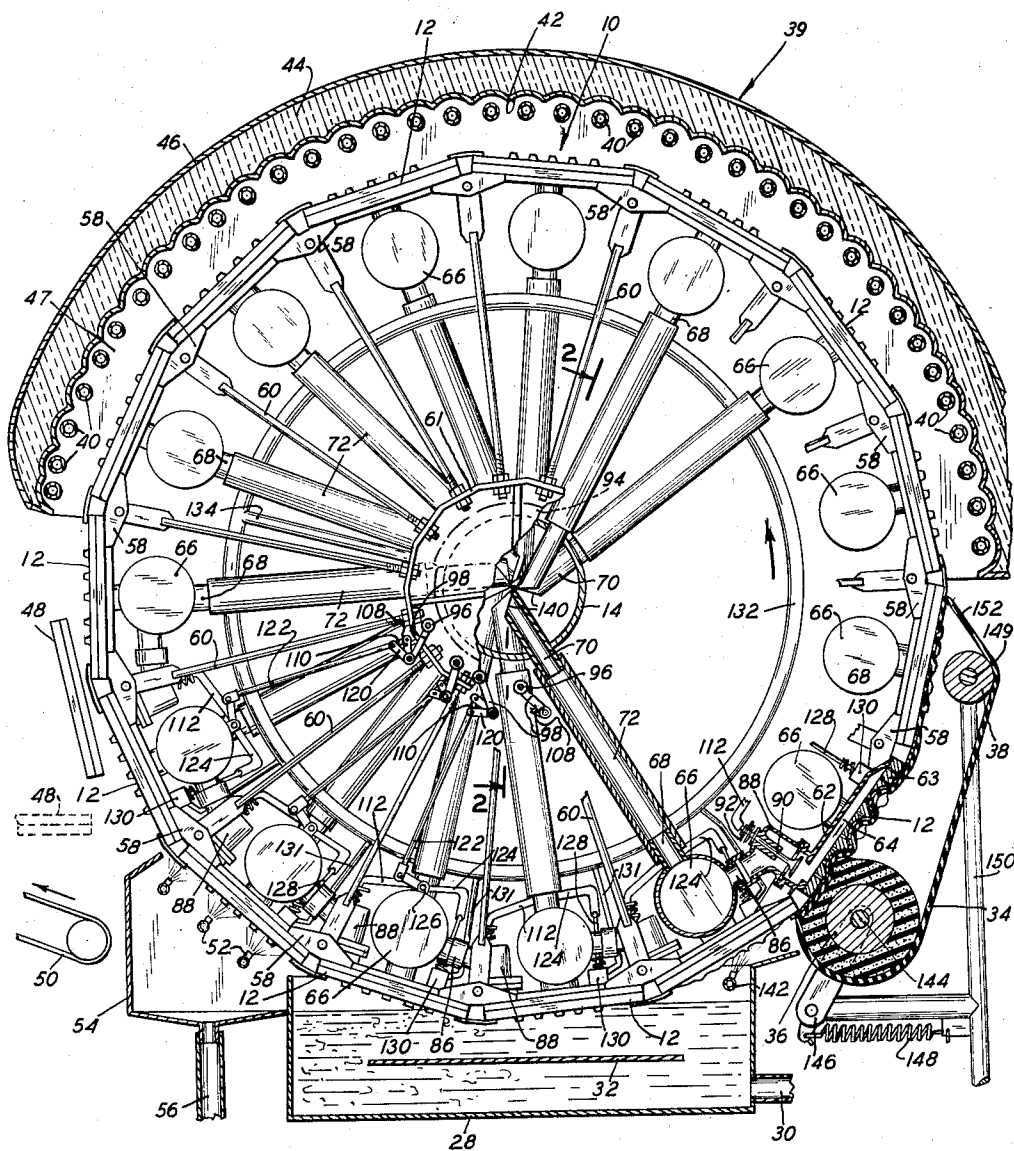


FIG. 1

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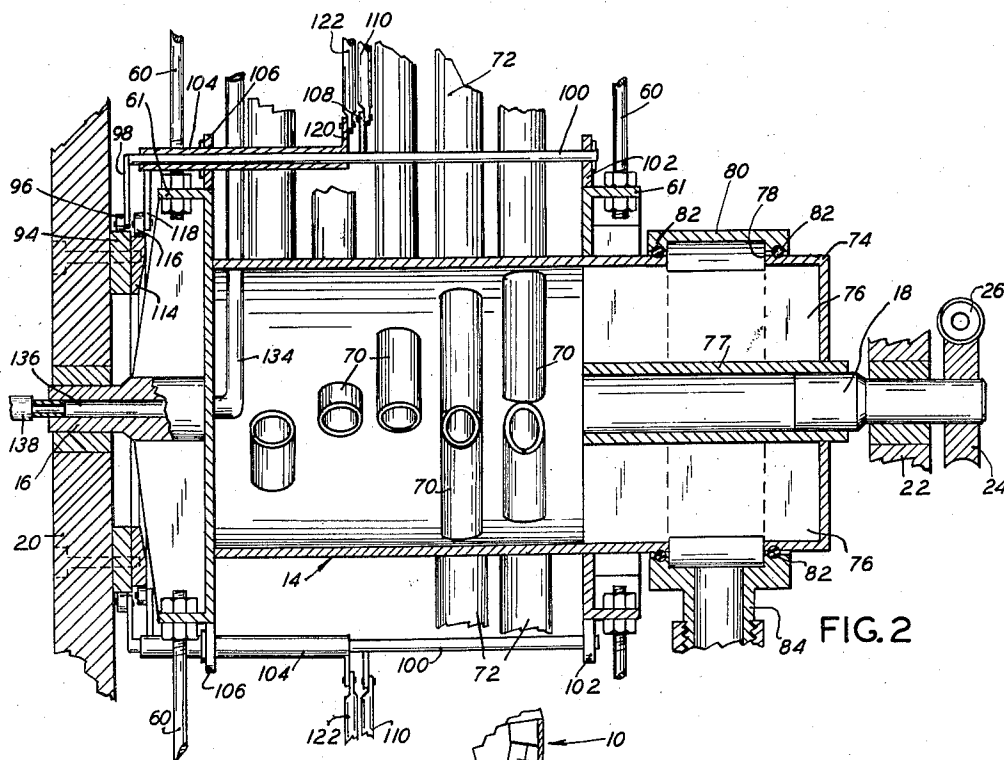


FIG. 2

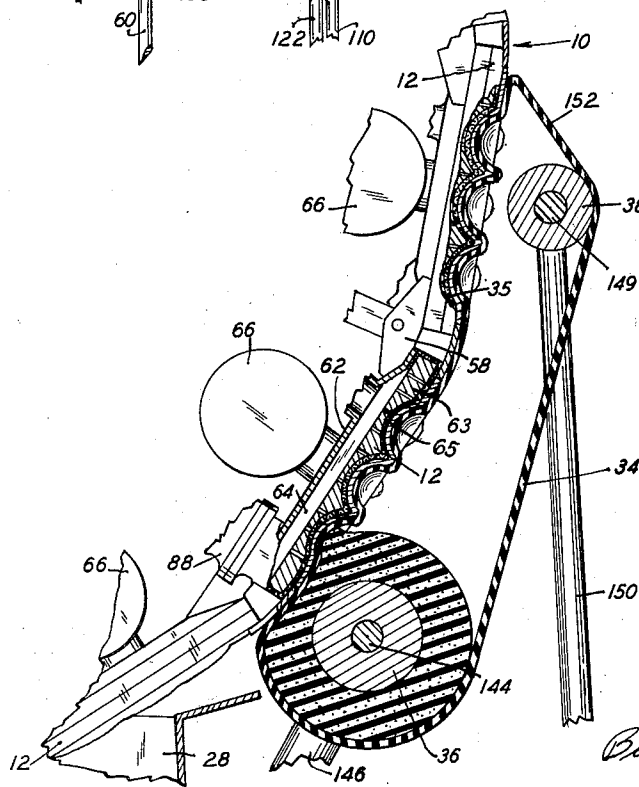


FIG. 3

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PULP MOLDING APPARATUS

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5 Claims. (Cl. 92—56)

This invention relates to pulp molding apparatus of the suction die type and more particularly to a machine for rapidly forming compacted molded pulp articles having a smooth outer surface without the employment of accurately formed expensive mating dies, such machine also embodying an improved system for discharging the water withdrawn from the pulp slurry during the forming operations.

When molded pulp articles are formed upon suction dies, the outer surface of the layer of pulp initially formed upon such dies presents a rough or uneven appearance because the distribution of the pulp fibers on the mold is not entirely uniform and also a considerable portion of the outer fibers are oriented at a large angle with respect to the outer surface of the layer of pulp so as to project outwardly therefrom. In order to smooth such outer surface and compact the layer of pulp, it has been considered necessary to provide accurately formed mating dies for the suction dies, such mating dies having a smooth surface in the form of the desired surface on the molded pulp article. The mating dies are usually made of metal, although such dies made of flexible material, such as rubber, also having mating surfaces accurately preformed to correspond to the desired surface of the molded article, have been proposed. Such dies are expensive and either a large number must be employed or the output of the pulp molding machine must be reduced so as to provide time for a lesser number of mating dies to be employed. Also, the employment of such mating dies requires additional apparatus for insuring accurate registry between a mating die and the suction die during the pulp smoothing and compacting operations.

In accordance with the present invention, a thin sheet of highly stretchable, resilient, flexible material is employed in conjunction with pulp molding suction dies. Such sheet is positioned to cover the surface of a given suction die and the vacuum in such suction dies draws the stretchable sheet into close contact with the outer surface of the layer of pulp on the suction die so as to smooth and compact such layer. It has been found that such sheets may be employed with suction dies having depressions of considerable depth, or projections of considerable height, or both, and can be employed even though the resulting surface of suction die has compound curvature such that substantial stretching of the sheet must take place in order to conform to the surface of the pulp on the die. A particularly suitable arrangement is to mount a plurality of suction dies on the periphery of a cylinder or wheel rotating about a horizontal axis so that the suction dies can dip into a body of pulp slurry maintained in a furnish tank below the drum and then be carried into contact with one run of a belt of such flexible, resilient material. By such an arrangement the contact with the sheet of flexible, resilient material takes place shortly after the emergence of the suction die from the pulp slurry and while the pulp thereon is still wet and moldable. The vacuum in the interior of the

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suction die pulls the sheet into close contact with the surface of the layer of pulp to smooth such layer and compact it. The endless belt or web of flexible sheet material is preferably pressed against the surface of such layer by a roll having a thick covering of flexible deformable material, such as sponge rubber, and the endless web of flexible sheet material may be trained loosely over a second roll so that the sheet is peeled from the compacted layer of pulp as the cylinder carrying the suction dies continues to rotate.

The pulp molding apparatus of the present invention also desirably includes a mild spray treatment of the pulp after its emergence from the pulp slurry and before application of the flexible sheet above described in order to assist in orienting the fibers parallel to the outer surface of the pulp layer and to, at least in part, wash away or incorporate more firmly into the pulp layer on the forming dies, fringe fibers or "whiskers," which tend to collect on the rails which usually surround the screen or other foraminous portion of the dies. The apparatus also preferably incorporates a partial drying step embodying radiant heating of the layer of pulp carried on the suction dies after the flexible sheet discussed above has been stripped from such layer of pulp, and also preferably incorporates an improved system for discharging the water drawn through the suction dies during operation of the apparatus. Such water discharging system collects water in separate water collecting chambers spaced from the suction dies as soon as the water passes through the foraminous surface of the suction dies. The water collecting chambers are thereafter elevated by rotation of the cylinder or wheel carrying the suction dies and are emptied between each molded pulp article forming operation on a particular suction die.

It is therefore an object of the present invention to provide improved pulp molding apparatus for forming compacted molded pulp articles having smooth outer surfaces.

Another object of the invention is to provide pulp molding apparatus of the suction die type in which the molded pulp articles are smoothed and compacted without the employment of mating dies having preformed surfaces corresponding to the surfaces of the desired article.

Another object of the invention is to provide pulp molding apparatus of the suction die type in which a thin sheet of highly stretchable, flexible, resilient material is employed to compact and smooth a layer of pulp upon suction dies having forming surfaces with compound curvature.

A further object of the invention is to provide improved pulp molding apparatus in which a layer of pulp upon a suction die is subjected to a spraying operation after its emergence from a pulp slurry and prior to a smoothing and compacting operation in order to properly position the fibers in the outer surface of such layer.

A still further object of the invention is to provide improved pulp molding apparatus of the suction die type in which an improved system of separating water in the vacuum system and discharging it from the apparatus is provided.

Other objects and advantages will appear in the following description of a preferred embodiment of the invention given in connection with the attached drawing of which:

Fig. 1 is an end view of a machine in accordance with the present invention shown partly in elevation and partly in vertical section and with certain of the parts omitted or broken away for clarity;

Fig. 2 is a partial section on an enlarged scale taken on the line 2—2 of Fig. 1; and

Fig. 3 is a fragmentary view showing the lower right hand portion of Fig. 1 on an enlarged scale.

Referring more particularly to the drawings, the apparatus shown includes a cylinder indicated generally at 10 and carrying a plurality of suction dies 12 on its periphery. The cylinder 10 has a hollow hub portion 14 provided with laterally extending stub axles 16 and 18 (Fig. 2) journaled in bearings in frame members 20 and 22 respectively, the remainder of the frame not being shown. The stub axles 16 and 18 have their bearing surfaces concentric with the hub 14 and the periphery of the cylinder 10 and support the cylinder 10 for continuous rotation about a horizontal axis. Such rotation can be produced in any desired manner, for example, by means of the worm gear 24 and worm 26 shown in Fig. 2.

The apparatus of the present invention also includes a furnish tank 28 for containing a body of pulp slurry, such pulp slurry being introduced into the furnish tank 28 through any suitable conduit, such as a pipe 30, positioned to direct the incoming slurry below a baffle 32. The apparatus also includes a finishing mechanism for compacting and smoothing the wet pulp. The finishing mechanism includes a belt 34, a spring pressed resilient roller 36 for applying the belt 34 to the surface of a layer of pulp 35 (Fig. 3) on the suction dies 12 and a stripping roller 38 for stripping or peeling the belt from the surface of the resulting compacted and smoothed layer of pulp upon the dies 12. After the finishing belt 34 has been stripped from the surface of the formed layer of pulp on the suction dies 12, such layer is carried through a heating chamber provided by a substantially semi-cylindrical structure 39 having a plurality of axially extending heating elements 40 supported therein. The heating elements may be of any desired type of radiant heating elements, for example, they may be of the fire tube type, i. e., be supplied with a mixture of gas and air which is burned in the tubes. The fire tubes 40 are spaced from the dies 12 and are positioned adjacent a reflecting member 42 which is backed by a layer of heat insulation 44 positioned between the reflecting member and a casing member 46. The semi-cylindrical structure may have end walls 47 secured to the casing member 46. Radiant heat is thus applied to the outer compacted surfaces of the pulp upon the suction dies 12 by the heating elements 40 while the vacuum is maintained in the suction dies 12 so that moisture, largely in the form of vapor, continues to be removed by the vacuum system. Thus partially dried molded articles are present upon the dies 12 as they emerge from the heating chamber and such molded articles are removed from the surface of the dies 12 and carried by a transfer die 48 to a conveyor 50 indicated diagrammatically in Fig. 1. The dies 12 are then washed by sprays 52 positioned in a spray housing 54 provided with a drain 56 and such dies again pass through the slurry in the furnish tank 28.

The dies 12 are secured at their edges to support elements 58 at the periphery of the cylinder 10, the support elements being secured to the outer ends of radially extending spokes 60 at each end of the cylinder, the spokes having their inner ends secured in flanges 61 carried by the hollow hub structure 14 of the cylinder. Each of the dies 12 includes a backing plate 62 secured to the support elements 58 and a detachable apertured member 63 having a layer of screen 65 thereon, the backing plate 62 being spaced from the apertured member 63 to provide a suction chamber 64 in the die 12. Each of the backing plates 62 carries a cylindrical tank or water collection chamber 66 extending axially of the cylinder 10, the water collection chambers 66 each being connected to the interior of the hollow hub 14 by a radially extending conduit preferably made up of a radially inwardly projecting tubular member 68 carried by each water collection chamber 66, a tubular element 70 extending outwardly from the outer surface of the hub 14, and a tubular sleeve 72 which may, for example, be of

flexible material, such as rubber, connecting the tubular elements 68 and 70.

The interior of the hollow hub 14 is maintained under a vacuum at all times. This is accomplished through a rotary vacuum connection including a cylindrical portion 74 (Fig. 2) spaced axially from one end of the main portion of the hub 14 and connected thereto by means of radially extending circumferentially spaced veins 76 and an axial tubular member 77. This structure provides a circumferential slot or gap 78 and a sleeve 80 is mounted concentrically on the end of the main portion of the hub 14 and on the portion 74 so as to cover the gap 78. The sleeve 80 is sealed to the hub structure by means of O-ring gaskets 82 so that the hub structure may rotate with respect to the sleeve 80. The sleeve 80 is provided with a downwardly extending pipe connection 84 leading to a suitable source of vacuum.

Each collection chamber 66 is connected by a conduit 86 and a valve chamber 88 to the suction chamber 64 of the die 12 which is one step forwardly of such water collection chamber in the direction of the rotation of the cylinder 10. Each valve chamber 88 is secured to the backing plate 62 of such die 12 and a valve 90 has its head between the valve chamber 88 and suction chamber 64 and is urged to valve closing position by means of a spring 92. The valve 90 for each suction die 12 is opened at an appropriate time by a valve actuating mechanism including stationary cam 94 (Fig. 2) carried by the frame element 20. The cam 94 surrounds the stub axle 16 of the hub 14 and is engaged by cam follower rollers 96, one roller 96 being provided for each valve 90. Each cam follower roller 96 is journaled on the end of a lever arm 98 secured to one end of an axially extending rocker shaft 100 having its other end journaled in radially extending ears 102 forming part of the hollow hub 14. The rocker shaft 100 is also journaled in a tubular member 104 which in turn is journaled in other radially extending ears 106 forming part of the hub 14. The shaft 100 has another lever arm 108 secured thereto intermediate its end, which lever arm is connected to a valve push rod 110 which has its other end pivotally connected to a lever arm 112 (Fig. 1) having one end pivotally connected to a bracket (not shown) secured to one of the cylindrical water collecting chambers 66 and the other end engaging the stem of a valve 90.

The shape of the cam 94 is such that the vacuum sources is connected to the suction chamber 64 associated with each suction valve 12 as soon as such suction valve is immersed in the slurry in the furnish tank 28 and the vacuum is maintained until shortly after such suction valve 12 emerges from the heating chamber. That is to say, the transfer die 48 is moved into registry with each suction die 12 as it emerges from the heating chamber by mechanism not shown and, when such registry has been effected, the valve 90 is closed and air pressure is introduced into the suction chamber 64 to blow the formed article from the surface of the die 12 onto the transfer die and the transfer die 48 is thereafter removed from engagement with a die 12 and moved to the position shown in dotted lines in Fig. 1 to drop the formed article upon the conveyor 50. Such transfer die may be conventional and the details thereof form no part of the present invention.

The mechanism for introducing air under pressure into the suction chamber 64 is similar to that for operating the valve 90 and includes another cam 114 (Fig. 2) mounted adjacent the cam 94 and secured to the frame member 20. The cam 114 is engaged by cam follower rollers 116 each mounted on a lever arm 118 secured to the sleeve or tubular member 104, each such sleeve having another lever arm 120 secured to its other end and pivotally connected to a push rod 122 having its other end pivotally connected to one arm of a lever 124 (Fig. 1) pivoted intermediate its ends in a bracket 126 secured to a water collection chamber 66. The other arm of

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each of the levers 124 is pivotally connected to the stem of a valve 128 mounted in a valve housing 130 also secured to the backing plate 62 and connected to a conduit 131 in turn connected to an air pressure manifold 132. The manifold 132 extends in a circle adjacent the inner peripheries of the water collection chambers 66 and is connected by a pipe 134 to an axial bore 136 in the stub axle 16 for one end of the cylinder 10, the axial bore 136 being connected to a source of air under pressure through any suitable type of sealing connection 138 providing for relative rotation between the axle 16 and a stationary conduit (not shown) leading to such source of air under pressure. The cam 114 is shaped so that air pressure is introduced into the interior of suction chambers 64 of each of the dies 12 after the valve 90 for such die has been closed to disconnect the suction chamber 64 from the source of vacuum and as soon as the transfer die 48 has been registered with the suction die 12. This air pressure in the die 12 may be maintained by the cam 114 only long enough to transfer the formed article from the die 12 to the transfer die 48 and, if desired, may be maintained during the washing step by means of the sprays 52 so as to assist in removing fibers from the surface of the suction die.

It will be noted that the valve 90 is located adjacent the trailing edge of the suction dies 12 with respect to the direction of rotation of the cylinder 10. This means that water withdrawn from the slurry in the furnish tank 28 during the formation of the layer of pulp 35 upon the outer surface of the suction valve 12 runs downwardly in the suction chambers 64 to the vicinity of the valve 90 and that such water is immediately sucked out of the chamber 64 into a water collection chamber 66. Such water remains in the chamber 66 during a partial rotation of the cylinder 10, i. e., until the conduit 72 leading from a suction chamber 66 is raised slightly above the horizontal. The vacuum system is thereby relieved of having to elevate the water from a suction die 12 to the hub of the cylinder 10.

The tubular members 70 forming the inner terminals of the conduits 72 are preferably arranged in groups of three, the elements 70 of each group being in the same radial plane and being positioned 120 degrees from each other. In the apparatus shown in the drawings, there are fifteen suction dies 12 and the tubular elements 70 in the hub are arranged in five groups of three, each group being displaced along the hub 14. Each of the tubular members 70 are displaced below the axis of the hub 14 at their inner ends when such tubular elements are being elevated during rotation of the cylinder 10. That is to say, the upper cylindrical element of each of such tubular members is substantially in alignment with the axis of the hub 14 so that the opening in the end of the tubular element 70 is below such axis. Each of the tubular elements 70 has its end beveled or formed at an angle to its axis, as shown at 140, to provide clearance for discharge of water into the interior of the hub 14. Such water is discharged into the hub below the axis of the hub 14 and is immediately drained therefrom through the conduit 84 (Fig. 2). Such conduit 84 may be connected to any suitable type of water separator, such as a barimetric column or a tank provided with a pump for removing water therefrom. As each water collecting cylinder 66 is elevated, the water is discharged therefrom into the hub 14 and drained from the hub as just described.

As the suction dies 12 leave the furnish tank 28, the layer of pulp 35 thereon is preferably subjected to a mild spraying action from jets 142 so as to wash any fibers from the rails conventionally surrounding the suction die and, at least to some extent, to orient the fibers on the surface of the layer of pulp. That is to say, jets in the direction shown in Fig. 1 will cause upstanding fibers on the surface of the layer of the pulp to be forced down and arranged substantially parallel with the surface of

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the layer of pulp and such jets will also wash off of the edges of the pulp article fibers which extend over the rails which surround the die, such fibers being frequently referred to in the art as "whiskers." During the withdrawal of the dies 12 from the slurry in the furnish tank 28, and during the spraying operation from the jet device 142, the vacuum is maintained in the suction chamber 64.

Immediately after the spraying action from the jet device 142, the inner run of the belt 34 is positioned against the layer of pulp upon the surface of the suction die 12. A preferred manner of positioning the inner run of the belt 34 against the surface of such layer of pulp is to employ the spring pressed roll 36 having a relatively thick layer of resilient material, such as sponge rubber, thereon. As shown in Fig. 1, the roller 36 is journaled on a shaft 144 carried on the free end of a lever arm 146 which is urged to the left in Fig. 1 by means of a tension spring 148. The belt 34 is driven by its contact with the pulp layer on the dies 12 and is trained loosely around the spring pressed roller 36 and the roller 38, which is journaled upon the shaft 149, so that the belt is free to follow the dies 12 during the rotation of the cylinder 10. The shafts 144 and 149 for the rollers 36 and 38, respectively, are supported at one end only so that the belt 34 may be easily removed and placed on the rollers and also the subframe structure 150 supporting the shaft 149 and the pivoted arm 146 carrying the shaft 144 is preferably made easily removable so that the belt 34 can be readily replaced and also access to the dies 12 provided.

Upon the belt being positioned against the surface of the layer of pulp 35 upon the die 12, the vacuum from the suction chamber 64 acting through the such layer of pulp pulls the inner run of the belt snugly against the surface of such layer. The belt 34 is imperforate and substantially impervious to air and is sufficiently stretchable that it can be pulled into firm engagement with the surface of the pulp within any depressions in the layer, even though such depressions have a substantial amount of compound curvature. That is to say, the flexible rubber or other flexible material will conform to the surface of a layer of pulp even though such layer has projections or depressions or both providing such compound curvature. The result is the smoothing of the surface of the layer of pulp and a compacting action on such layer, particularly with respect to the fibers adjacent the outer surface of the layer. This compacting action takes place rapidly and results in squeezing an additional small amount of water out of the layer of pulp. As soon as the compacting action has taken place, the belt may be peeled or stripped from the smoothed and compacted outer surface of the layer of felt. By providing a belt of sufficient length to produce a substantial loop or bight 152 adjacent the roller 38, the belt is peeled from the surface of the layer of felt without disturbing it. The compacted layer of felt is then heated in the heating chamber while additional moisture, largely in the form of vapor, is removed by the vacuum system above described. The molded pulp article thus formed can be removed from the dies 12 by the transfer die 48 and has sufficient strength to be carried to further drying operations by any desired transfer mechanic, such as the conveyor 50.

The operation of the apparatus of the present invention is apparent from the above description thereof. The cylinder 10 is rotated at an appropriate speed, for example, a speed such that a molded pulp article is removed from the cylinder every four seconds, which means that a cylinder having fifteen dies will make one revolution per minute. The valve 90 of each suction die 12 is opened to admit vacuum into the suction chambers 64 of the suction die just as the die is completely immersed in the pulp slurry in the furnish tank 28, such valve being opened by the lever arm 112 and linkage including the

push rod 110, rocker shaft 100, lever arm 98 and cam 94. The vacuum in the die removes water from the pulp slurry and causes a layer of pulp to build upon the outer surface of the suction die 12. The vacuum is maintained during removal of the suction die from the slurry in order to keep the layer of pulp thereon. Upon emergence of the die 12 from the slurry in the tank 28, the surface of the layer of pulp thereon is sprayed by the jet device 142 to assist in laying down any upstanding fibers on the surface of the layer of felt and also for the purpose of washing fibers from the rails surrounding the foraminous face of the die. The wash water from the jets 142 drains back into the furnish tank 28 but the amount of water thus introduced into such tank does not materially dilute the slurry therein.

Each suction die 12 is then carried past the spring pressed roller 36 and the flexible belt 34 is applied against the surface of the layer of wet pulp on the suction die. The yielding or resilient layer on the roller 36 as well as the yielding pressure of the roller against the surface of the pulp on the suction die produced by the tension spring 148, causes the inner run of the belt 34 to be brought into intimate contact with the surface of the pulp on the suction die. The vacuum also causes the belt to be pulled into any depressions in such dies so as to produce a smooth compact outer surface on the layer of felt. As the cylinder 10 continues to rotate, the belt 34 is peeled from the compacted smooth surface of the pulp on the die and this surface is then heated by passage of the dies through the heating chamber. The actuating mechanism for the valve 90, including the cam 94, causes the closing of the valve 90 and a similar actuating mechanism for the valve 128, including the cam 114, cam follower roller 116, lever arm 118, tubular shaft 104, lever arm 120, push rod 122 and lever 124 opens the valve 128 to admit air under pressure to suction chamber 64 from the air pressure manifold 132. The air pressure manifold 132 is connected to a suitable source of air under pressure through the pipe 134, axial bore 136 and sealing connection 138. Such air pressure is applied only after the transfer die 48 has been registered with the appropriate suction die 12 by mechanism not shown and may, if desired, be maintained during the washing operation provided by the jets 52. In any event, the valve 128 is closed by the cam 114 acting through the linkage above described before the valve 90 is again opened to apply suction to the interior of the suction valves 12. While an endless belt 34 of flexible, resilient material has been shown, it will be apparent that any other mechanisms for applying a sheet of flexible, resilient, readily stretchable material to the surface of the layer of wet pulp upon the suction die, after removal of the die from the pulp slurry, may be employed.

The apparatus of the present invention is particularly adapted for forming trays for packing fruit, such as apples or pears, or for holding eggs or similar articles having a plurality of depressions therein but is also useful for making various other types of articles of molded pulp. By employing appropriate transfer means for removing the partly dried articles from the cylinder, the dies 12 need not all be the same, i. e., they may form different articles. Also, instead of forming separate articles, the dies 12 may form a continuous molded web in which case such web may be stripped from the cylinder 10 and cut into separate articles.

I claim:

1. In a machine for forming molded pulp articles including a plurality of suction dies mounted on the periphery of a cylinder, a furnish tank containing a pulp slurry, means for supporting and rotating said cylinder about a horizontal axis to cause said dies to pass through said slurry, and means for producing a vacuum in said dies to form a layer of pulp on said dies and for maintaining said vacuum after said dies leave said slurry; the improvement of means for smoothing and compact-

ing said layer comprising an endless belt of flexible, resilient, stretchable, air-impervious sheet material supported upon rollers and having one run extending along the periphery of said cylinder in the direction of rotation thereof, one of said rollers being positioned to press said run of said belt against the surface of said layer of pulp so that the vacuum in said dies causes said sheet material of said belt to compact and smooth said layer and another of said rollers being positioned to strip said belt from said surface.

2. In a machine for forming molded pulp articles including a suction forming die having a surface of compound curvature carried on the periphery of a cylinder, a furnish tank containing a pulp slurry, means for supporting and rotating said cylinder about a horizontal axis to cause said surface to pass through said slurry, and means for producing suction through said surface to form a layer of pulp on said surface and for maintaining said suction after said layer leaves said slurry; the improvement of means for smoothing and compacting said layer comprising an endless belt of flexible, resilient, stretchable, air-impervious sheet material supported upon rollers and having one run extending along the periphery of said cylinder in the direction of rotation thereof, one of said rollers having a covering of flexible deformable material and being positioned to press said run of said belt against the surface of said layer of pulp so that said suction causes said sheet material of said belt to compact and smooth said layer and another of said rollers being positioned to strip said belt from said surface.

3. Apparatus for forming molded pulp articles including a suction die having depressions in its forming surface, means for immersing said die in a pulp slurry and establishing a vacuum in the interior of said die to form a layer of pulp on said surface and for withdrawing said die from said slurry while maintaining said vacuum, said means including a cylinder having a hub supporting said cylinder for rotation about a horizontal axis, said cylinder carrying said die on its periphery, passage means extending from said die and through said hub for connecting said die to a source of vacuum, and a water collecting chamber in said passage means adjacent said die and spaced rearwardly from said die with respect to the direction of rotation of said cylinder for collecting water drawn through said die from said pulp slurry and discharging said water through said hub only after a partial rotation of said cylinder, and means for smoothing and compacting said layer of pulp comprising a sheet of flexible, resilient, stretchable, air-impervious material, means for positioning said sheet against the exposed surface of said layer of pulp so that said vacuum causes said sheet to smooth and compact said layer and means to thereafter remove said sheet from contact with said layer.

4. Apparatus for forming molded pulp articles including a plurality of suction dies mounted on the periphery of a cylinder, a furnish tank containing a pulp slurry, means including a hub for supporting and rotating said cylinder about a horizontal axis to cause said dies to pass through said slurry, means for producing a vacuum in said dies to form a layer of pulp on said dies and for maintaining said vacuum after said dies leave said slurry including a passage means extending from said dies to said hub for connecting each of said dies through said hub to a source of vacuum, and a water collecting chamber in each of said passage means adjacent the periphery of said cylinder for collecting water drawn through one of said dies from said pulp slurry and for discharging said water through said hub only after a partial rotation of said cylinder, means for smoothing and compacting said layer comprising an endless belt of flexible, resilient, stretchable, air-impervious sheet material supported upon rollers and having one run extending along the periphery of said cylinders in the direction of rotation thereof, one of said rollers being positioned to press said run

of said belt against the surface of said layer of pulp so that the vacuum in said dies causes said sheet material of said belt to compact and smooth said layer and another of said rollers being positioned to strip said belt from said surface.

5. Apparatus for forming molded pulp articles including a plurality of suction dies mounted on the periphery of a cylinder, a furnish tank containing a pulp slurry, means including a hub for supporting and rotating said cylinder about a horizontal axis to cause said dies to pass through said slurry, means for connecting said dies to a source of vacuum to form a layer of pulp on said dies and for maintaining said vacuum after said dies leave said slurry including passage means extending from each of said dies to said hub, and a water collecting chamber in each of said passage means adjacent the periphery of said cylinder and spaced rearwardly from

the die with which it is associated with respect to the direction of rotation of said cylinder for collecting water drawn through one of said dies from said pulp slurry and for discharging said water through said hub only after a partial rotation of said cylinder.

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