

May 30, 1967

D. J. YOUNK

3,321,809

PAPERMAKING MACHINE STOCK DISTRIBUTOR APPARATUS

Filed Jan. 9, 1964

3 Sheets-Sheet 1

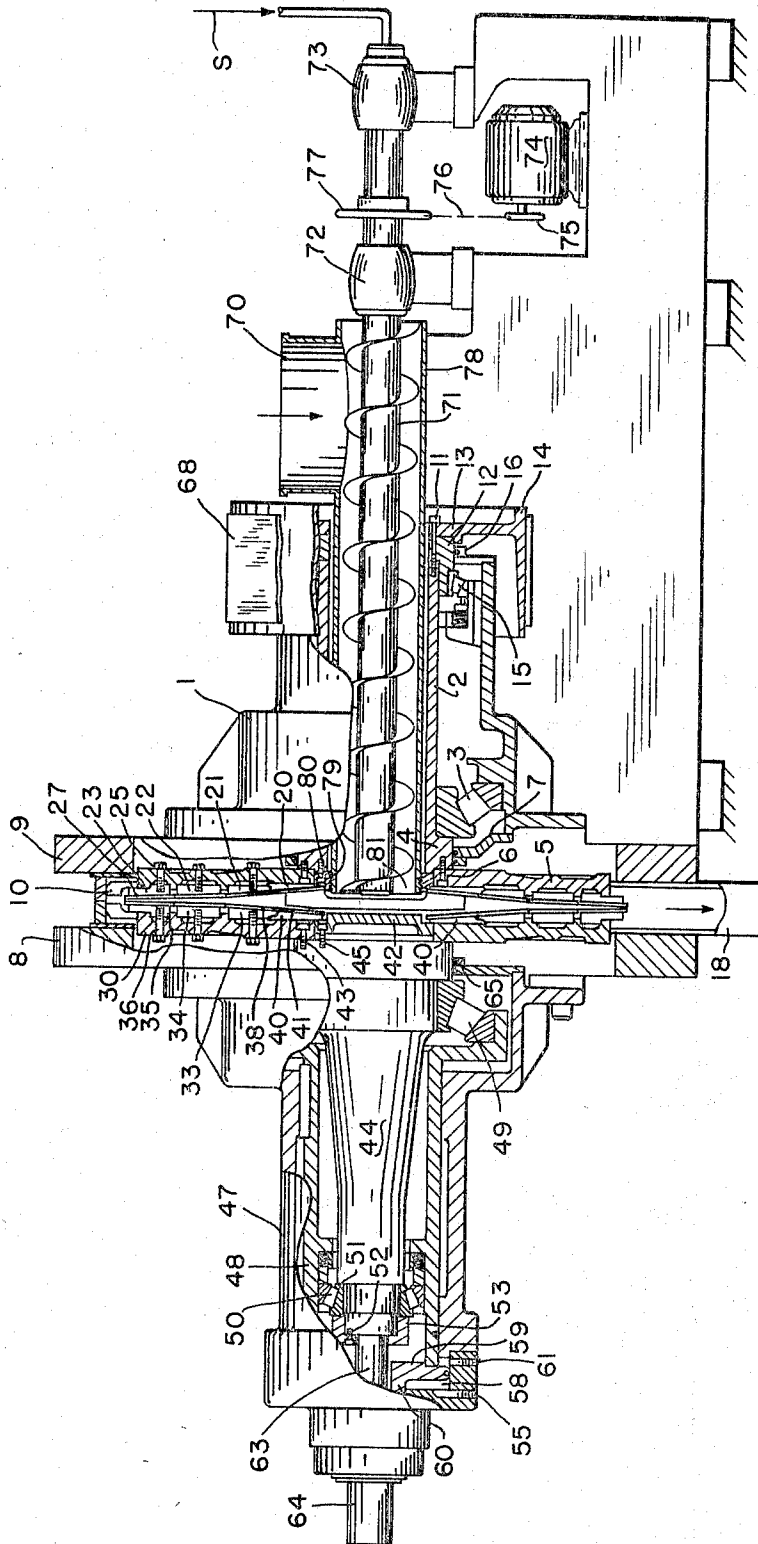


FIG. 1

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3 Sheets-Sheet 2

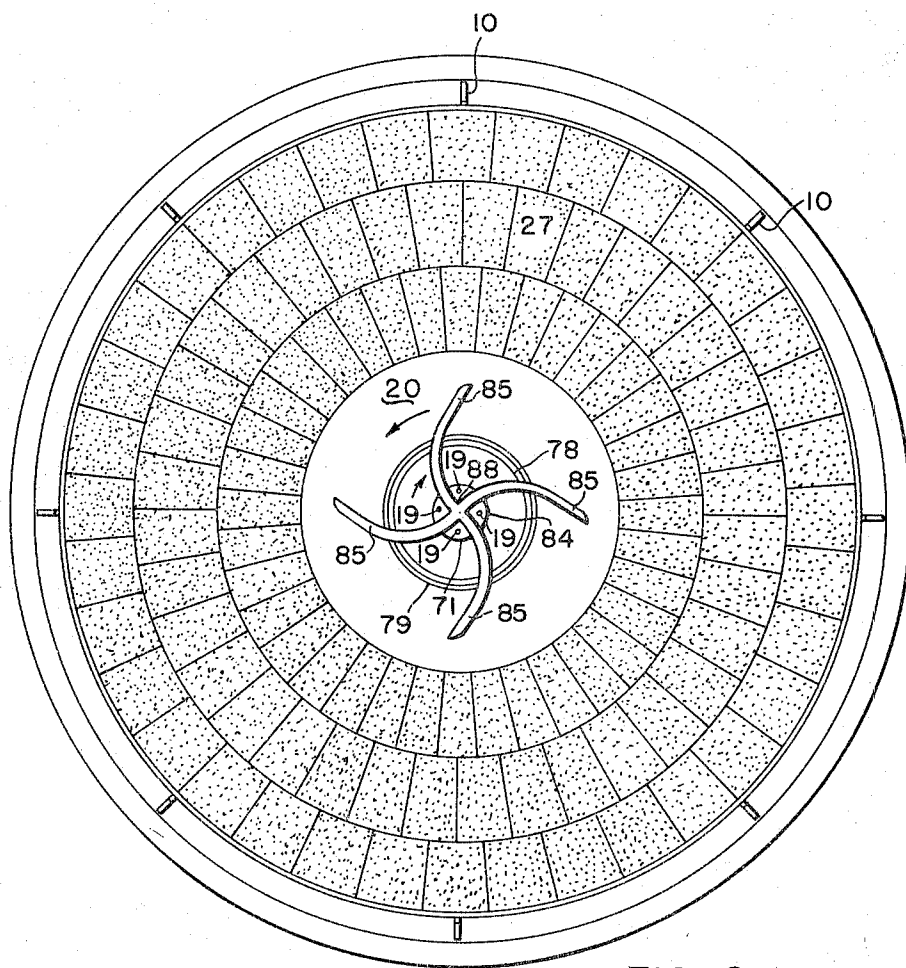


FIG. 2

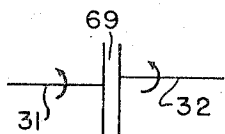


FIG. 3

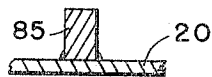


FIG. 4

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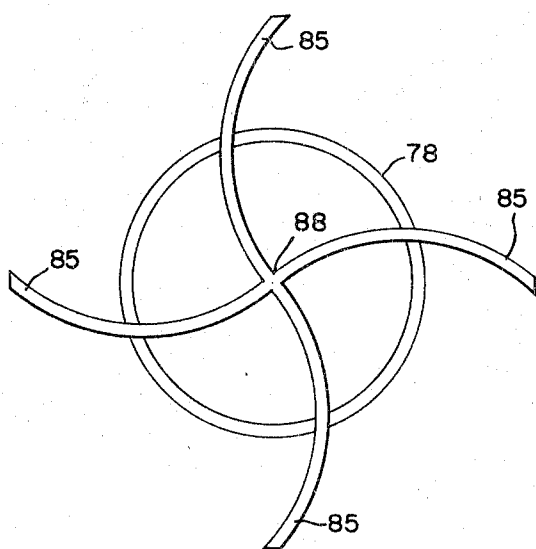


FIG. 5

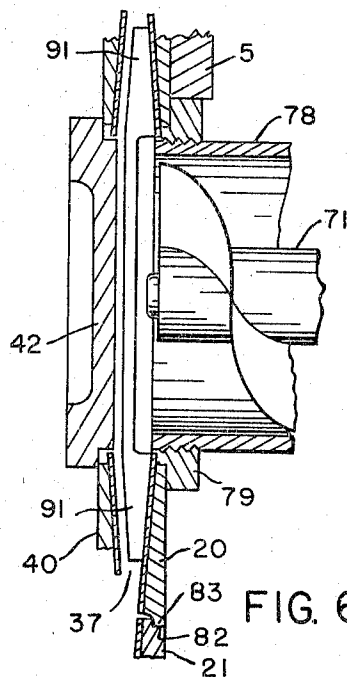


FIG. 6

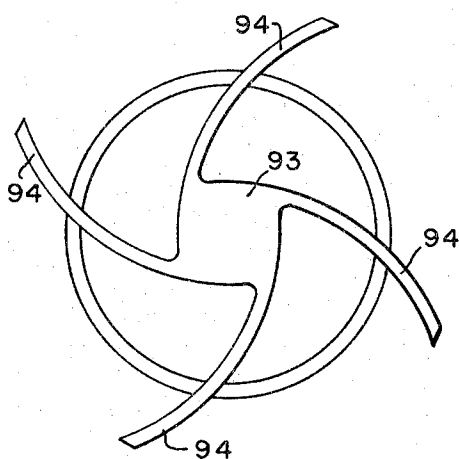


FIG. 7

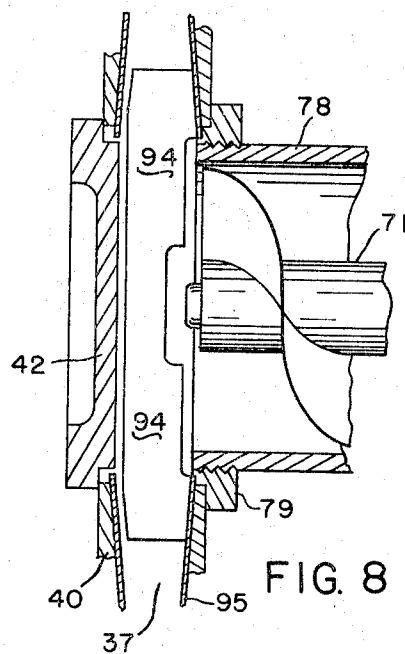


FIG. 8

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2 Claims. (Cl. 19—66)

This invention relates to the processing of stock for papermaking purposes. In specific aspect the invention is directed to improvements in fiberizing machines for increasing machine capacity and the quality of fiberizing.

J. T. Coghill, United States Patent No. 3,028,632 granted April 10, 1962, describes a machine for processing papermaking pulp in which a pair of axially offset rotary working plates have opposed working surfaces disposed to form between them a working space; these working surfaces are roughened or provided with tiny protuberances projecting into the working space to provide traction for nodules of pulp without obstructing rolling traverse of the nodules on the working surfaces. One of the plates is mounted floatingly to provide for movement toward and from the other plate and pressure means are available to constantly urge the floating plate toward the other working plate to apply pressure to pulp engaged between the plates. One of the plates is positively driven in rotation and the other is driven through the pulp engaged between the plates.

It has been found that the continuous operation of such equipment on a high capacity basis results in machine plug-ups and stoppages, necessitating the constant attendance of an operator. At lesser capacity operation the machine operates continuously but the degree of fiberizing is inferior. A primary object of the present invention is to overcome the mentioned difficulties and to substantially eliminate the necessity for operator attendance in the operation of such machines.

An important object of the present invention is to provide equipment for the processing and improved fiberizing of a variety of types of stock for papermaking purposes, particularly including stock of high consistency, that is, 15 to 50% and above such as raw wood chips as well as cooked wood chips, semichemical pulp, and including also regular commercial grades of pulp such as sulfite, kraft and soda.

A particular object of the invention is to provide a distributor means of simple but effective construction which is readily attached to a supporting working plate for rotation therewith at plate speed and which has relatively few parts, requires little space, and also is unlikely to require operator attention or repair.

Another object of the invention is to provide a method of fiberizing stock at high consistency, that is, 15% to at least 50% and above.

These and other allied objects of the invention are achieved by intercepting the stock as it issues from the stock inlet, and dividing and deflecting the stock to stock receiving zones which communicate the inlet with the working space of the machine. The stock receiving zones are formed on a distributor plate which is itself preferably fixedly secured to one of the rotary working plates for rotation therewith at working plate speed. The stock is accordingly changed in direction of movement and accelerated as it leaves the stock inlet; in effect, by the action of the distributor plate the stock is urged in a peripheral direction from the distributor plate axis to the working space and is thus essentially continuously cleared from the stock inlet in a diverging flow and supplied to the working space in a stock concentration which permits effective action by the working surfaces. Surprisingly, the

effectiveness of the machine is increased in a machine of given size despite the replacement of some of the working surface by the distributor plate.

In a preferred embodiment of the invention the distributor plate which is carried by one of the working plates for rotation with the plate at plate speed is an annulus provided coaxial with both the stock inlet and the working plate to which it is secured. The stock receiving zones are formed by vanes spaced at intervals around this distributor plate and the plate surface between vanes in a peripheral direction is sufficiently smooth to provide for stock movement in a direction from the distributor plate axis outwardly toward the plate periphery. Additionally, the vanes project at least partially across the axial inlet at its mouth to intercept stock issuing from the inlet before it traverses to the oppositely disposed working plate. The vanes thus serve to divide and disperse the issuing stock and to urge it to the stock receiving zones. The vanes are themselves formed with front faces which are convex in the direction of rotation. Also, they preferably project well across the central zone or bosom of the working plates but terminate short of that working plate which is opposed to that carrying the distributor plate; this inhibits stock from flowing rearwardly over the vanes.

The desirable length of the vanes on the distributor plate is dependent upon the working plate diameter, the rotational speed, and the nature of the stock undergoing treatment. If the vanes are of such a length that they impel the stock too forcibly, the stock is fed to the working space less uniformly; soft fluffy material is impelled less than chips. Accordingly, the vane length is not critical to operation but should be sufficient that the velocity imparted to the stock is such that the stock is constantly moved to the working space and evenly distributed. The desirable length may be determined by simple trial.

The invention will be more fully understood by reference to the following detailed description and accompanying drawings wherein:

FIG. 1 is a longitudinal view partially in section and with parts broken away illustrating one embodiment of a machine which incorporates the novel stock distributor;

FIG. 2 is an enlarged plan view of one working plate and the cooperative relation of the axial inlet and the stock distributor;

FIG. 3 is a diagrammatic view illustrating the off-set relation of the working plates in the embodiment of FIG. 1;

FIG. 4 is a somewhat enlarged fragmentary view showing a vane of FIG. 2 in end view on the distributor plate;

FIGS. 5 and 6 are, respectively, enlarged plan and edge views of the stock distributor of FIG. 2; and

FIGS. 7 and 8 are, respectively, plan and edge views of a modified arrangement of the vanes of the stock distributor means.

In the machine specifically described herein, as in the machine illustrated in Patent 3,028,632, both working surfaces rotate in one rotational direction, one plate being positively driven and the other being driven by the stock confined between the working surfaces; also, the axes of the plates are offset from one another to achieve a relative orbital motion of the working surfaces to effect the curling roll of the stock between the surfaces. The machine is described herein in sufficient detail to illustrate the cooperative relationship of the stock distributor with the apparatus. No means for tilting the plate is shown herein as such is not necessary to the practice of the invention. Both working plates may clearly be positively driven if so desired and either working plate may then carry the stock distributor if it is provided to inter-

cept the stock as it exits from the stock inlet mouth. Additionally, the working plates may be axially fixed and the provision of one floating plate, though advantageous, is not required.

Such machines, as specifically described, unbond or liberate the fibers of a pulp without substantial loss of freeness. At high stock consistencies, above about 15% consistency, it has been found that the stock distributor is essential to operation as noted hereinbefore.

Machines such as described differ from conventional refiners of the disc type wherein the freeness is generally lowered, and the plates rotate at relatively higher speeds and are not axially offset. The stock distributor has utility in these latter machines also at high consistency of stock fed to the refiner plates.

Referring to the drawings and initially particularly to FIG. 1, a fixed housing portion 1 has journaled therein a sleeve 2. Forwardly, a conventional anti-friction bearing 3 supports the sleeve 2; also, sleeve 2 has a forward flange 4 to which there is secured a driving plate 5 by bolts as at 6. A seal 7 surrounds the flange 4 and protects the bearing 3. Rearwardly, a collar 12 is secured to the sleeve 2 by bolts 11 (one shown) which pass through the hub 13 of a pulley 14; the collar 12, and accordingly the sleeve 2, is supported by spring loaded anti-friction bearing 15. A seal 16 similar to seal 7 is provided between the housing portion 1 and the collar 12 to protect bearing 15.

Secured to the front face of driving plate 5 are a plurality of concentric rings 20, 21, 22 and 23 which are fastened to the plate 5 by bolts as at 25. Welded or otherwise suitably secured to the front faces of the rings 21, 22 and 23 are working plates 27 formed on their front faces (FIG. 2) with roughened working surfaces. Such surfaces may be toothed or may be roughened as by spray application of tungsten carbide particles. The inner ring 20 is a substantially smooth surfaced internally conical plate which forms a feature of this invention and will be more particularly referred to in connection with FIGS. 2 to 8 inclusive. The front faces of the rings 21, 22 and 23 may also be internal conical surfaces but are preferably of increasing cone angle so that they are of progressively decreasing inclination to a plane perpendicular to the axis of sleeve 2, and the outer rings may be in such plane if desired as described in Patent 3,028,632.

A second rotary plate 30 is a floating plate and generally similar to the plate 5 in structure. Plate 30 is mounted so that its axis 31 is offset vertically from the axis 32 of plate 5 (FIG. 3). The offset may be in any direction. Plate 30 also has a plurality of rings 33, 34, and 35 secured to it by bolts 36, and these latter rings on their front faces carrying working plates designated at 38 which are formed on their surfaces with knurling, roughening, teeth or the like in the same manner as working plates 27.

The inner ring 40 is internally conical, that is, dished toward the axis of plate 30 at a considerable angle in the same manner as ring 20 of plate 5. Inner ring 40 has a plate 41 which is preferably smooth surfaced, and it bounds peripherally a central cap 42 which is also smooth surfaced. The cap 42 and plate 41 are oppositely disposed to the ring or conical plate 20 to form therebetween a central zone 37 (FIG. 6) which is relatively wide in contrast to the surrounding annular working space bounded by the roughened working surfaces.

The plate 5 is enclosed within casing portion 9; plate 30 is within the casing portion 8; paddles 10 carried by the outermost rings 23 (FIG. 2) and 35 are disposed within the casing. The casing discharge is indicated at 18.

The plate 30 is retained as at 43 by bolts which are secured in a forward extremity of a rotatably mounted shaft 44. Shaft 44 also retains cap 42 by means of screws, one of which is designated at 45.

A housing portion 47 has keyed thereto for limited longitudinal movement a carriage 48. The shaft 44 is supported for rotation relative to the carriage by forward anti-friction bearing 49 and a rearward springloaded bear-

ing 50 which has an inner race 51 retained in any suitable manner as by screws as at 52 and bearing backing collar 53.

The housing portion 47 is provided with an inlet 55 for supplying hydraulic fluid to a circumferential space 58 and the face 59 (serving as a piston face) of a tubular end closure 60 of the carriage 48. The numeral 61 designates the hydraulic fluid inlet for driving the carriage in the reverse direction. The extension 63 of shaft 44 is received within the end closure 60 and the housing extremity 64.

A seal similar to that at 7 is provided at 65 to protect the bearing 49.

The flat belt sheave or pulley 14 is driven from any suitable source (not shown) through belt 68. This drives the sleeve 2 and accordingly the plate 5 directly; the plate 30 is driven in the same direction of rotation as the plate 5 by the stock 69 between the plates (FIG. 3). The action of the plates causes the stock to be rolled and defiberized.

Stock is fed to the machine through hopper 70; a screw shaft 71 supported rightwardly (FIG. 1) by bearings 72 and 73 is driven by any conventional means such as reducer motor 74, sprocket 75, chain 76 and sprocket 77 on the screw shaft. Screw shaft 71 is coaxial with sleeve 2 and lies within a stationary tubular member 78 which is integral with hopper 70. A flanged collar 79 is secured forwardly by bolts as at 80 to sleeve 2 and rotates therewith; such serves to inhibit the entry of fibers to the sleeve area.

The screw or feed shaft 71 as shown rotates in a direction opposite to that of the working plates 27 and 38 as shown by the arrows in FIG. 2 and at a considerably slower speed. The stock is fed to the inlet 81 toward the central zone or bosom 37 axially of the working plate 27 as will be described in more detail in connection with FIGS. 2 to 8 inclusive.

Referring now particularly to FIGS. 2, 5 and 6, a preferred embodiment of the distributor and its cooperative relationship with the annular working surface of the driving plate is shown. The plate 20 is an annulus which serves as a distributor plate. It is retained by the adjacent ring 21 which has an inwardly extending lip 82 (FIG. 6) which cooperates with an outwardly extending peripheral lip 83 of distributor plate 20 so that the lips, which have machined surfaces, are in overlying relation securely retaining the distributor plate in position on the driving plate 5. Alternatively, the plate 20 may be welded to the ring 21. The annular distributor plate 20 on its inner periphery is in abutment with the collar 79 which surrounds the extremity of stationary tubular member 78. The extremity 84 of the feed screw is centrally disposed within the tubular member 78 (FIG. 2).

Steam may be provided in known manner to stock being worked through steam inlet S, feed shaft 71, and through apertures 19 (FIG. 2) in the feed screw extremity 84. Such steam usage is optional but useful with some stocks.

Welded (FIG. 4) to the distributor plate 20 are a plurality of longitudinally curved vanes 85; these vanes, in the embodiment illustrated (FIG. 2) are also welded together at their inner extremities at 88 for strengthening the structure. The distributor plate and the vanes are thus mounted for rotation with the annularly disposed working plates 27 and the rotation is such that the convex faces of the vanes front in the direction of rotation. Also, preferably the direction of rotation is opposite to that of feed screw 71 as indicated by the arrows in FIG. 2.

The distributor is of most importance at low speeds of working plate rotation, that is, between about 350 to 700 r.p.m. and at high stock consistency, i.e., 15 to 50%. Feed screw rotation is preferably between about 150 to 200 r.p.m. and in the absence of the distributor under these conditions at an overall diameter of about 50" clogging and stoppage of the unit under optimum fiberizing conditions is frequent. Optimum fiberizing conditions impose a requirement of a relatively high feed rate

not only to attain adequate production capacity but to provide quality in the material produced. Utilizing the distributor clogging and stoppage are substantially completely avoided; this has been demonstrated by repeated testing with and without the distributor.

It has been found by tests that if the vanes under given conditions project too far from the axis on the plate, poor distribution may result. This vane length, however, is a function of the working plate rotational speed, the nature of the stock and the working plate diameter, and the stock residence time desired between the working surfaces. The length for a particular set of conditions may be readily determined by simple test. If the distribution is poor, a pattern of small poorly worked fiber particles develops on the working surfaces, is retained thereby, and is readily viewable upon opening of the plates.

Whatever the nature of the stock, it is advantageous to provide the vanes so that they project over the stock inlet mouth; the vanes then intercept the inflowing stock, and deflect portions of the stock to the receiving zones defined by the vanes on the distributor plate 20 (FIG. 2). The inner portions of the vanes which effect the interception and apportioning of the stock to the receiving zones also serve as guides for the stock which tends to follow along the convex forward surfaces of the vanes. The extent to which the entering stock is impelled and accelerated by the vanes is dependent upon the relative rotational speed of the vanes and the stock itself as well as the vane length and the nature of the stock. Much more effective distribution is attained at a given vane rotational speed if the stock is moving from the feed screw in an opposite rotational direction to that of the vanes and working surface.

The plate 20 between the vanes in a peripheral direction is preferably smooth, imperforate and sufficiently smooth that the stock may move freely over it. The outside diameter of the plate 20 may be coincident with the peripheral extremity of the vanes and will serve the purpose well. Desirably, however, the distributor plate 20 may project well beyond the vanes as shown and such facilitates uniform distribution into the edge of the working surface. As will be noted from FIG. 2, when the vanes terminate short of the outer periphery of the plate, a continuous uninterrupted area complete in the circumferential sense is formed on the distributor plate between the outer extremities of the vanes and the plate periphery, that is, between the vanes and the working surface of the working plate 27. Apparently, as the stock leaves the extremity of the vanes it tends to drag slightly and to distribute itself more uniformly than when the vanes extend to the working surfaces

The vanes themselves are simply of generally rectangular cross-section (FIG. 4) but taper in height or thickness at their peripheral extremities 91 (FIG. 6) to conform closely to the tapered central zone of the machine. The number of vanes is optional but preferably more vanes are employed at lower speeds of the working plate and distributor to achieve optimum distribution. The vanes obviously should not be so great in width or number that they unduly block the stock inlet.

The vane arrangement illustrated in FIGS. 7 and 8 differs from the vane arrangement of FIGS. 5 and 6 in the provision of a hub 93 which supports the vanes 94 centrally and provides for wedging the stock outwardly on the vanes. Thus, in FIG. 7 the vanes themselves are tangential to the hub and the stock is urged outwardly quickly. In contrast, the vanes 85 (FIG. 5) cross each other at substantially 90° centrally. The structure of FIGS. 7 and 8 affords the additional advantage that it may be cast as a unit. The hub 93 is of course smaller in diameter than the axial inlet and the vanes (FIG. 8) are secured in position on the distributor plate 95.

The contour of the convex forward face of the vanes, like the vane length, influences the uniformity of dis-

tribution of the stock; a linear forward face provides relatively poor distribution; a forward face having a curvature which sweeps well backwardly slants the stock into the working space aiding distribution. Such vane contour may have a wide range while providing very effective distribution. Examination of the pattern in a trial readily indicates the effectiveness of the inter-related lengths, curvature and rotational speed factors.

The gravitational effect on the stock exiting from the stock inlet to the plates is not a significant factor and distribution is readily effected whether the plates be in a horizontal or vertical plane.

It will be understood that this invention is susceptible to modification in order to adapt to different usages and conditions and, accordingly, it is desired to comprehend such modifications within the invention as may fall within the scope of the appended claims.

What is claimed is:

1. In a machine for processing stock for papermaking purposes, an annular imperforate distributor plate, a stock inlet of the machine coaxial with the said distributor plate and surrounded by the distributor plate, a first rotary working plate having a working surface coaxial with and surrounding said distributor plate and to which working plate at the distributor plate periphery said distributor plate is secured for rotation with the working plate at working plate speed; a second rotary working plate having a working surface and disposed to form with the first working plate a working space, said working plates being vertically disposed and axially offset and said working surfaces being roughened to provide traction for stock being processed without obstructing rolling traverse of the stock on the working surfaces, a feed screw for feeding stock to be processed to the said stock inlet, and vanes secured to the distributor plate spaced at intervals around the distributor plate to provide stock receiving zones on the distributor plate, said vanes each having a front face which is convex in the direction of plate rotation and the vanes extending from the axis of the distributor plate across the stock inlet in spaced relation to intercept and deflect stock from the stock inlet to the annular distributor plate, said vanes having a substantial length on the distributor plate but terminating short of the outer periphery of the distributor plate thereby forming a continuous uninterrupted smooth surface area on the distributor plate between the outer extremities of the vanes and the working surface of the first working plate, the said area being complete in a circumferential sense, said vanes terminating short of the outer periphery of the distributor plate to such an extent that stock traversing the distributor plate over the ends of the vanes tends to drag itself slightly and to distribute itself uniformly in the continuous uninterrupted smooth surface area and said smooth surface area having a significant radial distance beyond the vanes' extremities to accommodate such stock movement.

2. A machine for processing stock for papermaking purposes as claimed in claim 1 and in which means are provided for driving the feed screw in an opposite rotational direction to the first working plate and the distributor plate.

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