Sept. 19, 1967 D. F. MORTON 3,342,425

PAPER MACHINERY

Filed Nov. 1, 1965

FIG-1

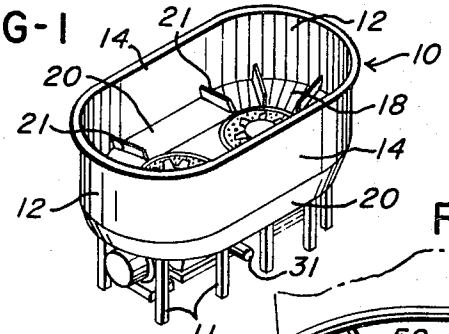


FIG-2

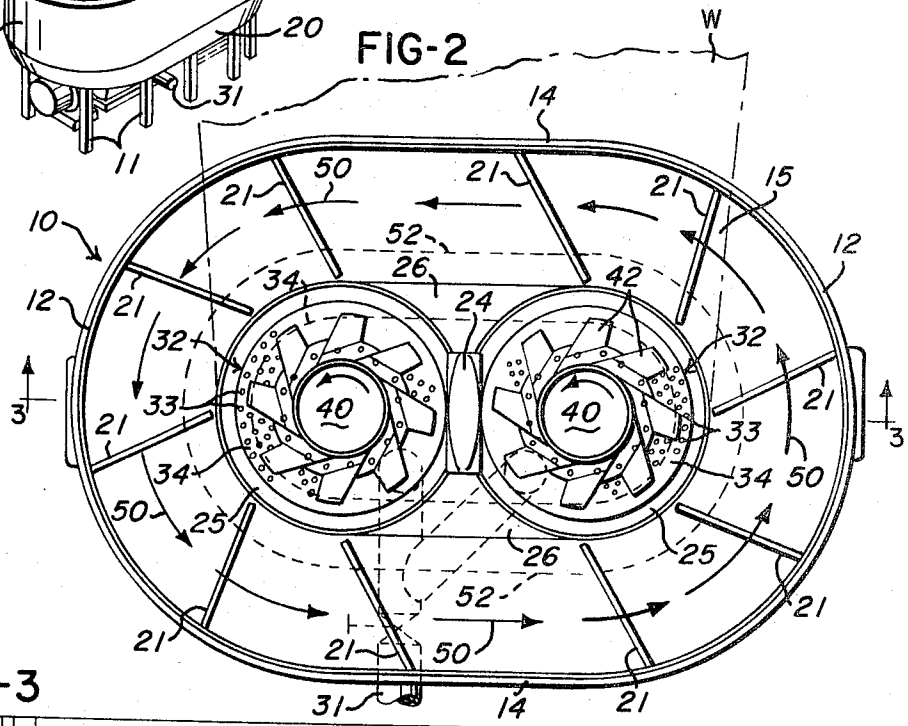
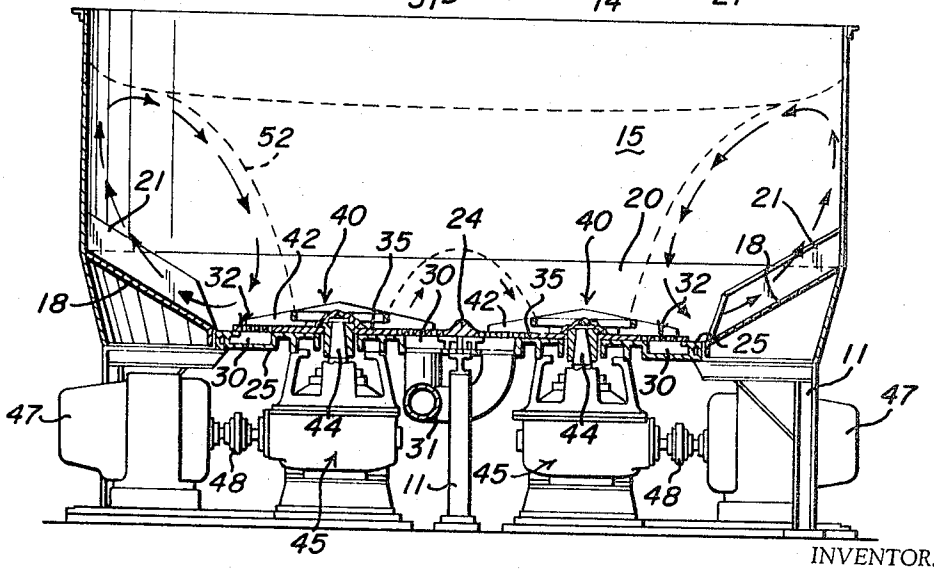


FIG-3



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PAPER MACHINERY

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This invention relates to an improved pulping apparatus for paper making stock and the like, and more particularly, to pulping apparatus which provides increased capacity for handling and repulping hard to submerge materials, such as a wide loose paper web, commonly known as "broke," which results when a newly formed paper web breaks during operation of a paper making machine or any full width sheet in bulk form.

The apparatus of the present invention has special relation to the type of apparatus disclosed in D. L. Stark Patent No. 2,860,550 and R. F. Vokes Patent No. 3,073,-535, both issued to the assignee of this application. In view of the trend towards larger and more efficient paper making machines which form wider paper webs at higher speeds, as for example a 300-inch web at 3,000 feet per minute, it is highly desirable that the machinery for repulping the newly formed web in the event of a break be constructed with optimum repulping capacity of tonnage.

Thus the present invention is basically directed to apparatus which provides a substantial increase in capacity for repulping paper materials which are hard to submerge such as the broke formed by a high speed paper making machine and thereby prevents an accumulation of broke until such time the web can be redirected or the paper making machine can be stopped. More specifically, the present invention is directed to improvements in the tank construction and arrangement of the rotors of the apparatus shown in Patent No. 2,860,550, and which have been found significant in providing a substantial increase in capacity so that the apparatus can handle a high tonnage of full width webs or sheets such as broke slabs or wads in crinkled form.

Accordingly, it is a primary object of the present invention to provide improved pulping apparatus having increased capacity for continuously repulping paper materials which are difficult to submerge such as a broken paper web by circulating a slurry of pulp and liquid to produce an elongated vortex within the apparatus so that a full width broken web or other full width sheets in bulk form can be fed directly into the vortex and into direct engagement with the repulping mechanism.

As another object, the present invention provides apparatus as outlined above wherein a plurality of adjacently spaced repulping rotors are positioned with parallel vertical axes of rotation and cooperate for circulating the pulp slurry to produce an elongated vortex which has sufficient length to receive a full width paper web or sheets such as slabs or wads in a crinkled form.

As a more specific object, the invention provides apparatus as outlined above including a tank having opposed spaced apart curved end portions connected by generally flat side portions and which cooperates with a plurality of closely spaced repulping rotors rotating in the same direction to provide the pulp circulation necessary to produce an elongated vortex for directly receiving the full width of a broken web or sheet in bulk form.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing:

FIG. 1 is a perspective view of a pulping apparatus constructed in accordance with the invention;

FIG. 2 is a plan view of the apparatus of FIG. 1 showing the flow pattern of the pulp slurry during operation; and

FIG. 3 is a view generally in section on the line 3—3 of FIG. 2 and showing in elevation the elongated vortex produced by the circulating flow pattern shown in FIG. 2.

Referring to the drawing, which illustrates a preferred embodiment of the present invention, the apparatus shown in FIG. 1 generally includes a vat or tank **10** which is supported by a frame **11** and is constructed with spaced apart and opposed semi-cylindrical vertical end walls **12** which are connected by flat vertical side walls **14** to define an elongated generally oval-shaped chamber **15**. The top of the tank **10** is open so that a broken web W of paper having a width slightly less than the length of the tank **10** can be fed directly into the tank from a suitable conveyor, such as the type shown in Patent No. 2,860,550.

Extending inwardly and downwardly from the lower edges of the end walls **12** and side walls **14** are curved bottom end sections **18** which are connected by flat bottom side sections **20** to define elongated annular bottom sections having a uniform downward slope. Thus the tank **10** is symmetrical about the lateral and longitudinal centerlines of the tank. Mounted on the bottom sections **18** and **20** and projecting upwardly therefrom are a series of vanes **21** which are provided for controlling the turbulence within the tank **10**.

Mounted within the center area defined by the sloping bottom sections on opposite sides of the lateral centerline of the tank and a deflector member **24** are a pair of circular housings **25** which are spaced adjacent each other and are connected by flat horizontal bottom members **26**. As shown in FIG. 3, each of the housing **25** defines an annular drainage or extraction chamber **30** connected to a common drain manifold **31**. Mounted on top of each of the housings **25** and covering the corresponding extraction chamber **30** is an annular perforated extractor plate **32** having multiple rows of perforations **33** and defining a working surface **34**. Extractor plates **32** having perforations **33** of different sizes may be used according to capacity and defibering requirements, as for example, perforations ranging from ⅛ inch up to one inch in diameter. The inner annular plates **35** (FIG. 3) serve to locate the corresponding extractor plates **32** in relation to the housings **25**.

Rotatably supported on parallel vertical axes which are colinear with the centerlines for the semi-cylindrical end walls **12** and intersect the longitudinal centerline of the tank **10** are a pair of repulping rotors **40** each having a plurality of generally radially extending blades or vanes **42** which sweep across the top working surface **34** of the annular extractor plates **32** causing defiberization of the pulp. The rotors **40** are preferably of the construction disclosed in detail in Patent No. 3,073,535 mentioned above.

As shown in FIG. 3, each of the rotors **40** is mounted on a shaft **44** which extends vertically from a gear reduction unit **45**. Each of the gear reduction units **45** is, in turn, driven by a separate motor **47** through a flexible

drive coupling **48**. As shown in FIG. 2, the rotors **40** rotate in the same direction so that the pulp slurry which is formed within the chamber **15** by the addition of water or water base solution through a suitable supply line (not shown), is circulated along a controlled flow path as indicated by the arrows **50** and at a sufficient velocity to provide an elongated generally oval-shaped vortex as indicated by the dotted lines **52**.

As shown, this vortex defines an elongated cone-shaped opening which has a top opening substantially longer than the distance between the rotor axes and a lower portion which has a length only slightly greater than the distance between the axes of the rotors **40**. The deflector **24** is provided to avoid the possibility of foreign materials or heavy bales of pulp from forming a mechanical interlock between the blades **42** of the rotors **40** causing a jamming of the rotors and drives.

From the drawings and the above description, it can be seen that a pulping apparatus constructed in accordance with the invention provides distinct features and advantages. For example, by positioning the rotors **40** adjacent each other and by rotating the rotors in the same direction, the separate vortices developed by each rotor combines to form one intense elongated vortex which has been found highly desirable for enabling a broken web W or other full width sheets to be fed directly into the vortex and into direct engagement with the rotors **40**. In addition to the close spacing between the rotors **40** and the common direction of rotation, it has been found desirable to construct the tank **10** with flat side walls **14** and flat bottom sections **20** along with the vanes **21** to help produce the elongated vortex **52** and to provide for a positive controlled pattern of uniform circulation of stock into the rotors and thus for maximum mixing and blending of the stock.

As a result, by developing an elongated vortex **52** in the manner described above, it has been found that the capacity of the pulping apparatus constructed in accordance with the present invention has been substantially increased. Primarily this increase results from enabling a broken web W or other full width sheets to be fed directly down into the vortex **52** for immediate repulping by the coaction between the rotor blades **42** and the perforated extractor plates **37** so that the paper stock or slurry can be quickly and continuously drained from the tank **10** through the drain manifold **31** connected to suitable pumps (not shown). Furthermore, the pulping apparatus can also be used for batch operation where it performs equally well on either partial or full batches.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for repulping paper material such as a broken paper web as received from a high speed paper making machine to form a pulp slurry which can be quickly removed and adapted to receive the full width of a web or sheet material so that the material is quickly repulped to prevent accumulation of the web within the slurry, comprising a tank including wall means and bottom means for defining a chamber having generally a top opening for receiving the material, a plurality of repulping rotors supported in closely spaced relation and positioned generally centrally within said bottom means, means for draining the pulp slurry from said chamber, and drive means for rotating each said rotor in the same direction for circulating the pulp slurry within said chamber to produce an intense elongated vortex so that a relatively wide material can be fed directly down into said vortex into engagement with said rotors without being retarded by the circulating pulp slurry.

2. Apparatus as defined in claim 1 including a series of vanes adjacent said bottom means for providing controlled circulation and turnover of the slurry within said tank.

3. Apparatus for repulping hard to submerge paper materials such as a broken paper web as received from a high speed paper making machine to form a pulp slurry which can be quickly removed, and adapted to receive the full width of web or sheet material so that the material is quickly repulped to prevent accumulation of the material within the slurry, comprising a tank including wall means and bottom means for defining an elongated chamber having a top opening for receiving the material, a pair of repulping rotors supported in closely spaced relation on opposite sides of the lateral centerline of said bottom means and on vertical axes intersecting the longitudinal centerline of said bottom means, means for draining the pulp slurry from said chamber; and drive means for rotating each said rotor in the same direction for circulating the pulp slurry within said chamber to produce an elongated center vortex so that relatively wide material can be fed directly down into said vortex into engagement with said rotors without being retarded by the circulating pulp slurry.

4. Apparatus for rapidly repulping hard to submerge materials such as a broken paper web as received from a high speed paper making machine to form a pulp slurry which can be quickly removed, and adapted to receive a web or sheet material having substantial width so that the material is repulped rapidly to prevent accumulation of the material within the slurry, comprising a tank having opposed curved end portions connected by flat side portions to define an elongated generally oval-shaped chamber having a top opening for receiving the material and including an elongated annular bottom section extending inwardly and downwardly from said end and side portions, a plurality of adjacently spaced repulping rotors positioned centrally within said bottom section and mounted on respective shafts positioned with parallel axes of rotation, means for draining the pulp slurry from said chamber, and drive means for said shafts for rotating each said rotor in the same direction for circulating the pulp slurry within said chamber to produce an elongated center vortex so that relatively wide material can be fed directly down into said vortex into engagement with said rotors without being retarded by the circulating pulp slurry.

5. Apparatus for rapidly repulping hard to submerge paper materials such as a broken paper web as received from a high speed paper making machine to form a pulp slurry, and adapted to receive a web or sheet material having substantial width so that the material is repulped rapidly to prevent accumulation of the material within the slurry, comprising a tank having a pair of opposed semi-cylindrical end portions connected by flat side portions to define an elongated generally oval-shaped chamber having a top opening for receiving the material, said tank including an annular generally oval-shaped bottom portion sloping downwardly toward the center of said tank, a pair of repulping rotors positioned centrally within said bottom portion and mounted with parallel vertical axes of rotation, the axis of each of said rotors being generally colinear with the centerline of the corresponding said semi-cylindrical end portions of said tank and said rotor axes being spaced apart by a distance slightly greater than the combined radii of said rotors, means for draining the pulp slurry from said chamber, and drive means for rotating each said rotor in the same direction for circulating the pulp slurry within said chamber to produce an elongated center vortex so that relatively wide material can be fed directly down into said vortex into engagement with said rotors without being retarded by the circulating pulp slurry.

6. Apparatus as defined in claim **5** including a series of vanes extending upwardly from said bottom portion

for providing uniform turnover and controlled circulation of the slurry within said tank.

7. Apparatus for rapidly repulping hard to submerge paper materials such as a broken paper web as received from a high speed paper making machine to form a pulp slurry which can be quickly removed and adapted to receive a web or sheet material having substantial width so that the material is repulped rapidly to prevent accumulation of the material within the slurry, comprising a tank having opposed curved end portions connected by flat side portions to define an elongated generally oval-shaped chamber having a top opening for receiving the material and including an elongated annular bottom section extending inwardly and downwardly from said end and side portions, a plurality of closely spaced repulping rotors including generally radially extending blades and mounted centrally within said bottom section on respective shafts positioned with parallel axes of rotation, an annular perforated extractor plate mounted adjacent the bottom of each said rotor and including a working surface adapted to cooperate with said blades to defiber the pulp, means for draining the pulp slurry from said chamber through said perforated plates, drive means for said shafts for rotating said rotors in the same direction for circulating the pulp slurry within said chamber to produce an elongated center vortex so that a relatively wide material can be fed directly down into said vortex into engagement with said rotor blades and said working surface without being retarded by the circulating pulp slurry, and deflector means spaced between said rotors to prevent jamming of said rotors by rigid material extending between said rotors.

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