ABSTRACT: An elongated tank particularly adapted for the repulping of broken sheets of damaged paper web or "broke" discharged from breaks in the web during the operation of a papermaking machine; the tank having a substantially flat central bottom portion with a pair of identical, but of opposite hand, oppositely rotating rotors mounted thereon; the positioning of the rotors with respect to the configuration of the tank walls and with respect to each other being such as to cause even the broad sheets of "broke" to be quickly submerged and drawn downwardly without first following a vortical pattern, thereby minimizing the time required for effective repulping of material.
PULPING APPARATUS FOR PAPERMAKING STOCK

BACKGROUND OF THE INVENTION

The desirability and even necessity of speedily repulping the damaged paper web or "broke" for reuse when breaks in the newly formed web occur during the operation of a paper machine are well recognized. While a break in the web on the paper machine may not occur frequently, nevertheless, when it does occur in a modern high-speed paper machine, even a break lasting for a period of only a few minutes can result in a huge quantity of "broke" accumulating. Consequently it is important not only to take care of the "broke" under such conditions as rapidly as it is produced, but also, since the "broke" is so highly suitable for immediate repulping and reuse, to repulp it as far as possible at a rate and on a scale somewhat commensurate with its production. The object of the present invention is to increase the rate at which such "broke" can be repulped.

Webs of considerable width are formed in modern paper machines. Consequently the device of the present invention includes an elongated tank capable of accommodating the full web width. The employment of elongated tanks for this purpose is not new in the art, being shown notably in U.S. Pat. No. 2,860,550, issued Nov. 18, 1958 to Spark, and in U.S. Pat. No. 3,342,425, issued Sept. 19, 1967 to Morton. The devices in both of these patents, like that of the device in the present invention, also include a pair of identical rotors, rotating on vertical axes in the bottom portion of the tank.

In the device of U.S. Pat. No. 3,342,425 the two rotors rotate in the same direction. The effect of their action is to cause the pulp as it is delivered into the tank to tend to follow an elongated single vortical course in the process of becoming submerged, and also a tendency to produce a twisting of the sheet as it contacts the pulp circulating in the tank. The effect in either case is to increase the time required for complete submergence of the sheet.

In the device of U.S. Pat. No. 2,860,550 the rotors rotate in opposite directions. However, the configuration of the tank walls adjacent the rotors and the relative positioning of the rotors with their axes coinciding with the axes of the semicylindrical walls of the respective ends of the tank cause each rotor to produce a separate vortical path and to tend to cause the pulp to become divided into two separate vortical courses or else to be drawn entirely into one or the other of the two possible vortical courses.

The object of the present invention is to increase the rate of submergence of the pulp as it is delivered into the tank, drawn downwardly and centrally in the tank, instead of following a vortical course, thereby resulting in the pulp becoming more quickly submerged.

OUTLINE OF THE INVENTION

An elongated tank, having semicylindrical end walls has a centrally positioned similarly shaped flat bottom section on which are mounted a pair of identical, but of opposite hand, oppositely rotating rotors. The vertical axes of the rotors are spaced inwardly respectively from the axes of the semicylindrical end walls of the tank and also from the corresponding semicircular ends of the central flat bottom portion of the tank but the axes of the rotors are spaced apart a distance less than twice the diameter of the rotors. The bottom of the tank surrounding the central flat bottom portion slopes outwardly upwardly towards the vertical wall of the tank. The relatively close positioning of the two oppositely rotating rotors and their spacing from the semicylindrical end walls of the tank cause the pulp, when deposited in the tank, first to tend to be drawn downwardly and centrally in the tank, instead of following a vortical course, thereby resulting in the pulp becoming more quickly submerged.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a top plan view of the tank, showing the two rotors mounted therein;
FIG. 2 is a sectional elevation on line 2—2 of FIG. 1; and
FIG. 3 is a diagrammatic representation drawn to smaller size illustrating the flow course followed by the top of the material in the tank during the operation of the rotors.

The elongated tank, indicated in general by the reference 10, has a vertical wall comprising two identical semicylindrical end sections 11 and 12 joined by a pair of substantially straight side sections 13 and 14 (FIG. 1). The bottom wall of the tank includes a central substantially horizontal section 15, similar in outline shape to the vertical wall of the tank, and thus having two semicircular end portions 16 and 16'. The central section 15 of the tank bottom is surrounded by an outwardly upwardly sloping bottom wall portion 17 which, at its outer extremity, intersects with the vertical walls of the tank.

A pair of identical, but of opposite hand, repulping rotors 19 and 19' are mounted on vertical axes located along the longitudinal centerline of the tank bottom at equal distances from the end walls 11 and 12 of the tank, respectively, and are spaced at conseqently equal distances from the corresponding ends of the semicircular portion 16 and 16' of the bottom section 15 of the tank.

The axes of the rotors 19 and 19' are spaced apart preferably a distance less than twice the diameter of the rotors. Also, as will be noted from FIG. 1, the axes of the rotors are spaced a substantial distance inwardly, along the longitudinal centerline of the tank bottom, from the axes of the end walls 11 and 12 of the tank respectively. As later explained, this is important in accomplishing the desired proper circulation pattern for the pulp delivered into the tank. Since the centers of the semicircular end portions 16 and 16' of the central bottom section 15 of the tank preferably coincide with the axes of the semicylindrical end walls 11 and 12 respectively, the axes of the rotors are correspondingly located inwardly, along the longitudinal centerline of the tank, from the centers of the semicircular end portions of the bottom section 15.

A circular opening is provided in the bottom wall section 15 beneath each rotor assembly, and a pair of circular housings 20 and 20' (FIG. 2) are secured to the tank bottom beneath these openings respectively, the external diameter of these housings corresponding approximately to the outside diameter of the rotors. The axes of the rotors extend up through central bearing enclosures in the housing 20 and 20' forming annular extraction chambers 21 and 21' respectively in the housing into which the pulp passes when pulped to sufficiently small particle size. The extraction chambers 21 and 21' are provided with discharge lines 22 and 22' respectively which lead to a common outlet 23 for the treated pulp slurry. Alternately the discharge lines 22 and 22' may be separately connected to individual stock pumps.

The rotor shafts extend up from driving gears located in housings indicated at 24 and 24' respectively in FIG. 2, which gears are operated by suitable driving means (not shown) causing the rotors to be rotated at the same speed but in opposite directions. While various types of pulping rotors having blades extending over stationary screen plates or other stationary cooperating elements, providing for restricted discharge of the treated pulp slurry down into the extraction chambers 21 and 21', may be employed in the carrying out of the present invention, rotor assemblies such as that described in U.S. Pat. No. 2,654,294, issued under date of Oct. 6, 1953, are preferred, wherein the rotor blades in each assembly extend over a concentric stationary ring having a frustrconical attritioning surface and the treated pulp slurry passes through narrow annular slot between the inner periphery of the attritioning ring and the periphery of the rotor hub. In FIG. 2 consequently the stationary attritioning rings over which the extending blades of the rotors 19 and 19' pass are indicated, more or less diagrammatically, at 25 and 25'. Alternately the concentric stationary rings may be provided with apertures through which the treated pulp slurry may pass.
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Due to the fact that the rotors 19 and 19' are spaced substantially inwardly from the semicylindrical tank walls and are positioned relatively close to each other, and rotate in opposite directions, a novel circulation pattern is produced in the top of the material in the tank. This is illustrated by the arrows in FIG. 3. Thus the material in the tank, instead of first following an elongated single vortical path, as previously mentioned with reference to the device in U.S. Pat. No. 3,342,425, or following a pair of vortical paths, as mentioned with reference to U.S. Pat. No. 2,860,550, will have a flow pattern characterized by a rolling action up the vertical walls of the tank and passing downwardly centrally from the surrounding walls. The pulp sheets deposited in the tank consequently are first drawn downwardly in this flow pattern, which results in their almost immediate submergence, following which they come into contact with the rotor blades. Since the time required for initial submergence of the pulp sheets is reduced, the time required for the repulping of the same is shortened. Thus the apparatus is enabled to take care of the "broke" more expeditiously and achieve the main objective of the invention. In addition, the circulation pattern described above is obtained without the use of vanes, baffles, or deflectors thus overcoming the tendency of pulp sheets to staple or hang up on internal projections in the tank.

I claim:

1. An apparatus for pulping paper-making stock, and particularly for repulping broken paper web received from a paper-making machine, including an elongated tank having semicylindrical end walls connected by substantially straight sidewalls, a flat, elongated central bottom portion in said tank, upwardly outwardly sloping bottom wall section in said tank between said central bottom portion and said side and said end walls, a pair of identical, but of opposite hand, pulping rotors mounted within said central bottom section on vertical axes, said rotor axes being located along the longitudinal centerline of said central bottom portion of said tank and located inwardly along said longitudinal centerline from the axes of said semicylindrical end walls respectively, the distance between said rotor axes being less than twice the diameter of said rotors, means for rotating said rotors in opposite directions at the same speed, and means for withdrawing the pulp slurry from said tank.

2. The apparatus as set forth in claim 1 with said central bottom portion of said tank having semicircular ends, and with said axes of said rotors also located inwardly along the longitudinal centerline of said tank from the centers of said semicircular ends of said central bottom portion.

3. The apparatus as set forth in claim 2 with said centers of said semicircular ends of said central bottom portion coinciding with said axes of said semicylindrical end walls of said tank respectively.