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2,796,807

METHOD AND APPARATUS FOR TREATING WASTE PAPER STOCK

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FIG. 1

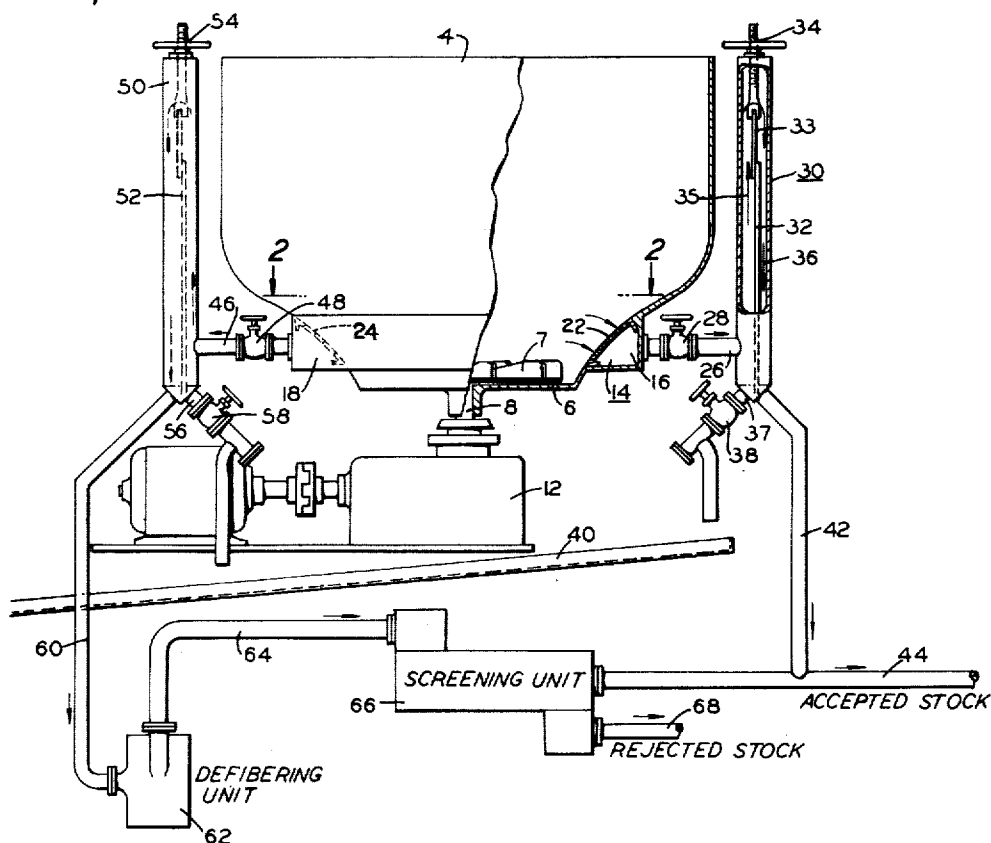
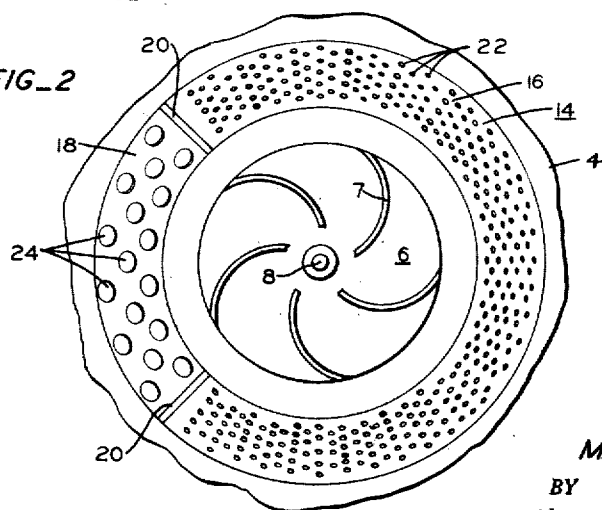


FIG. 2



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1

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METHOD AND APPARATUS FOR TREATING WASTE PAPER STOCK

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7 Claims. (Cl. 92—23)

This invention relates to a method and apparatus for treating fibrous material, and more particularly to a method and apparatus for pulping, refining and otherwise preparing stock used in the manufacture of paper.

In forming pulp from waste paper stock, it has been the practice to introduce the paper stock into a tank provided with a rotatable pulping member in the lower portion thereof. The rotation of the pulping member creates a strong whirlpool in a body of water maintained in the tank by continuous feed. The stock which is fed into this whirlpool is drawn to the bottom of the tank by suction, while being agitated by the whirlpool. Thus, the stock is disintegrated to a pulp. An annular screen having relatively small orifices has been provided at the bottom of the tank, through which the pulp continually flows. A type of apparatus of this character, commonly known as a "Hydrapulper," is disclosed in United States Patents 2,351,492 and 2,371,837, and others.

With respect to such type of apparatus, it has been found that some of the paper stock does not disintegrate to a sufficiently small size to allow all of the pulp to flow through the relatively small orifices. Masses of non-pulped paper accumulate against these orifices, frequently causing these orifices to become clogged, thus requiring a shutting-down of the apparatus for necessary cleaning. In order to prevent such clogging, various means have been provided in the past to keep the small orifices clear.

For example, the annular screen has been carefully positioned at a selected angle of inclination so that a substantial component of the inertia of the outwardly propelled material might be sufficiently effective to force material through the small openings. Further, the rotating pulping member has been carefully positioned in relation to the tank and the screen to impart to the outwardly propelled material sufficient pressure that it might be effectively forced through the small openings. These measures, although satisfactory in other ways, have not been satisfactory to prevent the frequent clogging of the apparatus.

The present invention provides an arrangement which eliminates this clogging of the relatively small openings, which increases the overall capacity of the pulping apparatus by approximately 15%, and which reduces the required clean-up time of the tank by approximately 75%. Further, the present invention reduces costly shut-down time resulting from the frequent clogging, and provides a method whereby the relatively large size pieces of unpulped paper, formerly discarded as waste, can be effectively recovered and efficiently utilized.

More particularly, the present invention provides an apparatus for forming pulp from paper stock of the type disclosed in the aforementioned patents, wherein means is provided for creating a whirlpool in a large tank of water into which the stock is introduced. The tank has the usual section of small openings through which the disintegrated pulp can flow; and in accordance with this invention, it is also provided with another section of rela-

2

tively large openings through which relatively large particles of non-pulped paper can flow to thus minimize clogging of the small openings. Further, the present invention provides a method of treating paper stock to form pulp comprising introducing the stock into a first pulping zone to reduce at least a portion of the stock to pulp, separating the unpulped stock from unpulped containing stock, and reducing this unpulped stock in a second pulping zone.

It will be obvious to one skilled in the art that various changes can be made in the arrangement, form, construction and type of the various elements of the apparatus disclosed hereinafter, as well as changes in the several steps of the method disclosed hereinafter, without departing from the scope or spirit of this invention.

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

Fig. 1 is a more or less schematic side elevation, partly in section, showing an apparatus embodying the present invention; and

Fig. 2 is an enlarged plan view of the pulping tank taken on the line 2—2 of Fig. 1.

Referring to the drawings, the pulper is generally of the type shown in United States Patent 2,371,837 in which 4 designates a tank wherein waste paper stock is pulped in the manufacture of paper; the tank having a frusto-conically surfaced bottom. The tank is open at its upper end to receive the waste paper stock, and to receive the water which is fed to the tank continuously. Positioned in the lower portion of tank 4 is the rotatable pulping member 6 in the form of an impeller having vanes 7 and which is fixed to a shaft 8 extending through a suitably sealed opening in the lower wall portion of the tank. The shaft is connected to a driving unit 12 which can be one of a number of known driving arrangements. Fixed pulping blades (not shown) can be positioned along the lower wall of the tank if so desired, as is disclosed in United States Patent 2,351,492.

The rotation of the pulping member creates a strong whirlpool in the body of water maintained in the tank by continuous feed, the water circulating outwardly and then upwardly along the side walls of the tank with a return down-flow centrally towards the pulping member 6. Thus, the waste paper stock, usually in the form of large bales, introduced into the tank is drawn downwardly by the created whirlpool toward the member 6 and is then swept outwardly and upwardly along the side walls of the tank before returning again to the pulping member 6. In this manner, a major portion of the waste stock is reduced to pulp.

Surrounding the lower portion of tank 4 is an annular compartment 14, the inner wall of which is of frusto-conical form so that it extends outwardly and upwardly at an angle to a horizontal plane and to the direction in which the material undergoing treatment is thrown outwardly by the pulping member 6. As can be seen in Fig. 2, the compartment is divided into two separate chambers 16 and 18, respectively, by the dividing plates 20 chambers 16 and 18 lying in substantially the same horizontal plane. Chamber 16 communicates with tank 4 through a section of relatively small openings 22 in the wall of tank 4 which allow passage of pulped or substantially entirely disintegrated paper; and chamber 18 communicates with the tank through a section of relatively large openings 24 in the wall of the tank.

Flow of pulp from the tank through openings 22 and into chamber 16 results from the combined effect of the difference in pressure head due to the height of the material in the tank and the pressure prevailing in the chamber 16 at the lower side of openings 22, in addition

to the effect of the inertia imparted to the outwardly moving material by the rotating pulping member 6. The section of small openings 22 need not permit relatively large particles of paper to pass therethrough; and these particles of non-pulped paper in turn pass through the section of relatively large openings 24 into chamber 18; their removal from tank 4 avoiding a foredescribed clogging of the tank that has heretofore been such a problem in the art. Flow of these large particles of paper from the tank also results from the same effects noted with respect to flow of pulp through the small openings.

Chamber 16 into which the pulp passes is provided with a discharge conduit 26 having a control valve 28 positioned therein. In normal operation, the valve 28 is opened and the pulp passes through conduit 26 to a vertical conduit 30 communicating at its lower portion with the conduit 26. The rate of discharge of the pulp is controlled by a flow control device positioned in conduit 30. This device comprises a conventional regulating dam 32, having a vertically adjustable upper plate 33, regulatable by a screw-down mechanism 34, as is known. The dam divides conduit 30 into an upflow side 35 and a downflow side 36.

Communicating with the bottom of conduit 30 on the upflow side 35 of dam 32 is an off-take clean-out conduit 37 having a control valve 38 positioned therein. When desired for cleaning-out purposes, this valve can be opened, and waste materials passed off to a gravity flow flume 40 positioned therebelow. During normal continuous operation, valve 38 is maintained closed, and pulp flows over dam 32, through a conduit 42 connected with downflow side 36 of vertical conduit 30, and into an outlet conduit 44 for delivery to the paper machine after treatment of the pulp in the usual manner.

Chamber 18 into which the large pieces of unpulped paper pass is provided with a discharge conduit 46 having a control valve 48 positioned therein. In normal operation, the valve 48 is opened, and the large pieces of unpulped, together with some pulped paper, pass through conduit 46 to a vertical conduit 50, which is similar to vertical conduit 30, and which communicates at its lower portion with the conduit 46. The conduit 50 is provided with an adjustable regulating dam 52 and a screw-down mechanism 54, similar to the dam 32 and screw-down 34.

In normal operation, the dam 52 is adjusted in accordance with the selected adjustment for the dam 32 in order to maintain a selected flow condition throughout the system. Communicating with the lower extremity of vertical conduit 50 on the upflow side of dam 52 is an off-take clean-out conduit 56 having a control valve 58 positioned therein. Like valve 38, when desired, this valve 58 can be opened, and waste materials passed off to the flume 40 passing therebelow.

During normal continuous operation, valve 58 is maintained closed, and the paper flows over dam 52 through a conduit 60 connected with the downflow side of vertical conduit 50 and into a conventional defibering unit 62. In this unit, which can be one of any number of known types of defibering units, and preferably a mechanical type, the large pieces of paper are disintegrated to a pulp is then passed through conduit 64 to a screening unit 66 (schematically shown) and the rejected stock is passed off through the conduit 68. The screened pulp comprising the accepted stock is then passed to conduit 44, joining the pulp from chamber 16. Thus, the large pieces of paper which formerly had to be frequently shoveled out of the tank and discarded are, by means of the present invention, efficiently and economically reduced to pulp and utilized, with minimum shut down of the apparatus for occasional cleaning purposes.

In commercial practice, the relatively small openings 22 cover the major portion of the periphery of the tank to function normally in allowing the paper pulp to flow out of the bottom of the tank, and are of the usual small

size of $\frac{1}{4}$ to 1 inch in diameter. The major portion of the stock passes through these small openings. The large openings 24 need only be utilized over a minor portion of the periphery of the tank, and they need only be large enough to permit the pieces of relatively tough paper that are not disintegrated to pass therethrough but which are sufficiently small to prevent passage of extremely large masses of paper that are under course of disintegration. For this purpose, the large openings may be anywhere from 2 inches to $3\frac{3}{4}$ inches in diameter. By providing the large openings over a limited periphery of the tank, the non-disintegrated pieces of paper do not eventually clog the small openings as they work about the tank and flow out through the large openings. The total area of all the small openings to the total area of all the large openings may vary widely, a suitable ratio being approximately 3.5 to 1, to 7 to 1. Although circular openings are employed, they may be of any other shape.

The following is an example of a commercial embodiment of the apparatus disclosed. The average capacity of the tank is approximately 17,000 gallons at operation level, the tank having a maximum diameter of about 20 feet. The diameter of the tank at the portion where the openings are located at about $10\frac{1}{2}$ feet at the top of annular compartment 14, and about $7\frac{1}{3}$ feet at the bottom of such compartment.

The apertured portion of annular compartment has an angle of inclination of about 40 degrees, and is so divided that chamber 16 with the small openings comprises approximately 300° of arc of the compartment, and chamber 18 with the large openings the remaining 60° of arc of the compartment. The small openings 22 are in rows, and measure approximately $\frac{3}{8}$ inch in diameter. They are substantially equally spaced apart on $\frac{3}{8}$ inch centers. The large openings 24 are also in rows, and measure approximately $2\frac{1}{2}$ inches in diameter, with a substantially equal spacing of approximately $3\frac{1}{4}$ inches on centers. The total area of the large openings is approximately 452 square inches, and that of the small openings is approximately 2,225 square inches. Thus, the ratio of the total small opening area to the total large opening area is approximately 4.9 to 1. Pulping member 6 is rotated at approximately 180 R. P. M., and creates an approximate peripheral velocity of the whirlpool of 4.8 feet per second at the wall of the tank, and 7.0 feet per second at the vortex edge of the whirlpool.

I claim:

1. In apparatus for forming pulp from paper stock, a tank adapted to contain water, an impeller adjacent the bottom of the tank rotatable about an upright axis, the tank having free head space above said impeller whereby upon rotation of said impeller a whirlpool is created in the water into which said stock is adapted to be introduced, said tank having adjacent the bottom thereof a generally upwardly extending screening section of small openings disposed radially outwardly with respect to said impeller through which pulp can flow, and also another screening section of relatively large openings disposed radially outwardly with respect to said impeller and in substantially the same horizontal plane as said first mentioned screening section through which relatively large particles of paper can flow, a first chamber about a part of the periphery of said tank and communicating with said tank through said section of small openings, an outlet conduit communicating with said first chamber to accommodate pulp passing from said tank through said first chamber, a second chamber about another part of the periphery of said tank and communicating with said tank through said section of relatively large openings, said chambers being separate from each other whereby material flowing into the respective chambers is maintained separated in said chambers, and paper disintegrating means connected to said second chamber for reducing the relatively large particles of paper to pulp.

2. In apparatus for forming pulp from paper stock, a tank adapted to contain water, an impeller adjacent the

5

bottom of the tank rotatable about an upright axis, the tank having free head space above said impeller whereby upon rotation of said impeller a whirlpool is created in the water into which said stock is adapted to be introduced, said tank having adjacent the bottom thereof a generally upwardly extending screening section of small openings along a first portion of the periphery of said tank disposed radially outwardly with respect to said impeller through which pulp can flow, and also another screening section of relatively large openings along a second portion of the periphery of said tank disposed radially outwardly with respect to said impeller and in substantially the same plane as said first section through which relatively large particles of paper can flow, an annular compartment surrounding said tank about said screening sections, said compartment being divided by imperforate dividing members into separate first and second chambers whereby material flowing into the respective chambers is maintained separated in said chambers, said first chamber being about said first portion of the periphery of said tank and communicating with said tank through said section of small openings, and said second chamber being about said second portion of the periphery of said tank and communicating with said tank through said section of relatively large openings, an outlet conduit communicating with said first chamber to accommodate pulp passing from said tank through said first chamber, paper disintegrating means connected to said second chamber for reducing the relatively large particles of paper to pulp, and means for combining the latter pulp with the pulp passing from said first chamber.

3. The apparatus of claim 2 in which said annular compartment is so divided that said first chamber covers the major portion of the periphery of the tank, and said second chamber covers the remainder of said tank periphery.

4. The apparatus of claim 3, in which the total area of the relatively small openings is greater than that of the relatively large openings.

5. In apparatus for forming pulp from paper stock, a tank circular in cross section adapted to contain water, an impeller adjacent the bottom of the tank rotatable about an upright axis, the tank having free head space above said impeller whereby upon rotation of said impeller a whirlpool is created in said water into which said stock is adapted to be introduced, a first peripheral portion of said tank disposed radially outwardly with respect to and adjacent said impeller being provided with a generally upwardly extending screening section of relatively small openings through which pulp can flow and a second peripheral portion of said tank also disposed radially outwardly with respect to and adjacent said impeller being provided with another generally upwardly extending screening section of relatively large openings in substantially the same horizontal plane as said first section through which relatively large particles of paper can flow, a first chamber having an arcuate contour about said first peripheral portion of said tank communicating with said section of relatively small openings, and a second chamber having an arcuate contour about said second peripheral portion of said tank and communicating with said section of relatively large openings, said chambers being separate from each other whereby material flowing into the respective chambers is maintained separated in said chambers.

6. In apparatus for forming pulp from paper stock,

6

a tank circular in cross section adapted to contain water, an impeller adjacent the bottom of the tank rotatable about an upright axis, the tank having free head space above said impeller whereby upon rotation of said impeller a whirlpool is created in said water into which said stock is adapted to be introduced, a first peripheral portion of said tank disposed radially outwardly with respect to and adjacent said impeller being provided with a generally upwardly extending screening section of relatively small openings through which pulp can flow and a second peripheral portion of said tank also disposed radially outwardly with respect to and adjacent said impeller being provided with another generally upwardly extending screening section of relatively large openings in substantially the same horizontal plane as said first section through which relatively large particles of paper can flow, said section of relatively small openings covering a major portion of the periphery of said tank and said section of relatively large openings covering a minor portion of said periphery, an annular compartment about said periphery, and means dividing said compartment into separate chambers communicating with the respective sections of openings whereby material flowing into the separate chambers is maintained separated in said chambers.

7. In apparatus for forming pulp from paper stock, a tank circular in cross section adapted to contain water, an impeller adjacent the bottom of the tank rotatable about an upright axis, the tank having free head space above said impeller whereby upon rotation of said impeller a whirlpool is created in said water into which said stock is adapted to be introduced, a first peripheral portion of said tank disposed radially outwardly with respect to and adjacent said impeller being provided with a generally upwardly extending screening section of relatively small openings through which pulp can flow and a second peripheral portion of said tank also disposed radially outwardly with respect to and adjacent said impeller being provided with another generally upwardly extending screening section of relatively large openings in substantially the same horizontal plane as said first section through which relatively large particles of paper can flow, said section of relatively small openings covering a major portion of the periphery of said tank and said section of relatively large openings covering a minor portion of said periphery, an annular compartment about said periphery, means dividing said compartment into separate chambers communicating with the respective sections of openings whereby material flowing into the separate chambers is maintained separated in said chambers, paper disintegrating means connected with the chamber communicating with said relatively large openings for reducing said relatively large particles of paper to pulp, and means for combining said latter pulp with the pulp that flowed into the chamber communicating with said relatively small openings.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,796,807

June 25, 1957

Marcus E. Sanford

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 62, for "pulp is" read — pulp. The pulp is —.

Signed and sealed this 6th day of August 1957.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents