Nov. 27, 1973 E. H. CUMPSTON, JR 3,775,525

DAMP PULP MOLDING

Filed July 19, 1972 2 Sheets-Sheet

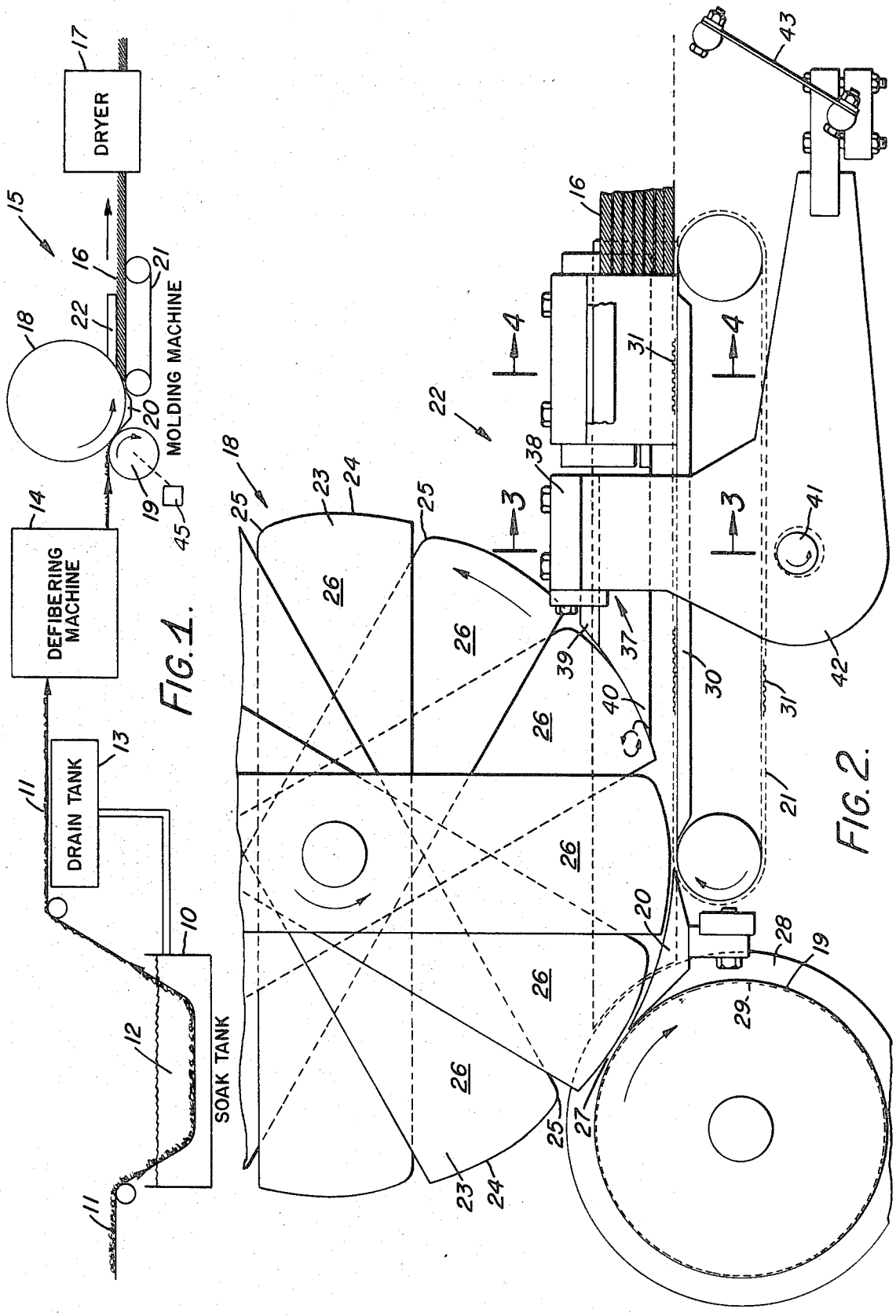


FIG. 1.

FIG. 2.

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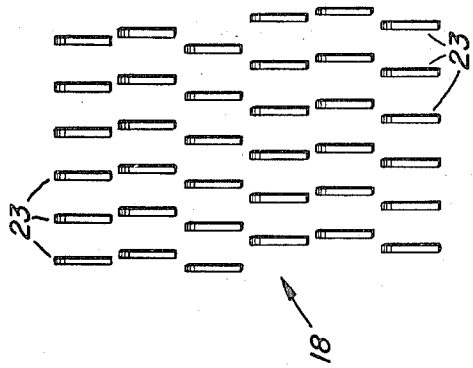


FIG. 5.

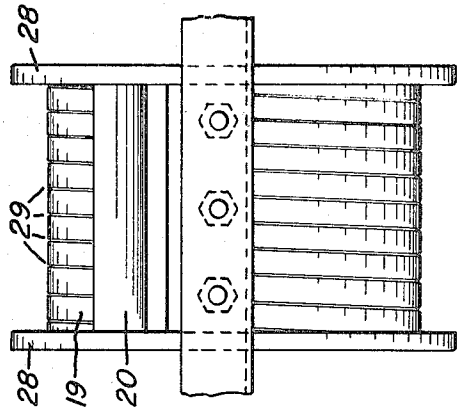


FIG. 6.

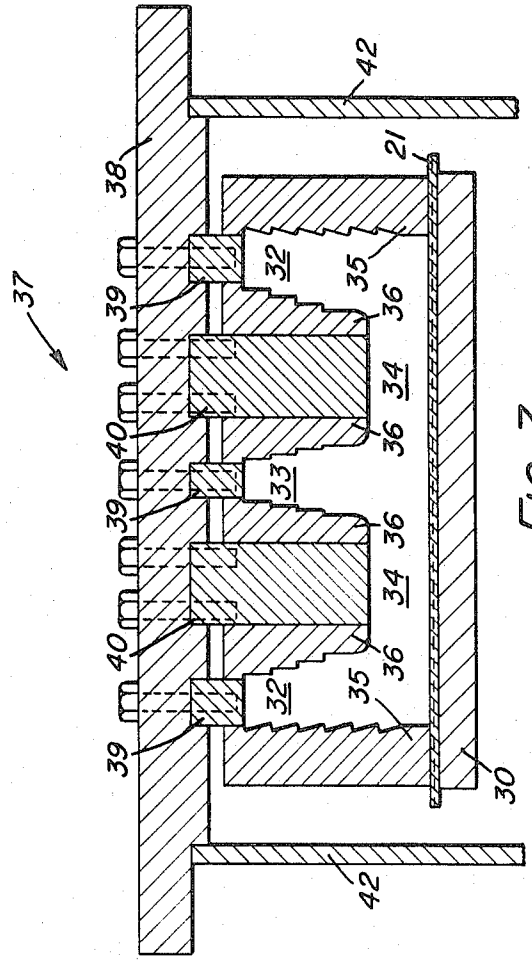


FIG. 3.

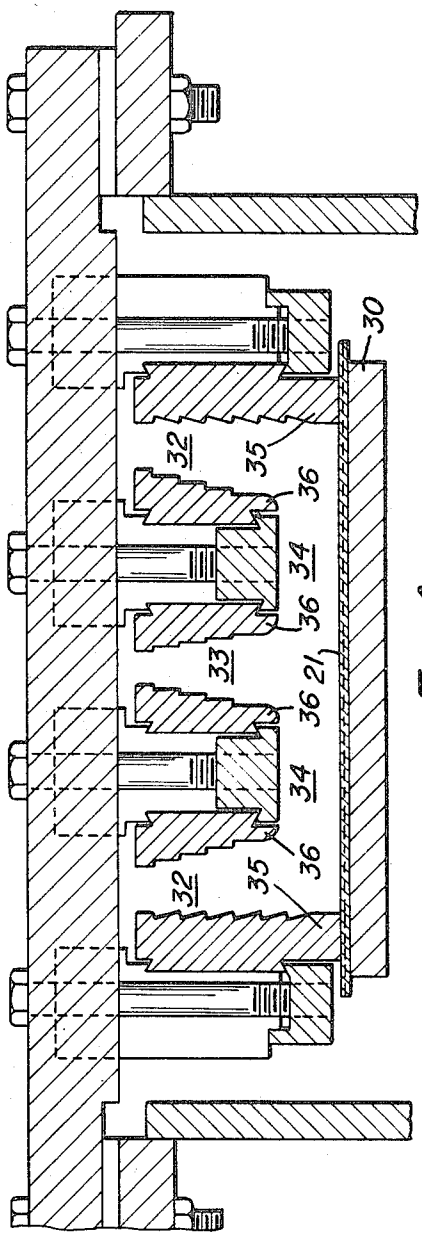


FIG. 4.

United States Patent Office 3,775,525 Patented Nov. 27, 1973

3,775,525

DAMP PULP MOLDING

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Filed July 19, 1972, Ser. No. 273,136
Int. Cl. D21j 3/00
U.S. Cl. 264—115 46 Claims

ABSTRACT OF THE DISCLOSURE

Damp, fibrous pulp such as cellulose fiber pulp of 20% to 40% solid material is molded by being worked repeatedly with a tool that moves fibers relative to each other for straightening out the fibers and removing air from the pulp to form a damp, felted pump which is then dried. Preferably the tool is a rotor having skid comb teeth that run repeatedly through the pulp in sled runner fashion and work the pulp into a former that is moved progressively away from the rotor to form a length of damp, felted pulp.

THE INVENTIVE IMPROVEMENT

The invention involves a new perspective view of the forming of products of felted pulp of materials such as cellulose fibers, a thorough appreciation of the characteristics and capabilities of cellulose fibers in various forms, and a practical appreciation of the realities of waste fiber recycling. From this background of information, the invention recognizes a new way of forming a felted pulp product from fibrous pulp material and includes method and apparatus suggestions for molding damp fibrous pulp into a useful product. The invention aims at simplicity, economy, compatability with existing circumstances relative to the initial use and recycling of waste fibrous material, and a functional capacity to make better use of waste fibrous material for a more complete recycling.

SUMMARY OF THE INVENTION

The inventive method of damp pulp molding includes forming a damp, fibrous pulp of 20% to 40% solid material, working a tool repeatedly through the damp pulp in the same general direction to move fibers relative to each other for straightening out the fibers and removing air from the pulp to form a damp, felted pulp, which is then dried. The invention preferably uses a rotor having a plurality of skid comb teeth, means for feeding damp, fibrous pulp material into the teeth of the rotor, a former adjacent the rotor for receiving worked and felted pulp from the rotor, and a dryer for the damp, felted pulp from the former.

BACKGROUND OF THE INVENTION

The invention involves an appreciation of many existing circumstances in the forming and recycling of felted fibrous products and leads to a realization of a new way of forming felted fibrous products. This new way is called damp molding, and has been hitherto unknown in the art of using cellulose fibers. Some of the background leading to the inventive discoveries is as follows:

Paper and cardboard are made from fibrous materials and especially cellulose fibers that are generally long relative to their diameter to have large surface areas for bonding together if the fibers are laid out approximately straight in a felted form so that they can stick to each other. Paper and board products are made of such felted fibers and are formed by suspending a small volume of fibers in a large volume of water (0.4% solid material, for example) and pouring the suspension out on a papermaking screen to drain off the water and leave the felted fibers. Large volumes of air can be substituted for the water, but air felting is slow, expensive, and adhesive has to be added to bond dry fibers together. However, wet or damp cellulose fibers make a strong and inexpensive bond with each other when they are mechanically refined in the presence of water and laid together in an approximately straight and felted manner.

The usual process of forming felted fibrous products such as paper and board has many disadvantages. Tremendous volumes of water are required, making the process highly sensitive to contaminants in the water supply, requiring large and expensive equipment and large and high-capacity factories, and having substantial polluting effects on the large volumes of water consumed and returned to a river or lake. Also, the thickness of paper and board products is limited, because water cannot be drained through a thick layer of felted fibers. Moreover, recycling of waste fibrous material makes the process even more complex and difficult because of the large volumes required for economic efficiency and the havoc caused by contaminants in the recycled fibers.

Up to the present these problems have prevented recycling of a high percentage of waste fibrous material even though waste paper and board comprise about 50% of municipal waste by weight and about 85% of municipal waste by volume.

One concept involved in the invention is a realization that fibrous pulp material can be formed into a useful product in a damp stage having 20% to 40% solid material. Molding or felting of damp fibrous material has not been accomplished before, and it was known that cellulose fibers could not be pressed into a satisfactory product. However, the invention shows a way to mold or felt fibrous pulp material in a damp state, and this has many advantages over the dilute methods previously known. For example, approximately one one-hundredth of the amount of water is required, and the process is not polluting to the environment. Equipment and plants can be far smaller than the usual papermaking plant to require a smaller capital investment and to allow plants to be located conveniently near the sources of either fresh pulp or waste fibrous material and the markets for molded products. The inventive process is also economical, relatively insensitive to contaminants, has a high yield, and produces a strong, natural cellulose fiber product that can be made for thicker than paper or board and formed or shaped as desired for many useful products.

For example, a grade of waste paper known as "corrugated" contains the strongest wood fibers available in quantity for recycling and comprises mostly boxes and cartons with supermarkets as a prime and convenient source. Since boxes and cartons are difficult to handle, many waste dealers shred them before baling, and shredded, corrugated waste has many properties convenient to the inventive damp pulp molding. When such waste is soaked in cold water for about 15 minutes and then drained, it consistently produces about a 30% solid material content that is convenient for both defibering and molding. Also, since the waste dealer shreds corrugated waste, major contaminants are removed to protect shredding and baling equipment, so that additional cleaning of such waste before defibering is unnecessary. Although corrugated waste contains the best and strongest fibers it also contains contaminants such as asphalt, adhesive, clay, tape, plastic, staples, etc., that make it a low-grade and low-priced product for most purposes. However, these contaminants do not significantly impair the inventive molding process.

Fibrous material at 30% solids does not produce effluent waste because all water removal occurs by drying. This eliminates a major and growing problem in the paper industry. Contaminants can remain in a 30% solid material product without causing special manufacturing

problems, and the product is strong enough to be cut and handled before drying. Also, at 30% solid material, there is plenty to water to allow the natural bonding characteristics of cellulose fibers to form a strong product without additives or adhesives. Furthermore, raw materials are available wherever people live, and markets for molded products can be widely developed in the same regions to minimize transportation and distribution.

Molded fibrous products made available by the invention can fill many needs not met by paper or board products from paper-making machines. For example, damp molded products can be felted to almost any thickness since water drainage is not required, and the molded product can have an infinite variety of cross-sectional shapes comparable to an extrusion. This allows structural strength, integral reinforcing elements, etc., allowing felted fibrous products to replace other structural materials. Contaminants and additives such as clay in waste magazine fiber are readily incorporated into the molded product without requiring removal with the resulting expense and possibly polluting effect.

DRAWINGS

FIG. 1 is a schematic diagram of the invention applied to forming a molded product from waste fibrous material;

FIG. 2 is a partially schematic, elevational view of a molding machine according to the invention;

FIGS. 3 and 4 are respective, fragmentary, cross-sectional views of the machine of FIG. 2 taken along the lines 3—3 and 4—4 thereof;

FIG. 5 is a schematic representation of one preferred arrangement of comb teeth for the rotor of a molding machine used in the invention; and

FIG. 6 is a fragmentary, elevational view of a feed roller and feed doctor blade for the molding machine used in the invention.

DETAILED DESCRIPTION

Damp pulp molding according to the invention is not limited to waste or recycled fibers or to cellulose fibers, but one of its most feasible uses is in forming a molded product from waste cellulose fiber material such as paper, cardboard, or corrugated waste. As shown schematically in FIG. 1, waste fibrous material such as waste paper or shredded corrugated waste **11** is immersed for a few minutes in a soaking tank **10** containing cold water **12** so that waste **11** takes on enough water for later pulping and molding. Waste **11** is preferably agitated in tank **10** to settle out large, heavy, or dense contaminants such as metal and other junk.

The soaked waste **11** is then led over a drainer **13** which drains excess water back into tank **10**. The time allowed for draining is preferably adjusted to achieve 20% to 40% solid material in waste **11** and preferably about 30% solid material.

Damp waste **11** is then fed to defibering and refining machine **14** which tears the pieces apart and separates and refines the fibers to form a damp, defibered pulp having a crumbly consistency. The output pulp of machine **14** is not wet enough so that water can be squeezed from a handful, but it is damp to the touch and preferably is about 30% solid material. The fibers are well separated and loose so that the output pulp flows as fine bits or crumbs of material.

This is fed to molding machine **15** that works the damp pulp into a molded or felted product **16** that is formed in a length delivered to dryer **17** for drying to increase strength. Product **16** can be sawed or cut, can be formed in many cross-sectional shapes analogous to extrusions, and can be used in packaging, as a structural material, etc.

A successful defibering and refining machine **14** is important to the invention and is now available. Molding machine **15** is unique in applying a new working method to damp, fibrous pulp, to form a strong, felted product **16** not hitherto available. The working of machine **15** is explained below.

Generally, machine **15** is based on a discovery that damp pulp can be worked into a felted and self-bonding product by passing a tool repeatedly through the pulp to move fibers relative to each other for straightening out the fibers and removing air from the pulp. If damp pulp is pushed, thrown, cast, forced, or pressed into a cavity or rolled out or pressed on a surface, the result is not a truly felted product or a strongly bonded product, but is a mass of fibers having many fault lines or flaws where the fibers have not bonded securely to each other. Such a product hence has lines or areas of weakness, is uneven in strength and dimension, and is generally useless. However, one of the inventive concepts is that damp pulp can be properly worked with a tool into a felted, three-dimensional form in which natural fiber bonding is strong and secure so that the resulting product is uniform, strong, and useful such as for packaging and structural purposes.

The successful working of damp pulp according to the invention to form a felted product involves working a tool repeatedly through the pulp, preferably in the same general direction, to work the air out from between the fibers and straighten the fibers out so they contact each other and bond securely together. Scratching or raking the pulp has not been successful, but a technique that works well is analogous to a sled runner driving through the pulp. For lack of a better term, this has been called a skid comb, and it involves skidding or sliding a blade or runner repeatedly through the pulp with the leading edge of the blade or comb tooth having a low or acute angle of attack so that the pulp is repeatedly grooved in the direction of travel of the skid comb. The precise movement or action of the pulp fibers is not fully known, but apparently such repeated grooving or working by a skid comb aligns many of the fibers, works the air out of the fibers, and leaves the fibers in a felted form in intimate contact with each other to produce a secure and natural bond between fibers for a product having high-strength after the excess moisture is removed by drying.

Another characteristic of the preferred skid comb working of the pulp is that each tooth of the comb is narrow enough to penetrate the pulp to form a fairly deep groove. Rather than packing the pulp down under a fairly wide area, the teeth are narrow enough to part the fibers and groove into the pulp. A preferred form of skid comb is described below, but generally any type of skid comb tooth should be less than one centimeter wide, and preferably about five millimeters or less in width.

The preferred form of skid comb for working damp pulp according to the invention is a rotor having skid comb teeth with outwardly cammed or sloped leading edges spaced axially and radially around the rotor so that when the rotor turns at a high peripheral speed against the damp pulp, the skid comb teeth move repeatedly and rapidly through the pulp to groove it repeatedly, work it back and forth, and move it along the periphery of the rotor into a former. The former preferably has an endless belt bed or base for moving progressively away from the rotor, and the cross-sectional shape of the former is otherwise preferably defined by fixed and vibrating doctor blades that direct the felted pulp away from the rotor periphery and into the retreating, formed pulp. The rotor then works against the pulp in the former and presses or works felted pulp continuously into the adjacent edge of the formed pulp so that an extrusion-like product is drawn away from the rotor. Damp pulp is preferably fed to the rotor by a feed roller approximately tangential to the rotor and rotating toward the rotor to wedge pulp into the skid comb teeth of the rotor.

Machine **15** is best shown in FIGS. 2–4, but its main components are schematically set out in FIG. 1 as a rotor **18**, a feed roller **19** driven by motor **45**, a feed doctor blade **20**, an endless belt mold or former bed **21**, and a doctor blade **22**.

As best shown in FIGS. 2 and 5, rotor **18** has a plurality of skid comb teeth **23** that are spaced axially and radially around rotor **18**. The outer ends or perimeters **24** of teeth **23** move repeatedly through damp pulp material to work it in sled-runner or skid-comb fashion as described above, and the leading edges **25** of teeth **23** are cammed or angled to extend gradually outward to perimeters **24** in the direction of rotation of rotor **18**. Each tooth **23** then acts as a cammed skid or runner working through the damp pulp.

FIG. 5 schematically shows one preferred form of axial and rotational spacing of teeth **23**. A tooth **23** is formed on each end of a diametrical plate **26** extending across rotor **18**. Plates **26** are axially spaced from each other and rotationally offset relative to each other so that any adjacent teeth **23** are well spaced apart. Teeth **23** can also be made in many other ways. For example, teeth **23** can be axially bent from slotted disks or formed from triangular or rectangular pieces or formed as bars on a drum, etc., so long as teeth are axially and radially spaced. Teeth **23** then rapidly and repeatedly make grooves in different axial positions through the damp pulp to work it into a felted mass as described above. Teeth **23** are preferably arranged relative to each other so that successive teeth groove the pulp in different tracks, without any tendency to feed pulp sideways or axially of rotor **18**. The pulp is moved back and forth as grooves are made by teeth **23** and is fed peripherally of rotor **18** without any net sideways motion. Also, teeth **23** are preferably less than one centimeter in width as described above for making relatively narrow grooves in the pulp.

In one preferred embodiment of machine **15**, rotor **18** was made 24 inches in diameter and driven by a 30 H.P. motor at 600 r.p.m. Of course, other sizes, power drives, and speeds are possible, and teeth **23** can be spaced around rotor **18** in many different ways.

Feed roller **19** is arranged approximately tangential to rotor **18** and driven by motor **45** in the direction of the arrow to turn toward rotor **18**, preferably at a substantially slower peripheral speed. This produces a nip **27** into which damp pulp can be fed and wedged into the skid comb teeth **23** of rotor **18**. The skid comb teeth **23** of rotor **18** tend to force pulp outward away from rotor **18**, but feed roller **19**, rolling relatively slowly into nip **27**, wedges damp pulp into the spaces between skid comb teeth **23** so that pulp is worked by teeth **23** from nip **27** along the perimeter of rotor **18** to the former where the molded product is shaped.

As best shown in FIG. 6, feed roller **19** preferably has flanges **28** straddling rotor **18** and has a shallow, helical groove **29** winding in a low pitch like a screw thread along the peripheral surface of roller **19**. Groove **29** helps make feed roller **19** self-cleaning and gives roller **19** a better frictional grip on the pulp. Feed roller **19** receives damp pulp preferably from a live feed hopper (not shown) that delivers damp pulp at the desired rate onto the surface of feed roller **19** for wedging into nip **27**.

Feed doctor blade **20** is fitted around the perimeter of rotor **18** between feed roller **19** and endless belt **21** as illustrated to estabilsh a pulp working zone. Feed doctor blade **20** extends close to the surface of feed roller **19** and close to the perimeter of rotor **18** for substantially bridging the gap between feed roller **19** and endless belt **21**. Damp pulp is generally fed into nip **27** at a rate faster than accommodated by the former above belt **21** so that a reservoir of damp pulp is formed in the working zone adjacent feed doctor blade **20**. Since the space in this working zone is restricted, pulp extends from feed doctor blade **20** up into the regions between skid comb teeth **23** so that teeth **23** pass repeatedly through the damp pulp at much higher speed than the rate of travel of the pulp itself. Hence, when the pulp reaches belt **21** in the forming area it is well-worked and felted so that when properly laid in the former it will bond integrally to form a strong product. The reservoir of pulp being worked adjacent feed doctor blade **20** also accommodates some unevenness in the feed of roller **19** and affords a steady supply of worked pulp for the former even during brief interruptions of the feed of roller **19**.

Endless belt **21** runs over forming table **30** to form a moving bed for a former receiving felted pulp **16**. The upper surface of belt **21** preferably has transverse ridges **31** for a firm grip on the bottom of product **16** for moving product **16** progressively away from rotor **18**. Rotor **18** then progressively fills the adjacent edge of the molded product **16** with felted pulp which moves progressively away from rotor **18** somewhat like an extrusion. In effect, many thin layers of felted pulp are laid successfully into the molding former as belt **21** moves to make the molded product **16** retreat progressively to make room for ever more layers. Such layers are worked together to form a three-dimentionally felted product of damp pulp, because skid comb teeth **23** are narrow enough to penetrate through successive layers and blend them together with straightened fibers in a felted form without lines of weakness. As this process proceeds, it is preferred to overfeed pulp to rotor **18** to ensure that the felted pulp always fills the molding former. The overfed pulp is easily collected and returned for refeeding to rotor **18** through feed roller **19**.

The cross-section of product **16** can have as many shapes as desired for different purposes, and the shape chosen for illustration in machine **15** is best shown in FIG. 3 as having outer ridges **32** and a central ridge **33** separating a pair of channels **34**. Fixed doctor blades **35** form the outside edges of product **16**, and fixed doctor blades **36** form the side walls of channels **34**.

A vibrating doctor blade assembly **37** preferably forms the tops of ridges **32** and **33** and the bottoms of channels **34**. Doctor blade assembly **37** includes a bridge **38** carrying upper blades **39** and lower blades **40**. Bridge **38** is driven in a vibratory motion by an eccentric shaft **41** moving arm **42** on a spring mount **43** to achieve an eccentric motion of preferably one to three millimeters. In the region of the tips of vibrating doctor blades **39** and **40**, the result is an elliptical motion having the long axis of the ellipse approximately tangent to rotor **18** as suggested by the arrows. The tips of blades **39** and **40** move downward against product **16** and against the direction of rotation of rotor **18**, and upward away from product **16** and with the direction of rotor **18**. The result is a repeated pulling and pressing of felted pulp fibers away from rotor **18** to direct felted pulp into the gradually moving product **16**. As mentioned above, overfed pulp passes beyond the doctor blades and is refed to rotor **18**. Fixed doctor blades **35** and **36** preferably have serrated or stepped edges for helping to hold down molded product **16** against moving belt **21** in opposition to the lifting force exerted by rotor **18**. Also, the elliptical motion of vibrating blades **39** and **40** in pulling away from rotor **18** on the downstroke, tends to hold the molded product **16** against moving belt **21** and to move or feed product **16** away from rotor **18** in cooperation with belt **21**.

Molded product **16** is strong enough as it leaves rotor **18** so that lengths of it can be handled and cut as desired. This allows the drying of product **16** in dryer **17** to be either rapid or slow as desired, because the integrity of the product does not depend on rapid drying. No water is removed from the pulp until after it is formed, so that the damp pulp in freshly formed product **16** has the same 20%–40% solid material as the pulp fed by roller **19**. The lack of water removal from the formed product makes the invention distinctive from dilute methods of forming cellulose fibers into products, and affords a great saving in the water required, capital investment, and the polluting effects of the process. The water evaporation from the formed product **16** can be done in many ways with many different ovens or heating equipment but is preferably made even and uniform so that product **16** retains its desired shape during the drying process. Also, product **16**

can have many shapes and sizes and can be made with many different arrangements of a moving form and a rotor with skid comb teeth.

Persons wishing to practice the invention should remember that other embodiments and variations can be adapted to particular circumstances. Even though one point of view is necessarily chosen in describing and defining the invention, this should not inhibit broader or related embodiments going beyond the semantic orientation of this application but falling within the spirit of the invention. For example, those skilled in the art will appreciate different pulps, fibers, solid and liquid ratios, shapes, sizes and speeds of working tools and skid comb teeth, different arrangements of feed and forming mechanisms, doctor blades, configurations of molded products and other variations within the scope of the invention.

I claim:

1. A damp pulp molding method comprising:

(a) forming a damp, fibrous pulp of 20% to 40% solid material;

(b) working a tool repeatedly through said damp pulp in the same general direction to move fibers relative to each other for straightening out said fibers and removing air from said pulp to interengage said fibers in a damp, felted pulp;

(c) moving said damp, felted pulp away from said tool in a continuous length; and

(d) drying said damp, felted pulp.

2. The method of claim **1** including working said tool through said pulp in sled runner fashion.

3. The method of claim **1** including using a skid comb to work said pulp.

4. The method of claim **3** including rotating said skid comb.

5. The method of claim **1** wherein said pulp is about 30% cellulose fiber material.

6. The method of claim **1** including using a form to shape said damp, felted pulp, and working said damp, felted pulp into said form with said tool.

7. The method of claim **6** including moving said form progressively away from said working tool to form a length of said damp, felted pulp.

8. The method of claim **1** including rotating a rotor having a plurality of skid comb teeth for working said damp pulp.

9. The method of claim **8** including wedging said damp pulp into said skid comb teeth of said rotor.

10. The method of claim **9** including using a feed roller approximately tangent to said rotor for wedging said damp pulp into said roller.

11. The method of claim **8** including arranging a former adjacent said rotor so said skid comb teeth work said damp, felted pulp into said former.

12. The method of claim **11** including using an endless belt surface support for said formed pulp.

13. The method of claim **11** including overfeeding said rotor and returning overfed pulp for refeeding to said rotor.

14. The method of claim **13** including using a feed roller approximately tangent to said rotor for wedging said damp pulp into said rotor.

15. The method of claim **11** including vibrating a doctor blade to direct said damp, felted pulp from said rotor into said former.

16. The method of claim **15** including using a fixed doctor blade cooperating with said vibrating doctor blade for defining said former.

17. The method of claim **16** including using an endless belt support surface for said formed pulp.

18. The method of claim **1** including using waste fibrous material, soaking said material in water, draining said material, and defibering said material to form said damp pulp.

19. The method of claim **18** where said damp pulp is about 30% cellulose fiber material.

20. The method of claim **18** including rotating a rotor having a plurality of skid comb teeth for working said damp pulp.

21. The method of claim **20** including arranging a former adjacent said rotor so said skid comb teeth work said damp, felted pulp into said former.

22. The method of claim **21** including wedging said damp pulp into said skid comb teeth of said rotor, overfeeding said rotor, and returning overfed pulp from refeeding to said rotor.

23. The method of claim **22** including vibrating a doctor blade to direct said damp, felted pulp from said rotor into said former.

24. The method of claim **23** including using a fixed doctor blade and an endless belt support surface to define said former.

25. A damp pulp molder comprising:

(a) a rotor having a plurality of skid comb teeth;

(b) means for feeding damp, fibrous pulp of 20% to 40% solid material into the interteeth regions of the periphery of said rotor;

(c) means for passing said damp pulp through a working zone along said periphery of said rotor where said skid comb teeth work repeatedly through said damp pulp;

(d) a former adjacent said rotor and beyond said working zone for receiving damp, felted pulp from said rotor; and

(e) means for drying said damp, felted pulp output from said former.

26. The molder of claim **25** wherein said pulp feeding means comprises a feed roller approximately tangent to said rotor for wedging said damp pulp into said skid comb teeth of said rotor.

27. The molder of claim **26** including means for rotating said feed roller at a peripheral speed substantially slower than the peripheral speed of said rotor.

28. The molder of claim **26** including a feed doctor blade extending along the periphery of said rotor to form said working zone from the region of said feed roller to the region of said former.

29. The molder of claim **28** including a shallow helical groove in the surface of said feed roller.

30. The molder of claim **25** including means for moving said formed pulp progressively away from said rotor to form a length of said damp, felted pulp.

31. The molder of claim **30** wherein said former comprises an endless belt support surface.

32. The molder of claim **31** including a doctor blade arranged for directing said damp, felted pulp from said rotor into said former, and means for vibrating said doctor blade.

33. The molder of claim **32** wherein said means for vibrating said doctor blade includes an eccentric drive arranged for moving said doctor blade downward against said damp, felted pulp and against the direction of rotation of said rotor and upward away from said damp, felted pulp and with the direction of rotation of said rotor.

34. The molder of claim **32** comprises a fixed doctor blade cooperating with said vibratory doctor blade for directing said damp, felted pulp into said former.

35. The molder of claim **25** wherein said skid comb teeth are spaced axially and radially of said rotor.

36. The molder of claim **35** wherein the outer, leading ends of said skid comb teeth are shaped for gradually approaching the perimeter of said rotor to work into said damp pulp in sled runner fashion.

37. The molder of claim **25** wherein said skid comb teeth are axially narrow enough for penetrating said damp pulp in deep grooves worked into said damp pulp.

38. The molder of claim **37** wherein said skid comb teeth are less than one centimeter in axial width.

39. The molder of claim **38** wherein said skid comb teeth are spaced axially and radially of said rotor.

40. The molder of claim 39 wherein the outer, leading ends of said skid comb teeth are shaped for gradually approaching the perimeter of said rotor to work into said damp pulp in sled runner fashion.

41. The molder of claim 40 including a feed roller approximately tangent to said rotor for wedging said damp pulp into said skid comb teeth of said rotor.

42. The molder of claim 41 including means for rotating said feed roller at a peripheral speed substantially slower than the peripheral speed of said rotor.

43. The molder of claim 42 including a feed doctor blade extending along the periphery of said rotor to form said working zone from the region of said feed roller to the region of said former.

44. The molder of claim 43 wherein said former includes an endless belt support surface moving progressively away from said rotor.

45. The molder of claim 44 including a doctor blade arranged for directing said damp, felted pulp from said

rotor into said former, and means for vibrating said doctor blade.

46. The molder of claim 45 including a fixed doctor blade cooperating with said vibratory doctor blade for directing said damp, felted pulp into said former.

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R. H. TUSHIN, Assistant Examiner

U.S. Cl. X.R.

19—66 R; 162—194, 202, 286, 293