Nov. 1, 1955 R. D. DUNCAN 2,722,164

DEFLOCCING ROLL FOR PAPER MACHINE HEADBOXES

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Fig. 6.

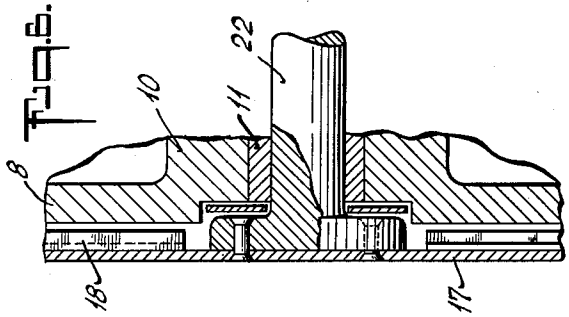


Fig. 1.

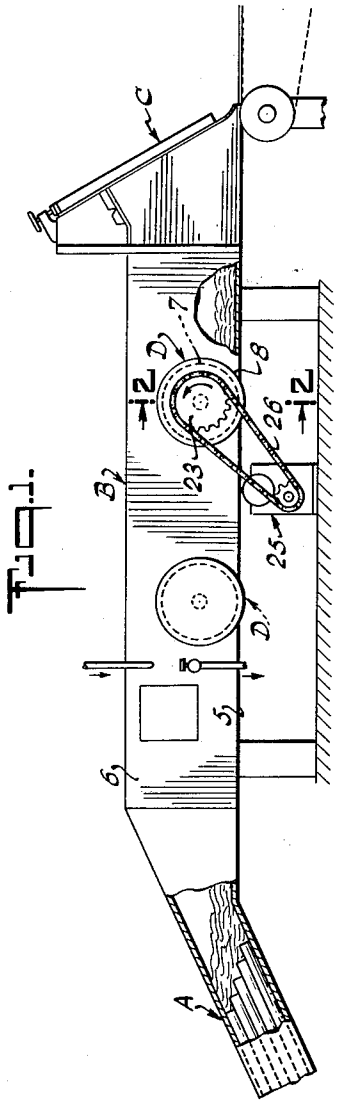


Fig. 5.

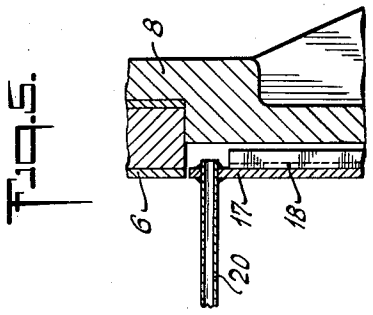
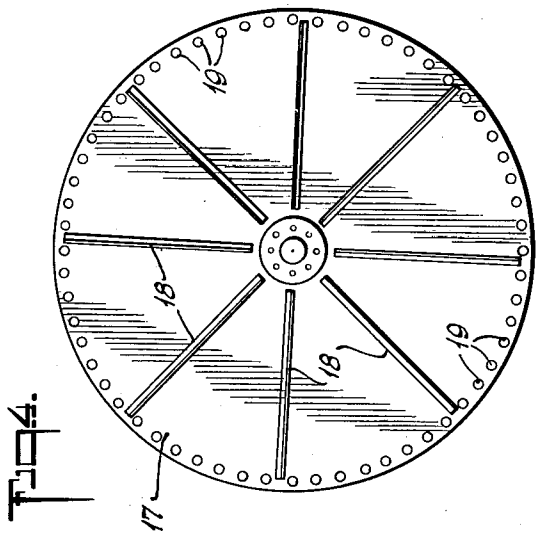


Fig. 4.



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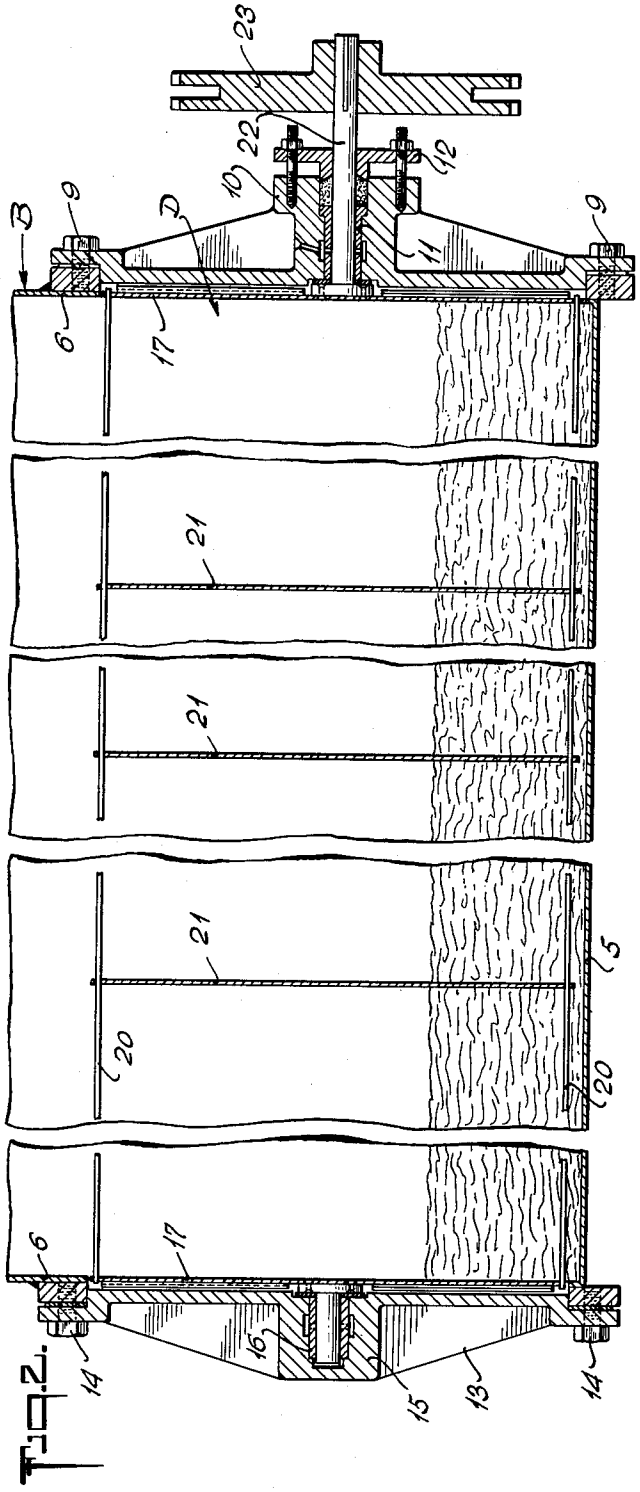

FIG. 2.

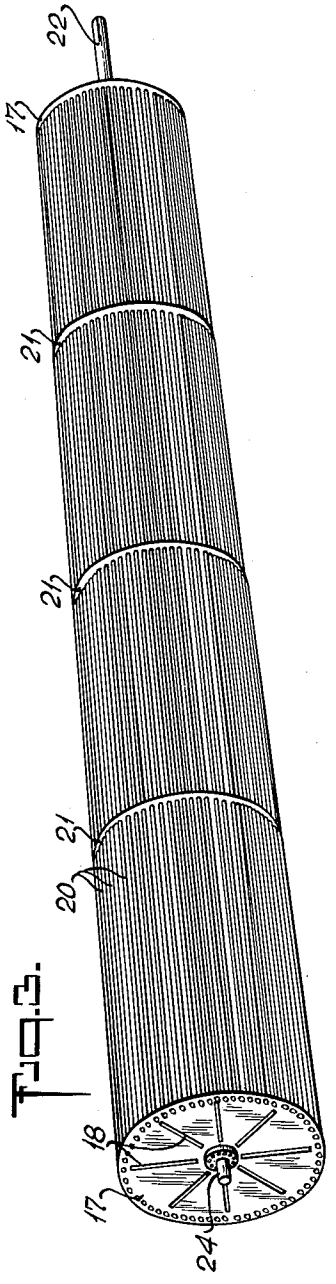

FIG. 3.

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DEFLOCCING ROLL FOR PAPER MACHINE HEADBOXES

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Application August 15, 1950, Serial No. 179,586

3 Claims. (Cl. 92—44)

This invention relates to new and useful improvements in paper machine headboxes and particularly seeks to provide novel apparatus especially useful to break up any floc formations which may occur in a flowing pulp suspension.

This invention comprises a deflocing roll usable with any type of headbox having a substantial channel portion ahead of the slice, but is particularly designed to break up such floc formations as may develop in a stock suspension moving under "frozen flow" conditions. An example of a headbox capable of establishing "frozen flow" conditions in the stock suspension may be found in copending application Ser. No. 157,869, filed April 25, 1950, by Weston T. Bennett, and the deflocing roll of the present invention has been expressly designed to operate in conjunction with a headbox of the type disclosed therein.

An object of this invention, therefore, is to provide a cage type of deflocing roll for paper machine headboxes.

Another object of this invention is to provide a device of the character stated positioned within a channel portion of a headbox and rotatable about a transverse axis with respect to the direction of flow of stock suspension.

Another object of this invention is to provide a device of the character stated which comprises a pair of header discs, a plurality of spacing discs between the header discs, a plurality of circumferentially spaced rods adjacent the periphery of the discs to form a cylindrical cage type deflocing roll and stub shafts extending outwardly from each header disc for rotatably mounting the deflocing roll.

A further object of this invention is to provide a device of the character stated in which the diameter of the cylinder cage is at least twice the depth of the flowing stock suspension in which the deflocing roll is partially immersed.

A further object of this invention is to provide a device of the character stated in which the spacing of the cage-forming rods is such that the sum of the diameters of all of the rods is equivalent to from 16% to 27% of the circumference of the circle passing through the center lines of the rods.

A further object of this invention is to provide means for rotating the deflocing roll preferably in the direction of the flow of the stock suspension.

With these and other objects in view, the nature of which will be more apparent, the invention will be more fully understood by reference to the drawings, the accompanying detailed description, and the appended claims.

In the drawings,

Fig. 1 is a somewhat diagrammatic side elevation of a paper machine headbox and shows a deflocing roll constructed in accordance with this invention installed therein;

Fig. 2 is a transverse section taken along line 2—2 of Fig. 1;

Fig. 3 is a perspective view of the deflocing roll;

Fig. 4 is an end elevation thereof;

Fig. 5 is an enlarged detail longitudinal section adjacent the periphery of one end of an installed deflocing roll; and

Fig. 6 is an enlarged detail longitudinal section at the same end of the deflocing roll but showing the central portion thereof.

It is characteristic of papermaking fibers in water suspension to floc into more or less independent aggregates. The degree of such flocculation is dependent in particular upon the physical nature of the fibers, their concentration (stock consistency) and the fluid flow conditions of the suspension. When the type and concentration of stock being handled range over relatively narrow limits as in the case of newsprint headbox stock it is the fluid flow conditions which are paramount in either inducing or minimizing floc formation. Thus if a body of flowing newsprint headbox stock is made sufficiently turbulent by agitation, pumping, high velocity flow, etc., a random pattern of velocity gradients between parallel planes of the suspension are created which are of such magnitude and number that the degree of flocculation of the fibers is only slight (small floc size) or does not occur at all. Under such conditions flocculation and floc growth are prevented or minimized because the characteristic floc structure has not sufficient strength to withstand the overwhelming forces on the fibers resulting from the shear zones established between the velocity gradients. If the turbulence in this body of stock is caused to gradually diminish, velocity gradients are approached which promote flocculation by bringing about contact between fibers and fiber flocs resulting in a condition where the strength of the floc structure is more nearly in balance with the forces tending to pull it apart and hence both floc growth and deterioration may occur concurrently. With further reduction in turbulence conditions of flow will be approached at which the rate of growth and size of the floc is at or near a maximum. Finally, if the body of stock of greatly reduced turbulence is pictured as flowing in a wide channel at a velocity below the critical for turbulent flow and all turbulence has been eliminated from it the type of flow thereupon established is termed "frozen flow" which is characterized by a thin shear zone adjacent to any surface of the channel contacted by the stock in which the fibers tend to roll or shear past one another while all the rest of the cross-section of the flowing stock suspension appears to be frozen into a solid moving parallel to the axis of the channel and with uniform velocity throughout its cross-section. Once the "frozen flow" condition has been established there is no movement of the flocs in relation one to the other, and thus the floc pattern is fixed.

In a headbox so designed that stock is conducted to the slice in a "frozen flow" state the smaller the floc size in the stock approaching the slice the smaller will be the floc size in the finished paper sheet. In the interest of obtaining a sheet of uniform fiber distribution, commonly described as "close-up" or "well-filled," it is desirable to minimize the floc size going to the slice. A deflocing roll constructed in accordance with this invention meets this need, and its design and operation are particularly applicable to a headbox capable of establishing "frozen flow" conditions in the stock ahead of the slice.

It has been observed when a small obstacle is held in a channel in which flocced newsprint headbox stock is flowing in a "frozen flow" condition that in the downstream direction from the obstacle will be a long path of well-deflocced stock. The degree of the deflocing and the period for which it persists is dependent on the nature of the turbulence which the obstacle induces. This indicates that if flocced stock in a frozen state of flow can be mechanically deflocced in a suitable manner the de-

flocced state will persist by virtue of its frozen or near frozen flow condition long enough to pass through a slice. The deflocculating roll constructed in accordance with the present invention provides the mechanical means by which such deflocculating action may be effected.

The action of the deflocculating roll constructed in accordance with this invention is to introduce many shear zones (turbulence) of uniform pattern and strength across the full width and depth of the "frozen flow" body of stock moving in the channel. The uniformity of the pattern of this turbulence and its strength are such that the body of stock again assumes a "frozen flow" condition a short distance downstream from the deflocculating roll and the floc size is uniform and has been greatly reduced or eliminated.

Referring to the drawings in detail, it will be seen that the invention as illustrated is embodied in a paper machine head box comprising an intake portion A, a relatively long horizontal channel portion B and an adjustable slice C. A deflocculating roll D constructed in accordance with this invention is installed in a horizontal channel B in either of the two positions indicated in Fig. 1 in the drawings.

The horizontal channel portion B is a closed conduit and includes a bottom **5**, side walls **6**, **6** and a top (not shown) and receives a constant flow of an aqueous pulp suspension from the intake portion A under such conditions that "frozen flow" becomes established as the pulp suspension flows along the channel portion B.

One side wall **6** is provided with a circular aperture **7** closed by a cover casting **8** and secured to the side wall as by a plurality of bolts **9**. The center of the cover casting **8** is provided with a hub **10** bored to receive a bushing **11** and an adjustable packing gland **12** for rotatably receiving a stub shaft of the deflocculating roll, as will be hereinafter more fully described.

The other side wall **6** is similarly provided with an aperture closed by a cover casting **13** secured to the side wall as by a plurality of bolts **14**. The center of the cover casting **13** is provided with a hub **15** recessed to carry a bushing **16** for rotatably receiving a stub shaft extending from the adjacent end of the deflocculating roll, as will be hereinafter more fully described.

The deflocculating roll D per se includes a pair of header or end discs **17**, **17** provided on their outer faces with a plurality of radially disposed scraper bars **18** which may also serve to minimize flexing of the discs. A plurality of holes **19** are drilled through each disc **17** adjacent the periphery thereof to receive the ends of a corresponding number of relatively small diameter rods or tubes **20** disposed in parallelism to form together with the header discs **17** a cage-like roll. The central portions of the rods **20** are held in their cylindriform relationship as by a plurality of relatively thin spacer discs **21** having the same diameter as the end discs **17** and similarly drilled adjacent their peripheries. The diameters of the rods **20** will be subject to such variations as may be required due to the use of different types of stock as will the spacing between adjacent rods. However, for illustrative purposes if it were assumed that a deflocculating roll constructed in accordance with this invention is to be used in connection with newsprint headbox stock smooth rods of ¼ inch diameter represent the optimum. Smaller diameter rods tend to gather fibers and would be a potential cause of stock lump formations, while larger diameter rods produce a less uniform deflocculating action and have a narrower range of operating speeds within which to produce the desired type of deflocculating results. Similarly, for newsprint stocks, the spacing between adjacent rods has been found to be at an optimum when the sum of the rod diameters comprising the roll face is equivalent to 20% of the circumference of the circle normal to the longitudinal axis of the roll and passing through the center lines of the rods. While the above mentioned figure of 20% represents the optimum, reasonably satisfactory

results can be achieved with deflocculating rolls in which the sum of the rod diameters is equivalent to from 16% to 27% of the circumference of the pitch circle passing through the center lines of the rods.

The necessity for so regulating the rod spacing in order to achieve satisfactory deflocculating action automatically provides means for determining the exact number of rods to be used in constructing a deflocculating roll of any given diameter of pitch circle passing through the center lines of the rods. Thus for a roll of 24 inch pitch circle diameter using ¼ inch diameter rods, sixty rods would have to be used in order to meet the 20% optimum rod spacing determination. Alternately, for other types of stock or for different operating speeds it might be found desirable to employ rods of, say, ½ inch diameter in a deflocculating roll having a pitch circle of 24 inches, in which case only thirty rods would be required to meet the 20% spacing optimum. Similarly, if rods of ⅛ inch diameter were used on a 24 inch roll, one hundred twenty of them would be required to meet the same spacing optimum. It will be appreciated, of course, that deflocculating rolls of different pitch circle diameters will require corresponding variations in the number of rods used in the construction of each roll.

One end disc **17** carries a relatively long stub shaft **22** which is journalled in the bushing **11** of the cover casting **8** and extends beyond the packing gland **12** a distance sufficient to support a driving gear **23** rigidly affixed thereto. The other end disc **17** carries a relatively short stub shaft **24** journalled in the bushing **16** of the cover casting **13**.

The deflocculating roll D is adapted to be driven in a counterclockwise direction as viewed in Fig. 1 of the drawings through the medium of a reduction gear driving unit generally indicated at **25** and drive chain **26** extending between it and the gear **23**.

The most favorable speed range is from 5 to 15 R. P. M. with 8 to 10 R. P. M. representing the optimum for a roll having a diameter of about 24 inches when immersed in a stream of "frozen flow" headbox stock of about 8 inches depth. It will be appreciated that the above rotative speeds and roll diameter are also subject to considerable variations due to varying depths of the stream of stock and to types of stock being used.

The axis of rotation of the deflocculating roll should always be positioned at such a height that the lower edge of the installed roll shall come as close as possible to the bottom **5** of the headbox horizontal channel portion, and the clearance therebetween preferably should not exceed ½ inch. It will be appreciated that the length of the deflocculating roll is substantially equal to the width of the associated headbox channel portion which is in turn substantially equal to the width of the paper machine wire. In those cases where deflocculating rolls are to be employed with wide headboxes there may be some tendency for the central portion of the deflocculating roll to sag downwardly toward contact with the bottom of the headbox. In such cases it has been found to be entirely practical to employ a pair of very short trunnions (not shown) under each of the spacing discs **21** whereby to support the central portion of this cage-type deflocculating roll.

I claim:

1. In combination with a paper machine headbox wherein is provided an intake portion, a relatively long horizontal portion for establishing "frozen flow" conditions in the stock and a slice at the discharge end thereof; a deflocculating roll rotatably mounted within the horizontal portion of said headbox and including a pair of end discs having plurality of rods extending therebetween and arranged in cylindriform relationship concentric with the axis of rotation of said roll, means to support the central portions of said rods against flexing, and means for rotating said roll, the spacing between center lines of said rods being established by having the sum of the diameters of said rods equivalent to from 16% to

27% of the circumference of the circle passing through the center lines of said rods in a plane normal to the longitudinal axis of said defloccing roll.

2. Defloccing mechanism for paper machine headboxes comprising a headbox channel portion including bottom and side walls for conducting a flowing stream of headbox stock, a cage-type defloccing roll rotatably carried by the side walls of said channel portion and including a plurality of closely spaced rods arranged in cylindriform relationship, the said roll being so positioned within said channel that at least the lower portion thereof is immersed in the flowing stream of stock, means to support the central portions of said rods against flexing, and means for rotating said roll, the spacing between center lines of said rods being established by having the sum of the diameters of said rods equivalent to from 16% to 27% of the circumference of the circle passing through the center lines of said rods in a plane normal to the longitudinal axis of said defloccing roll.

3. A defloccing roll for paper machine headboxes comprising a pair of end discs, a plurality of rods extending between said end discs and arranged in cylindriform relationship, a plurality of spacer discs located intermediate said end discs for supporting the central portions of said rods against flexing, and an outwardly extending stub shaft carried by each said end disc, the spacing between center lines of said rods being established by having the sum of the diameters of said rods equivalent to from 16% to 27% of the circumference of the circle passing through the center lines of said rods in a plane normal to the longitudinal axis of said defloccing roll.

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