Nov. 10, 1953 E. COWLES 2,658,426

MACHINE FOR PULPING PAPER STOCK

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Fig. 1.

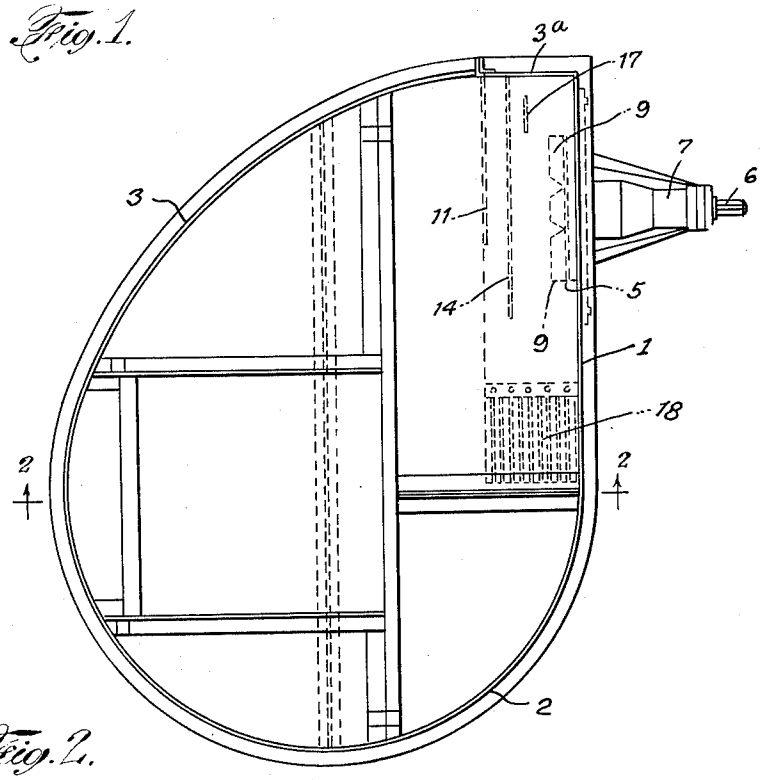
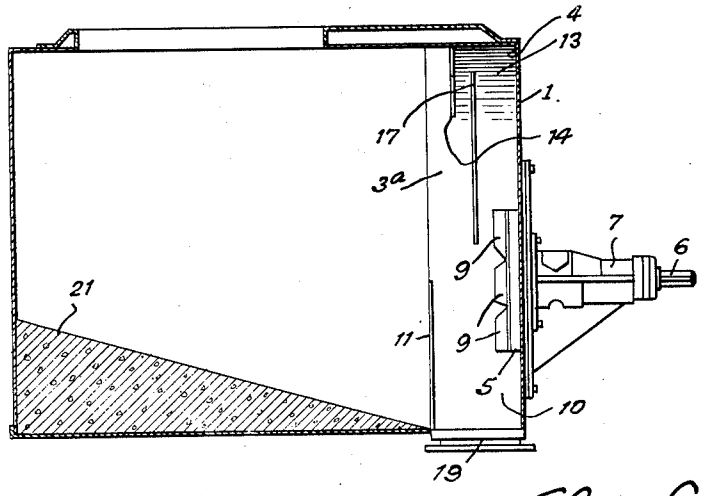


Fig. 2.



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Fig. 3.

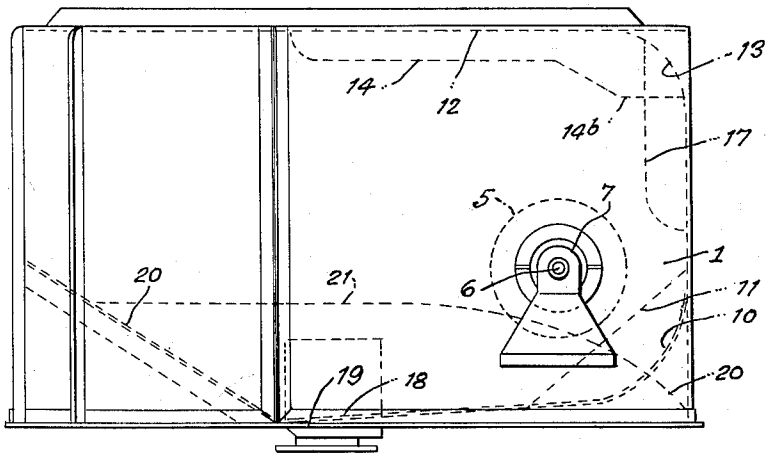
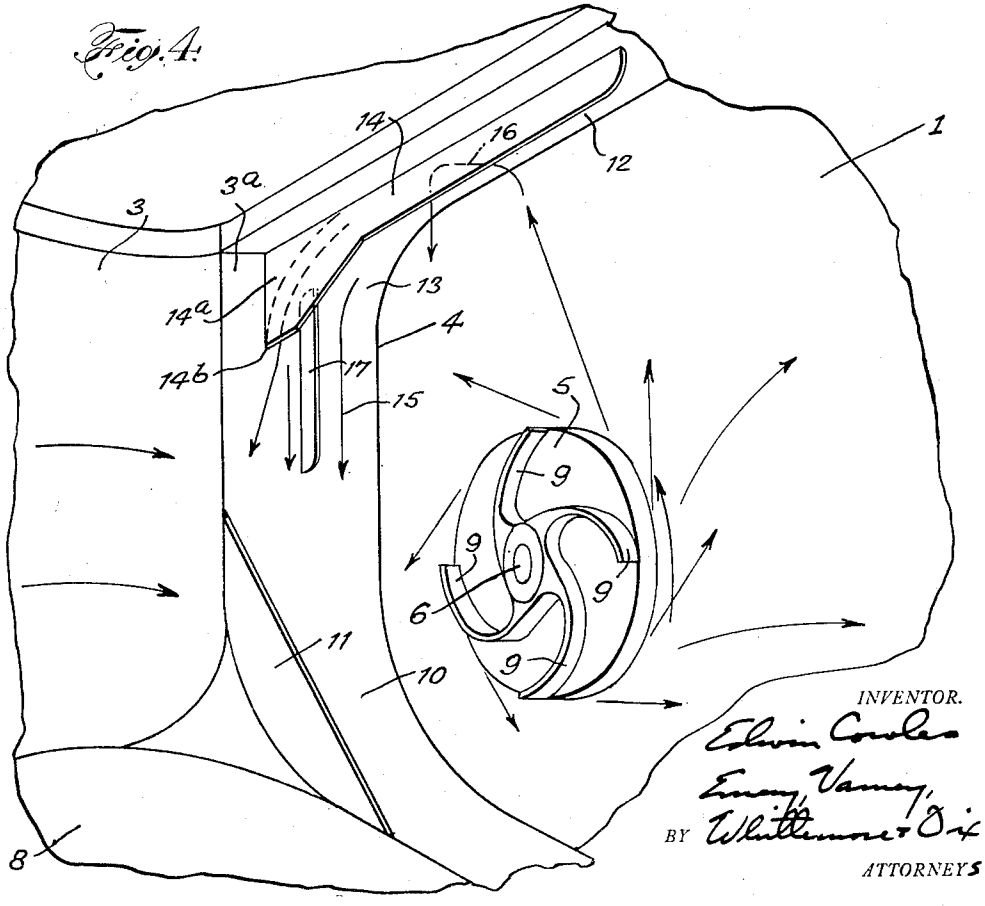


Fig. 4.



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MACHINE FOR PULPING PAPER STOCK

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Application July 1, 1952, Serial No. 296,680

5 Claims. (Cl. 92—26)

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This invention relates to machines for pulping paper stock, and pertains more particularly to machines of the general type illustrated in my prior Patent No. 2,351,492, in which a vaned impeller mounted for rotation in the bottom of a tank discharges stock outwardly to defiber the stock, and at the same time creates a vortical circulation of the stock in the tank which tends to submerge floating stock and repeatedly brings all portions of the stock into the zone of action of the impeller.

Experience with said machines in actual day to day operation in paper mills has demonstrated that if good vortical circulation of the entire contents of the tank is to be maintained, the diameter of the impeller should be at least one fourth, and preferably one third to one half the diameter of the tank. However, it has been found that in such machines, and more particularly in the larger sizes of said machines in which the tank diameter is frequently as much as 20' and in which the impeller diameter should be from 6' to 10' for good circulation, the mechanical and engineering requirements of a drive adequate to transmit the required power input and to maintain the desired peripheral speed of the impeller are quite severe. In order to insure reliability of operation over extended periods gear reducing units have been employed to transmit power to the impeller shaft and such units have added considerably to the cost of such machines.

Experience with said machines has also demonstrated that for any given horsepower input, a small diameter impeller produces more efficient defibering action than a larger diameter impeller. For example, a 4' diameter impeller rotating at a speed to consume 100 horsepower is more efficient than an 8' diameter impeller of the same vane design rotating at a speed to consume 100 horsepower as shown by the fact that the horsepower per ton per day consumed by the smaller impeller to produce a given amount of defibering is less than that consumed by the larger impeller to produce an equal amount of defibering. However, the 4' impeller cannot be relied upon to maintain adequate vortical circulation in a 20' tank, and larger impellers have been required in large diameter tanks for this reason.

It is an object of the present invention to provide a machine having a tank of large capacity in which a relatively small impeller may be employed, said impeller and tank being so constructed and arranged as to make it possible for a small impeller to create and maintain adequate circulation of all portions of the stock in the

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tank and adequate submerging action in the manner hereinafter described, but without the necessity of maintaining vortical circulation of all portions thereof. Such impellers, because of their relatively small diameter not only operate at higher efficiency, but also makes possible the use of smaller, lighter, cheaper gear reducing units, and in many cases makes possible the use of a simple V-belt drive at a cost considerably less than the cost of a gear reducing unit.

This application is filed as a continuation in part of my copending applications Serial No. 72,868, filed January 26, 1949, and No. 146,965, filed March 1, 1950, both now abandoned.

Other objects and advantages of the invention will appear hereinafter.

A preferred embodiment of the invention selected for purposes of illustration is shown in the accompanying drawings, in which:

Figure 1 is a top plan view.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a front view.

Figure 4 is a perspective view of the interior of the tank, looking upward from the bottom.

Referring to the drawings, the invention is illustrated as embodied in a tank of modified cylindrical contour having a flat front wall 1 and curved side and rear wall sections 2 and 3. The flat front wall 1 is tangent to the curved side wall section 2 and section 2 merges smoothly into section 3 which, as shown, is preferably on a radius somewhat larger than the radius of wall 2. Wall 3 terminates in a short flattened section 3a which joins wall 1 to form a corner 4. The radius of curvature of the section 2 is less than the length of the front wall 1. A tank of this type causes the stock to follow a natural flow pattern and offers a minimum of resistance to circulation of stock in the tank.

An impeller 5 is mounted on a shaft 6 extending through the front wall 1, being supported in a bearing housing 7 and rotating on a horizontal axis. Preferably the impeller is located near the corner 4 and near the bottom 8 of the tank. Said impeller includes vanes 9 which discharge stock outwardly around the entire periphery of the impeller, the direction of discharge being the resultant of radial and tangential components of motion imparted to the stock by the impeller vanes, but always in directions substantially parallel to the flat front wall 1.

In carrying out the present invention, I have made use of a prior invention disclosed in my prior U. S. Patent No. 2,557,174 in which a baffle

wall surrounding a portion only of the periphery of the impeller is utilized to intercept and deflect a portion of the peripheral discharge from the impeller and to redirect the intercepted discharge in the direction of a portion of the peripheral discharge which is not intercepted.

Thus, at the bottom of the tank, adjacent the corner 4, a curved baffle 10 extends around a portion of the periphery of the impeller, rougly one quarter thereof, which said baffle is preferably of volute form. The baffle is located between the front wall 1 on one side and a wall 11 on the other side so that the stock which is intercepted and deflected by the baffle is confined and redirected in the direction of the discharge from an adjacent quadrant of the impeller, thereby creating a powerful current moving parallel to the flat wall 1. This current, which constitutes the dominant circulating current within the tank, is, in turn, deflected by the curved walls 2 and 3, producing and maintaining a constant clockwise (viewed from the top of the machine) circulation of the entire contents of the tank which tends to bring all submerged portions of the stock repeatedly into the zone of action of the impeller. Due to the manner in which the wall 3 forms a corner with the front wall 1, the stock moves directly toward the face of the impeller.

The second requisite of a successful machine is the ability to submerge pieces of stock which tend to float on the surface. When dry stock is first introduced the problem is particularly acute, but it exists throughout the operation due to the fact that a large part of the energy introduced by the impeller is dissipated below the surface and the surface is relatively quiescent, particularly at the higher stock consistencies.

For this purpose a cover 12 is provided above the impeller to intercept the upward discharge from the impeller. The said cover is preferably horizontally disposed and extends along the flat wall 1 of the tank. Adjacent the corner 4 it has a section 13 which curves downwardly and joins the side wall 3*a*.

A wall 14, parallel to wall 1, and lying in a plane between the wall 1 and wall 11, extends downwardly from the cover 12. The said wall is relatively narrow except near the point where it joins the wall 3*a* where the section 14*a* is somewhat wider and has a lower edge 14*b* which is located at the maximum operating level of the machine. That is, the machine may be operated at lower levels, but for the best performance should not be operated at a level above that of the edge 14*b*.

The stock which is intercepted by the cover 12 is redirected thereby. Some of the stock follows a path more or less parallel to the wall 1 and, as indicated by arrow 15, is deflected downwardly by the curved section 13 and wall 3*a* to augment the main circulating current. Some of the stock, however, moves laterally, as indicated by arrow 16, toward wall 14 where it is again intercepted and deflected downwardly against the surface of the stock, leaving the wall in the form of a curtain of a volume and velocity sufficient to submerge floating pieces of stock which move into its area.

This curtain is particularly effective because of its location immediately above and in front of the impeller. The submerged region in front of the impeller is a region of low pressure into which stock is being drawn from all sides. The velocity and volume of the curtain of stock is sufficient to penetrate well below the surface and to push floating stock into the low pressure region where it is immediately carried toward the impeller.

It will now be understood why the bottom edge of the wall 14 should not extend below the operating level of the contents of the tank, for to whatever extent it may be allowed to do so, it destroys the effectiveness of the curtain of stock to submerge floating stock.

Moreover, it is important to prevent a reverse or counterflow below the surface of the stock such as might produce an eddy or dead area below the wall 14 near the wall 3. For this purpose a vertical fin 17 is mounted on the wall 3*a* parallel to wall 1 and located between that wall and wall 14. It should extend downwardly a substantial distance from a level near that of the edge 14*b*. This fin prevents stock discharged by the impeller and intercepted by the wall 3*a* from moving laterally in a direction counter to the main circulatory movement.

It will be noted that while a portion of the discharged stock is diverted and utilized to insure submergence of floating stock, a considerable portion of the stock so diverted is returned to the main circulatory current, adding its energy thereto.

In order to provide for the removal of finished stock, either to empty the tank on the completion of a batch operation or continuously during a continuous operation the bottom of the tank is provided with a grating 18 through which stock may flow to an outlet chamber 19. The grating is located adjacent the flat wall 1, below and somewhat offset from the impeller in a position to be swept by the main circulating current. The ribs of the grating extend parallel to the flow of the current and the force of the current tends to keep the grating clean and unobstructed.

It has been found to be highly desirable to provide a sloping bottom section 20 near the bottom of the curved wall section 2 having a surface which intercepts and deflects upwardly the stock moving along the wall 1 near the bottom of the tank, thus aiding the mixing of stock from the upper and lower levels of the tank. It also aids the transfer of energy to the body of stock at the end of the tank and improves the circulation of the main body of stock throughout the tank. Preferably said slope extends close to the end of the grating 18 and a second sloping bottom section 21 extends from the wall section 3 close to the side of the grating to facilitate emptying of the tank.

It will be understood that the invention may be variously modified and embodied within the scope of the subjoined claims.

I claim as my invention:

1. Apparatus for treating paper stock, comprising, in combination, a tank having a flat front wall, and having a curved wall section joining one end of said flat wall and tangent thereto, said curved wall section joining another wall section curved on a radius greater than the radius of the first section, said second section joining the other end of said flat wall, the radius of curvature of said first wall section being less than the length of said flat front wall, and an impeller mounted for rotation on a horizontal axis extending through said front wall at right angles thereto and discharging stock outwardly from the periphery in directions substantially parallel to said front wall.

2. Apparatus as claimed in claim 1 in which said tank has a sloping bottom section near the bottom of said first named curved wall section

which said sloping bottom intercepts and deflects upwardly stock moving along the bottom of said front wall.

3. Apparatus for treating paper stock, comprising, in combination, a tank having a front wall, an impeller mounted for rotation on a horizontal axis extending through said front wall at right angles thereto and discharging stock outwardly from the periphery in directions substantially parallel to said front wall, a curved baffle surrounding a portion of the periphery of said impeller below the axis thereof to intercept and redirect stock in the direction of the discharge from an adjacent portion of the impeller which is not intercepted, a cover lying above said impeller and above the level of the stock in the tank, and a wall extending downwardly from said cover and spaced from said front wall, said wall having its lower edge above the level of the stock in the tank so that some of the stock intercepted and deflected by said cover is again intercepted and deflected by said wall and discharged downwardly against the surface of the stock in the tank.

4. Apparatus as claimed in claim 3 in which said front wall is flat and said tank includes curved side and rear walls, said flat front wall joining one of said side walls at a tangent thereto and joining the other side wall to form a corner.

5. Apparatus as claimed in claim 3 in which said tank includes a side wall which joins said front wall to form a corner, which said side wall intercepts and deflects stock discharged in the region between said baffle and said cover, and a vertical fin extending downwardly along said side wall below the bottom of said downwardly extending wall and lying in a plane between said wall and said front wall.

EDWIN COWLES.

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520,680	Hibbert	May 29, 1894
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