Oct. 8, 1935. W. B. McMARTIN 2,016,647

DEVICE FOR TREATING PAPER STOCK

Filed Oct. 14, 1933

Fig. 1.

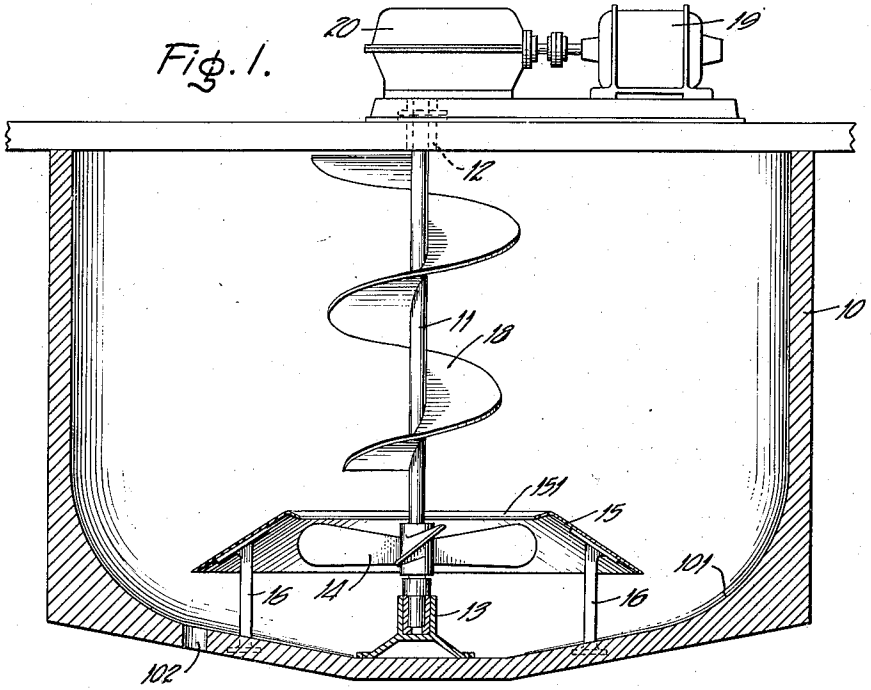


Fig. 2.

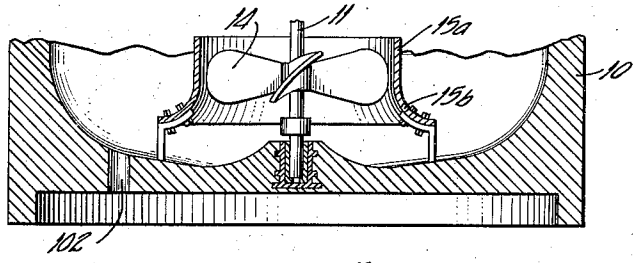


Fig. 3.

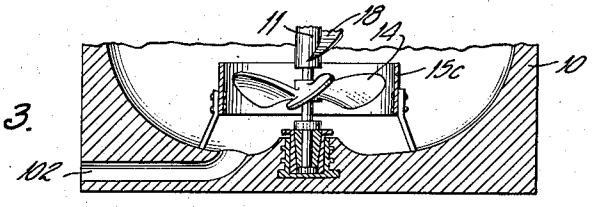
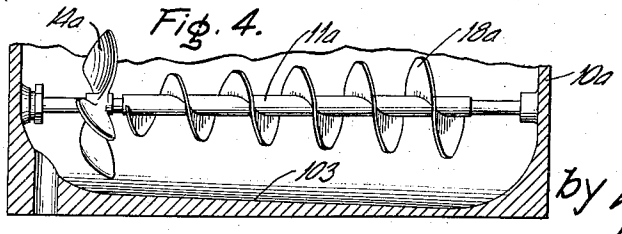


Fig. 4.



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2,016,647

DEVICE FOR TREATING PAPER STOCK

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Application October 14, 1933, Serial No. 693,583

5 Claims. (Cl. 259—97)

My invention relates to paper making and more particularly to a device for treating paper stock by agitation, and this application is a continuation in part of my application Serial No. 567,901 filed October 9, 1931.

It is quite usual to provide stock chests with paddle-like agitators which rotate at very low speed and serve merely to effect a slow stirring of the stock. Where only a single paddle is employed, the stirring or stock movement is confined more or less to a rather limited zone about the paddle, and where several paddles are distributed throughout the stock the power consumed in operating them is very great.

It is desirable in all cases to keep the stock moving. Moreover, where the chest is used as a drop chest, it is quite essential that the beater loads be thoroughly and quickly blended otherwise stock of variable character finds its way to the machine with resulting variations in the finished sheet. With the present available equipment it is very difficult to mix and thoroughly blend colored stocks so that mottled and off-shade papers are avoided.

It has been proposed to use rotating worms or screws for agitating and blending the stock, but these merely advance or propel the material forward with little or no intermixing, and prolonged circulation is required to attain even a fair degree of blending. With a worm or screw there is no lateral "outthrow" of stock, even at substantial speed, and the action is simply a pushing or conveying movement which produces circulation with substantially no intermixing. This is apparent to anyone familiar with the operation of screw conveyors many of which operate in open troughs.

Screw propellers having separate blades, on the other hand, if rotated at substantial speed, not only push the stock forward but throw it out laterally or radially to such an extent that unless the radial stock movement is limited or restrained by some surrounding means the propeller, particularly with concentrated stocks, may merely tend to cut an opening for itself and produce very little if any forward pushing or circulating stock movement. On the other hand, this lateral outthrow produces the violent agitation and intermixing of the material which is so essential in attaining a rapid, efficient and positive blending. A screw propeller of relatively large diameter as compared with the diameter of the chest is not necessary, in fact it is not desirable because of the power required to operate it and because a comparatively large propeller interferes with the rapid circulation of the stock.

The principal object of my invention, therefore, is to provide a stock agitator which will quickly and positively produce a complete blending and intermixing of the stock in the chest with a minimum power expenditure. Another object is to provide a device of the character described which will operate efficiently with stock of much higher consistency than is possible with present agitators, I accomplish this object by so combining a screw or worm with a screw propeller having separate blades that the worm, which requires a relatively small amount of power to operate it and may extend through a major portion of the chest, maintains a constant and positive flow of stock towards a screw propeller of moderate size which, in turn, produces not only a violent agitation and intermixing of the material, but in which the tendency to radial outthrow of stock is so restrained and directed that the propeller itself impels the stock forwardly and assists in maintaining a rapid circulation in the chest, all with a minimum power expenditure.

My invention, therefore, includes the novel elements and the combinations and arrangements thereof described below and illustrated in the accompanying drawing in which—

Fig. 1 is a vertical section of my invention in its preferred form in which the propeller is surrounded by a frusto-conical ring flared downwardly and outwardly;

Fig. 2 is a fragmentary sectional view similar to Fig. 1, illustrating a modified form of ring surrounding the propeller;

Fig. 3 is a fragmentary sectional view illustrating a further modified form of ring surrounding the propeller; and

Fig. 4 is a vertical, fragmentary section illustrating my invention applied to a horizontal type of chest.

Like reference characters indicate like parts throughout the drawing.

Referring now to the drawing and first to Fig. 1, 10 indicates a vertical chest or receptacle for paper stock or stuff, an outlet for the stock being indicated at 102. A centrally disposed shaft 11 has its upper and lower bearings at 12 and 13 respectively. To the lower portion of the shaft 11 is secured a screw propeller 14 comprising a plurality of blades surrounded by a tubular member or ring 15 which, in the embodiment of my invention illustrated in Fig. 1, is frusto-conical and flared downwardly and outwardly through-

out its major portion, the upper edge 15' of the ring being turned downwardly and inwardly the better to direct the stock from the region of the chest above the ring into the propeller. The ring 15 is mounted on brackets 16 suitably secured to the bottom of the tank, the lower portion of the tubular member thus being spaced from the tank bottom to permit the material, which is forced downwardly and outwardly by the propeller, to flow underneath the lower edge of the ring from which the material is directed upwardly by the curved bottom 10' of the tank.

Secured to the shaft 11 above the propeller is a screw or worm 18 the pitch of which is in the same direction as that of the propeller and which is thus rotated at the same speed as the propeller and which serves primarily to push the stock downwardly toward the propeller. The diameter of the worm preferably gradually decreases from the upper end thereof to the lower end as indicated in the drawing. In the embodiment illustrated, the shaft is driven by an electric motor 19 through a gear reducing device 20 which may be of any approved construction, the reduction being such that the shaft will preferably be driven at a speed from 100 to 250 R. P. M. The indvidual blades of the propeller extend through a comparatively small arc only circumferentially of the shaft whereas the screw conveyor having a continuous helical surface extends through a comparatively large arc and, in the embodiment illustrated, extends approximately twice around the shaft.

The operation of the device illustrated in Fig. 1, is as follows:

The screw propeller 14 subjects the fluent paper stock or stuff to a violent agitation, and tends to throw the material outwardly. The material flows through the space between the ring 15 and the bottom of the chest, the outward flaring of the ring deflecting the material outthrown from the propeller towards the outer wall of the chest, and the circulating movement of the material being further facilitated by curving the bottom of the chest outwardly and upwardly from beneath the propeller. The zone of violent agitation is thus more or less limited to the immediate vicinity of the propeller. At the same time the screw or worm 18 feeds the material from the upper and intermediate portions of the tank to the propeller.

In Fig. 2 I have illustrated a slightly modified form of my invention in which the tubular member 15a is cylindrical throughout its upper portion, the outwardly flared portion 15b thereof which permits outthrow of the material being confined to the lower portion of the ring.

In Fig. 3, I have illustrated the tubular member 15c as cylindrical throughout.

It will be understood that the size of the propeller will be designed in accordance with the shape and size of the chest. For example, a larger propeller will be used with a comparatively shallow chest of large diameter than with a deep chest of comparatively small diameter. I find that the average diameter of the screw conveyor may be somewhat less than one-half that of the propeller, although it will, of course, be understood that my invention is not limited to the foregoing proportion.

In the embodiment of my invention illustrated in Fig. 4 the chest 10a is horizontal and the propeller 14a is secured to a shaft 11a horizontally mounted in the bottom of the tank 10a, the bottom of which slopes as at 10' and the screw or worm 18a tapers towards the propeller. The propeller and the adjacent portion of the worm are located above the higher portion of the bottom of the chest while the portion of the worm of larger diameter is located above the lower portion of the tank, so that the lowermost points of the successive turns of the screw are located in a line substantially parallel to the bottom of the tank. While I have chosen a stock chest for the purpose of illustrating a receptacle suitable for my agitator, it will be understood that it may be used with any tank or other receptacle in which it is desirable to agitate, mix or circulate fluent material.

The maximum tank consistency now found practicable in devices of this character is about 3½%. When the consistency exceeds this percentage substantially, the propeller, which is rotated at a relatively low speed, simply cuts through the material in the zones and produces very little if any circulation. I have found, in practice, that the device embodying my invention is capable of satisfactorily handling paper stock having a consistency as high as 6%, and hence a tank equipped with my invention is capable of treating the same amount of stock as a tank of twice the size and equipped with agitating devices heretofore used.

It will, of course, be understood that the speed of rotation of the shaft on which the propeller and worm are mounted will be varied to fit the size of the tank, the shape thereof, and other factors. On small tanks, the shaft may advantageously be operated at a speed of 250 revolutions per minute, while on larger tanks, a speed of only 100 revolutions per minute may be required. Again, with a comparatively shallow tank of large diameter, a larger propeller may be used than in a deep tank of comparatively small diameter. A ratio of propeller diameter to tank diameter, when the tank is vertical, of 1 to 3 will usually be found satisfactory. I have built a device in which the diameter of the screw or worm is less than one-half of that of the propeller, although, of course, it will be understood that I am not limited to these proportions. The diameter of the screw or worm, however, is, in any event, preferably less than that of the propeller.

In the operation of the device, large chunks of material may be thrown into the receptacle and will be sucked down by the worm to a position within the influence of the propeller. In the absence of the worm, the large chunks of material float on the top of the stock and cannot be broken up.

I have found in practice that a screw propeller provided with a plurality of blades in combination with a screw or worm which feeds the material to the propeller, causes the material to be subjected at one point to a violent intermixing agitation. At the same time the propeller forces the material downwardly and outwardly towards the outer walls of the chest thereby assisting in creating a rapid circulation of the material which is promoted by the provision of a tubular member surrounding the agitator.

In my application Serial No. 567,901 the type of ring about the propeller is that shown in Fig. 3 of the drawing. I find that by outwardly flaring the bottom of the ring, as shown in Fig. 2, a marked increase in the efficiency of the device is noted and a still greater increase is obtained than by forming the ring as shown in Fig. 1.

I have found that a plurality of spaced screw propellers or a plurality of spaced worms will not

produce an agitator which is anywhere near as efficient as the combination herein disclosed. The propellers alone consume an excessive amount of power and tend either to throw most of the stock outwardly or, where the consistency is high, merely to turn in the stock. In either case, circulation which is essential to bringing the stock repeatedly into the zone of cutting action of the propeller blades, is impeded or entirely lacking, and the effect of one propeller is largely neutralized by the other.

Worms alone, on the other hand, merely drive the stock forward. There is no substantial lateral out throw and no cutting and rapid intermixing action such as is effected by the separate blades of a screw propeller. Circulation is not only slow but the stock tends to travel in striae with little if any turbulence which is obviously quite essential to rapid and complete blending.

By combining a worm and screw propeller, and so positioning and proportioning these two elements relative to each other and to the confining walls of the chest or other receptacle within which they are located that the worm will feed the stock downwardly through the central portion of the chest to the propeller and the out throw of the propeller will be so directed as to drive the stock outwardly and upwardly around the stock which is moving downwardly under the action of the worm, not only a very rapid circulation is attained with a minimum power consumption, but every bit of stock is repeatedly brought into the zone of action of the propeller blades to be cut, blended and intermixed thereby.

While I have described my invention in its preferred embodiment, it is to be understood that the words which I have used are words of description and not of limitation. Hence, changes within the purview of the appended claims may be made without departing from the true scope and spirit of my invention in its broader aspects.

What I claim is:

1. A device of the character described comprising a chest, a vertical shaft rotatably mounted therein, means for rotating said shaft, a screw propeller having a plurality of blades mounted on the lower portion of said shaft, a tapered worm pitched in the same direction as the propeller mounted on the upper portion of said shaft and having its largest diameter at the top and extending from a point near the normal level of material in said chest to a point near said propeller, and a stationary ring slightly spaced from and extending about the periphery of said propeller for restraining the outthrow of material therefrom.

2. In a device of the character described, the combination with a receptacle adapted to contain a fluent material, of a screw propeller having separate blades and mounted to rotate about a vertical axis within said receptacle near the bottom thereof, and a downwardly and outwardly flared stationary ring surrounding said propeller and having a length substantially coextensive with the axial length of said propeller; whereby unlimited lateral outthrow of material from said propeller is restrained but substantially free lateral flow is permitted after the material passes the propeller.

3. In combination a receptacle for paper stock in fluent condition, said receptacle having a sloping bottom, a horizontally extending shaft provided with a propeller located above the higher portion of the bottom and a screw conveyor tapering towards said propeller and having the portion of greater diameter located above the lower portion of the bottom of the tank.

4. In a device of the character described, a chest, a vertical shaft rotatably mounted therein, a worm on the upper end of said shaft pitched to advance the material downwardly, a screw propeller on said shaft below said worm and pitched to advance the material in the same direction as said worm, said propeller comprising a plurality of blades each of which extends through a comparatively small arc only, and a tubular element surrounding said propeller and spaced from the bottom of said chest to restrain the lateral outthrow of material from said propeller and direct the flow thereof downwardly, the diameter of said propeller being greater than that of said worm.

5. In a device, a chest, a shaft rotatably mounted therein, a continuous worm mounted on one portion of said shaft and pitched to advance the material in said chest towards one of the walls thereof, a screw propeller mounted on another portion of said shaft intermediate said worm and one of said walls and pitched in the same direction as said worm, each of said blades extending through a comparatively small arc only circumferentially of said shaft, said worm gradually decreasing in diameter towards said propeller, whereby said worm will convey material to said propeller where it will be subjected to the cutting and slicing action of said blades and projected against said wall.

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