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ARTICLE PRESS METHOD AND APPARATUS FOR PULP MOLDING MACHINES

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FIG. 1

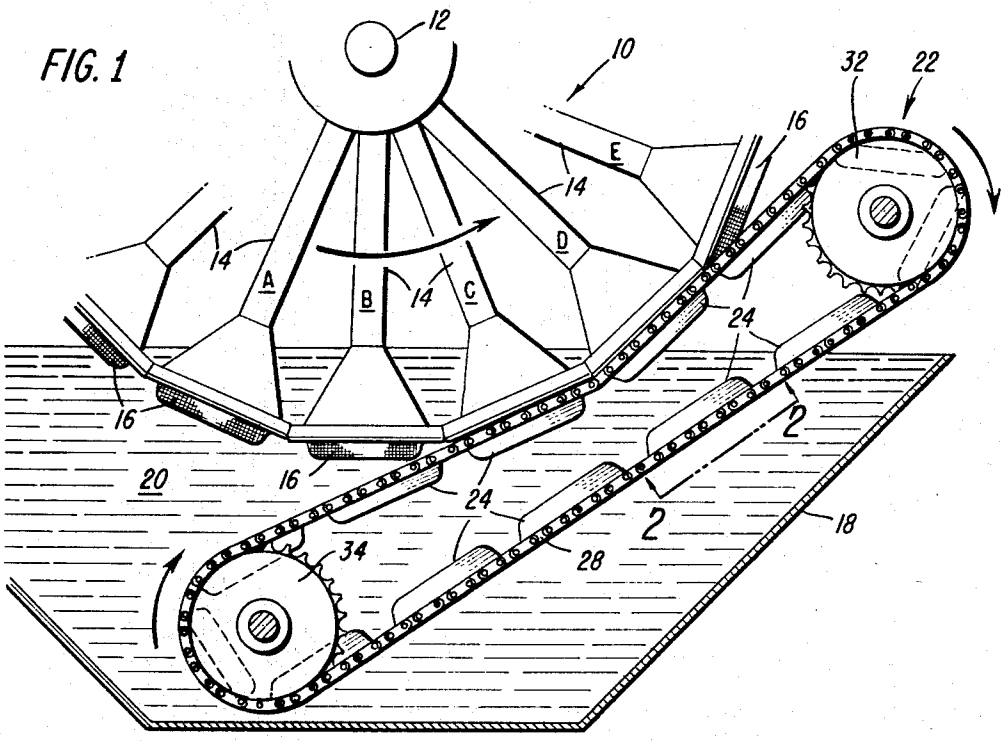


FIG. 2

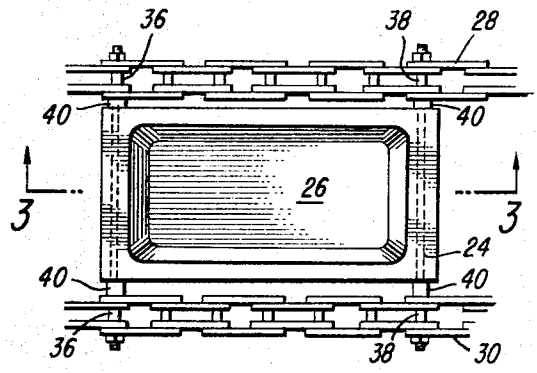
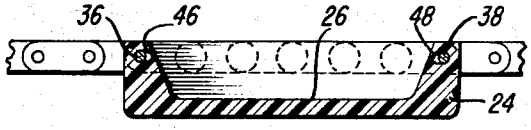


FIG. 3



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ARTICLE PRESS METHOD AND APPARATUS FOR PULP MOLDING MACHINES

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This invention relates to a pulp molding method and apparatus and more particularly to a device for rapidly molding compacted pulp articles having an essentially completely smooth outer surface and without the necessity of employing complex mating dies.

When suction molded pulp articles are formed, the surface of the articles not in contact with the mold are produced with a rough and uneven configuration; these characteristic bumps are made by bundles of fibers and are due to evacuation of water from between the pulp fibers. It is desirable to obtain a smooth surface rather than the rough and uneven surface in order to provide a more attractive product. In addition, it is desirable to compress the rough pulp article in order to provide a denser and stronger article.

In the past these ends have been obtained by first forming the article and then subsequently applying pressure to the article by the use of accurately formed mating dies. Such mating dies, having a smooth surface in the form of the configuration desired on the molded pulp article, have been provided adjacent the molding drum so that the mating dies come in contact with the rough surface of the deposited pulp article while such article is still on the suction mold and after the mold has been withdrawn from the pulp slurry. Such mating dies have been made of metal or rubber. The dies according to this prior practice are expensive to provide and necessitate in their operation a reduction in product output due to reduced operating speeds. In addition, such mating dies generally require the use of complex registry apparatus.

Another prior art practice of compressing and smoothing the molded pulp product comprises removing the molded pulp article from the suction die and then pressing it between hot matching dies. This practice suffers from the same problems and disadvantages as the system of the preceding paragraph.

It has also been proposed to use a stretchable belt adjacent the uneven surface of the molded pulp article while the article remains on the suction die; in this manner vacuum is applied through the pulp article to the stretchable belt which is then sucked in against the rough and uneven surface to effect a smoothing. This practice, although reducing the cost of equipment, has failed to produce a satisfactory product as desired. All of the known prior art methods of smoothing molded pulp articles start with a comparatively rough surface which is characteristic of the texture of molded pulp.

The present invention contemplates obviating the aforementioned problems by eliminating the characteristic bumps before they are formed and by compressing the article while it is still in a soft and moldable condition. This is accomplished by applying pressure to the pulp deposit on the pulp mold while the deposit is still in a wet and gelatinous stage beneath the surface of the pulp slurry. The pressure applying means comprises a series of hard, elastic and deformable plugs having a surface configuration complementary to the surface configuration of the pulp molds and which mate with the molds while still in the slurry to squeeze and compress the pulp deposits on the molds.

It is therefore an object of the present invention to provide an improved method and apparatus for producing smooth surfaces on molded pulp articles.

It is another object of the present invention to provide an improved and novel method and apparatus for producing a compressed pulp molded article of improved strength.

It is another object to provide a method and apparatus for producing molded pulp articles having greater strength, hardness, density and uniformity.

It is yet another object of the present invention to provide an apparatus which is simple and economical to produce and yet which may be used with conventional pulp molding equipment without reducing the rate of production of molded pulp articles.

It is another object of the present invention to provide an apparatus which operates simply and quickly without the need for ancillary registry equipment.

It is another object of the present invention to provide a method and apparatus which improves the rate and uniformity of drying of molded pulp articles thereby increasing the production rate and reducing the warpage of articles on drying.

Other objects and the nature and advantages of the instant invention will be apparent from the following description taken in conjuncntion with the accompanying drawings, wherein:

FIG. 1 is a fragmentary view showing the apparatus of the present invention.

FIG. 2 is a view of a pressure applying means according to the present invention taken along line 2—2 of FIG. 1.

FIG. 3 is a sectional view of a pressure applying means taken along line 3—3 of FIG. 2.

Referring more particularly to the drawing, there is shown generally in FIG. 1 a molding drum **10** comprising a central core **12**, a plurality of hollow spokes **14** passing from the core **12** to the periphery of the drum, and a plurality of pulp molds **16**, each provided at the end of a hollow spoke **14**. Beneath the molding drum **10** is a pulp slurry vat **18** which contains a pulp slurry stock **20** through which the submerged pulp molds **16** travel. In a manner well known in the art, the drum is rotated while vacuum is applied through pulp molds **16**; this effects deposition of pulps on each mold **16** as it passes through the pulp stock **20**. During rotation of the drum, each mold **16** may rotate through a series of stations including a pulp depositing station, a pressure applying station, a drying station and an article removing station. The present invention relates to the pulp depositing and pressure applying stations.

Each mold **16** is formed of a perforated material and covered with a screen as is well known in the prior art. As a mold **16** passes through slurry **20** vacuum is applied through to hub **12**, the hollow spokes **14**, and finally through the perforated mold **16** to effect deposition of pulp upon the screen of the mold. Conventionally, as pulp forms on the die and water drains out of the pulp, the wood fibers tend to aggregate into bundles with the water draining through passageways of least resistance formed between the bundles. During the formation of the article under the surface of the slurry, however, the water acts as a carrier for the even distribution of fibers, since conventionally there is about 99 parts of water for each part of fiber in the stock slurry **20**. Thus, due to the high water to fiber ratio, distribution of fibers and draining of water from the pulp deposit will be essentially uniform while such deposit is in the slurry. The instant the mold **16** comes out of the slurry **20** however, the gelatinous pulp held to the mold by vacuum still has so much water in it that the fibers are still well dispersed. It is only after the bulk of the water is drained out that the fibers tend to aggregate together and form the characteristic bumps.

To prevent the fibers from aggregating together to form the characteristic bumps and to further effect compression of the molded pulp article while it is still in a compressible and moldable state, a pressure applying means shown generally at **22** is provided to initiate compression of the pulp deposit while it is still beneath the surface of the stock slurry **20**. The articles produced after being compressed by pressure applying means **22** are very dense, strong and smooth and, when removed from the die are much drier than articles of the prior art. By applying pressure while the deposited pulp is still in the gelatinous and water draining stage, the fibers stay dispersed and form uniformly over the pulp molds **16**. Besides greatly densifying the ultimate article and providing an article strength on the average of twenty percent greater than any articles of the prior art, the pressure applying means provides an exceptionally smooth surface on the entire outer surface of the molded pulp article.

The pressure applying means **22** of the present invention comprises a series of plugs **24** each having an inner surface **26** which is complementary in shape to the outer surface of the pulp molds **16**. The plugs **24** are comprised of a material which is sufficiently hard to maintain its desired surface configuration **26** during molding but, on the other hand, is sufficiently elastic and deformable to flex under strain so that the plug may be broken away from the vacuum exerted through the mold and product after the desired pressure application. In other words, the material from which the plugs **24** are formed must be hard enough to properly exert pressure and to provide a true and accurate shape to the outer portion of the plup deposit, but, on the other hand, must be flexible enough so that when pulled away from the mold to which it is attached by suction, the plug **24** will bend sufficiently to allow air to enter its sides and thus break the vacuum. A suitable material has been found to be polyurethane. Other materials, such as stiff natural or synthetic rubber may be used.

Each plug **24** is provided between two endless chains **28** and **30** each of which is aligned on and passes about two rotating chain sprockets; as seen in FIG. 1, chain **28** passes about the two chain sprockets **32** and **34**. Thus sprocket **34** and its equivalent for chain **30** are disposed within the pulp slurry while sprocket **32** and its equivalent for chain **30** are disposed above the exit end of the vat **18**. In order for the plugs **24** to mate accurately and properly with the molds **16**, the distance between each mold **16** must be uniform; due to present product take-off equipment such uniformity is conventional. Thus, by simply providing an equal and uniform space between each plug **24**, a plug **24** and a mold **16** will mate uniformly and consistently without the necessity of any complex registry equipment. For this reason it is necessary that the plugs **24** be accurately spaced and accurately maintained both along and between the chains **28** and **30**.

In the illustrated embodiment the plugs **24** are attached to the chains **28** and **30** by passing bolts **36** and **38** through each chain and through a plug **24** so that the chains **28** and **30** are contacted by the extremities of the bolt and the plug is contacted in the middle of the bolt. In order to allow the passage of the bolts **36** and **38** through the plug **24**, each plug is provided with two laterally directed holes **46** and **48**. Thus bolt **38** passes through hole **48** at one longitudinal end of each plug **24** and bolt **36** passes hole **46** at the other end of each plug. Holes **46** and **48** are provided with a somewhat eliptical cross-section so that the plug **24** may move longitudinally (transversely to the direction of the bolts **36** and **38**) in a manner similar to a "lost motion" hinge. This "lost motion" hinge assembly is necessary as the plugs **24** pass around the sprockets **32** and **34**. In addition, such a "lost motion" action will permit registry of a plug **24** on a mold **16** by self-seating in cases where the molds and plugs are slightly out of registry. Spacers **40** may be provided on each bolt between each chain and each plug in order to insure that the plugs remain in proper lateral registry to the molds.

The endless chains **30** and **28** are preferably allowed to turn freely on the idle sprockets such as **32** and **34** and are driven by the movement of the molds in engagement with the plugs **24**. Alternatively, the sprockets such as **32** and/or **34** may be driven, but this requires the use of synchronizing registry equipment. It is necessary for the chains **28** and **30** to be relatively tightly stretched so that the plugs **24** come into tight contact with the molds **16** to provide full and uniform contact of the gelatinous surface of the pulp deposits by the plugs **24** without trapping any air therebetween. The contact must also be tight so that the plugs will exert the necessary pressure to provide the desired smoothing and compacting. Therefore, means for adjusting the tension (not shown) of the chains may be provided, such as, for example, merely providing one set of sprockets **32** movable away from and towards the other set **34**.

As a mold **16** advances through steps A and B (note FIG. 1), pulp is deposited freely on the mold **16**. Between steps B and C the mold **16** comes in contact with a plug **24** and at step C the gelatinous pulp deposit is pressed uniformly by such plug **24**. The pressure exerted by the plug **24** is continued through step D where the mold has emerged from the stock slurry and between steps D and E the mold **16** is pulled away from the plug **24**. Thus as the mold rotates through steps C and D the pressure exerting plug **24** moves along with the mold **16** and continues to exert force which tends to squeeze water out of the pulp deposit. This squeezing action, along with the vacuum applied from the other side of the pulp article through the mold removes most of the water in the pulp deposit. Shortly after the plug has come in contact with the gelatinous pulp deposit and has shielded that deposit from the remainder of the pulp slurry, the suction behind the mold **16** becomes effective on the plug to pull the plug into even tighter contact with the pulp deposit; such suction does not become effective until the majority of the water has been pulled from the pulp deposit and the pulp deposit is no longer gelatinous. Thus between steps D and E, when the plug becomes separated from the mold **16**, it is necessary to break the vacuum connection between the plug **24** and the mold **16** and at this point the flexibility of the plug **24** enables the plug to bend sufficiently so that air may enter between the plug **24** and the mold **16** in order to break the vacuum.

It is essential in the present invention that pressure be applied to the pulp deposit while it is still in its moldable and gelatinous stage. If the pressure application is held up until vacuum is drawn through the deposit and the water is displaced by air, i.e. shortly after the mold has left the stock slurry **20**, the deposit will have already obtained its characteristic bumps and, in addition, it will be impossible to apply the type of compression which will compact the deposit sufficiently to provide the increased strength obtained by articles made in accordance with the present invention.

While the invention has been described and shown as a vertical drum revolving on a horizontal axis, it will be understood by those skilled in the art that the invention also contemplates a drum placed horizontally and revolving about a vertical axis. If desired, other systems, rather than a continuous and/or intermittent rotating drum with molds about its periphery, may be used.

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

What is claimed is:

1. In the method of suction molding pulp articles wherein a series of shaped pulp molds is passed through a vat

containing a slurry of pulp and wherein vacuum is applied to the molds to effect the deposition of pulp thereon and comprising applying pressure to the pulp deposit on each shaped mold in sequence while said pulp deposit is submerged beneath said pulp slurry, and maintaining application of pressure until said each mold has passed out of said pulp slurry, the improvement comprising applying said pressure to essentially the entire surface of said pulp deposit with a hard and flexible complementary shaped pressure exerting surface, flexing each said pressure exerting surface after each adjacent mold has left said pulp slurry to permit air to enter between said pulp deposit and said pressure exerting surface, and removing said pressure exerting surface from said pulp deposit.

2. In a pulp molding apparatus including a pulp slurry vat, a series of shaped pulp molds mounted on carrier means to pass through said vat, a vacuum means for applying suction through said molds, and pressure applying means at least partially extending into said vat and into the slurry contained therein and provided adjacent and in facing relationship to said pulp molds at a position corresponding to a segment of the travel of said molds partially through said vat, and partially above said vat the improvement wherein said pressure applying means comprises a series of surfaces, each surface being shaped complementary to the shape of said pulp molds, said presure applying means further comprising aligning means for maintaining said complementary surfaces in position and for urging each said complementary surface against a pulp deposit on a corresponding complementary mold, each said surface being hard and flexible whereby said surface may flex for permitting air to enter between said pulp deposit and said surface to permit separation thereof.

3. A pulp molding apparatus as defined in claim **2**

wherein said aligning means comprises chain sprockets and said pressure applying means further comprises a pair of endles chains passing about said chain prockets and supporting therebetween said complementary surfaces.

4. A pulp molding apparatus in accordance with claim **3** wherein said chain sprockets are idle sprockets and said complementary pressure applying surfaces and said chains are driven about said sprockets by engagement of said complementary surfaces with said molds.

5. A pulp molding apparatus in accordance with claim **3** wherein two pair of chain sprockets are provided, one pair being disposed within said vat and said slurry and the other pair being disposed above said vat and adjacent said drum at the drum exit end of said vat, each of said endless chains being associated with one sprocket of each sprocket pair.

6. A pulp molding apparatus in accordance with claim **2** wherein said hard and flexible surface is formed of polyurethane.

7. An apparatus in accordance with claim **3** wherein each of said surfaces is connected to each of said endless chains at both the leading and trailing edges of each of said surfaces, said connection on said surfaces being provided through elongated slot means to permit said surfaces to pass about said sprockets and permit said surfaces to self-seat.

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