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FIBER WASHING METHOD AND APPARATUS

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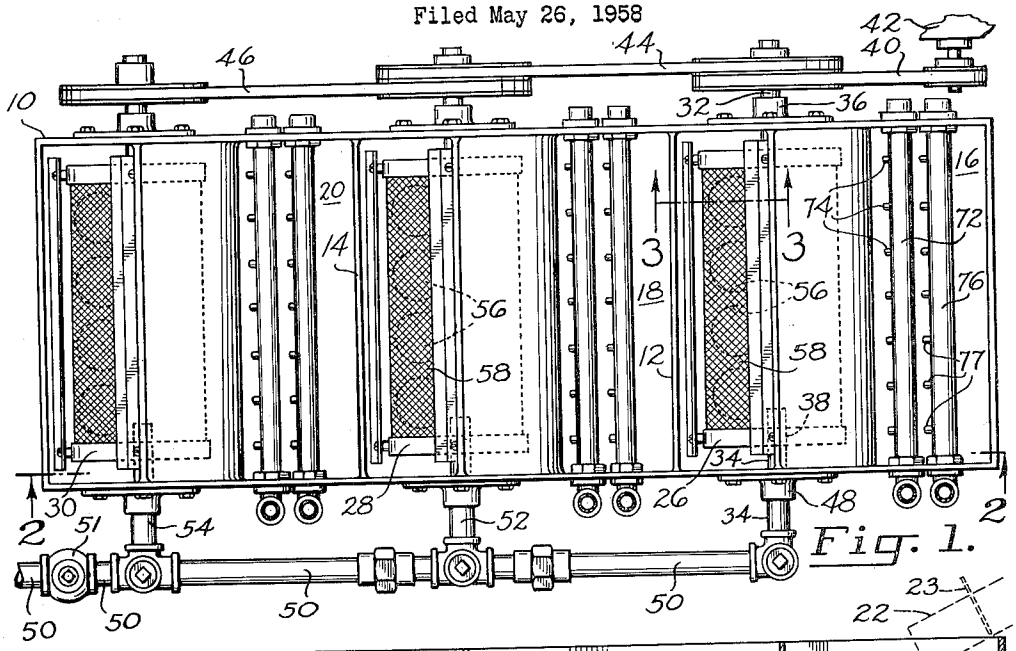


Fig. 1.

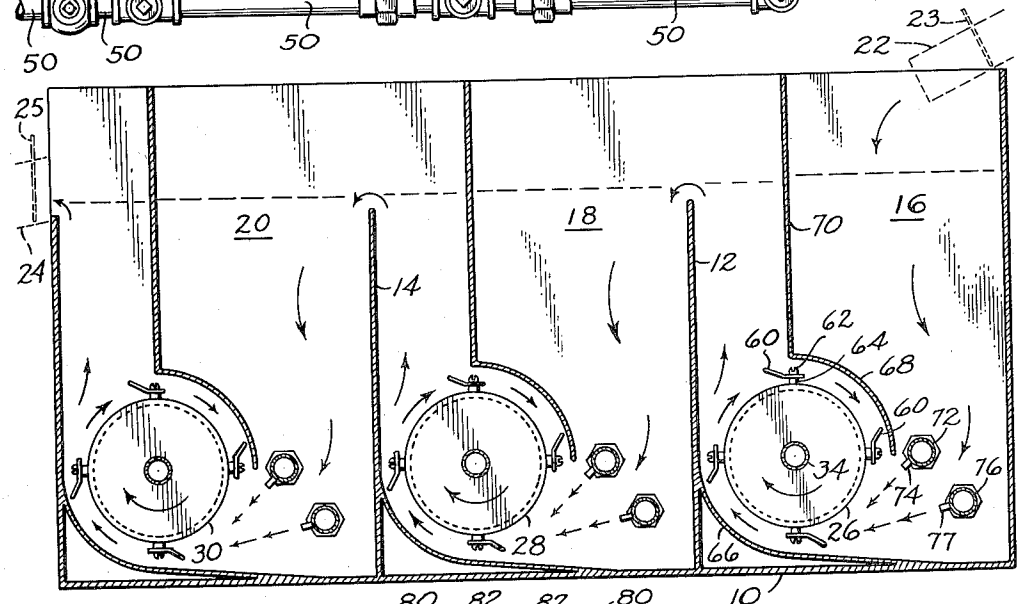


Fig. 2.

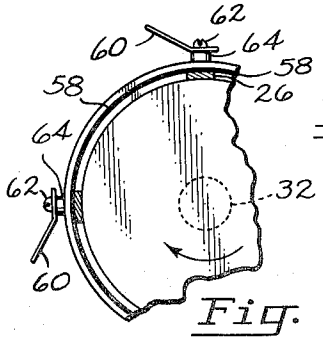


Fig. 3.

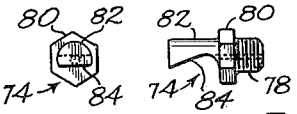


Fig. 4. Fig. 5.

Clarence L. Copeland
INVENTOR.

BY Eugene D. Farley
Atty.

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FIBER WASHING METHOD AND APPARATUS

Clarence L. Copeland, 505 N. H St., Aberdeen, Wash.

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This invention relates to method and apparatus for washing fibrous materials.

The recovery of cellulosic fiber from waste newspapers, magazines, and like sources presents a difficult problem because of the difficulty inherent in washing out and separating the small particles of printers ink, paper-making filler and like materials which they contain. It is toward the solution of this problem that the present invention is directed.

The manner in which the foregoing and other objects of this invention are accomplished will be apparent from the accompanying specification and claims, considered together with the drawings wherein like numerals of reference indicate like parts, and wherein:

FIG. 1 is a plan view of apparatus employed in the presently described fiber washing method;

FIG. 2 is a sectional view of the apparatus of FIG. 1, taken along line 2—2 of that figure;

FIG. 3 is a fragmentary, detail view in section taken along line 3—3 of FIG. 1; and

FIGS. 4 and 5 are detail views in front and side elevation, respectively, of a jet nozzle employed in the apparatus of the aforementioned figures.

Generally stated, the fiber washing method of my invention comprises first suspending a mixture of fibrous material and foreign particles such as ink or papermaker's filler in an aqueous medium. The resulting suspension is introduced into a chamber, preferably the first of a plurality of chambers connected in series, where it is vigorously agitated.

After the particles have been dislodged from the fibers, to which they cling tenaciously, they are separated from the suspension by filtering them through filter means the pores of which are dimensioned to pass the particles but not the fibers. The processed suspension then is transferred to the next chamber of the series and thus passed from chamber to chamber until the separation is complete and a fiber product is obtained which is suitable for reuse in papermaking processes.

Considering the foregoing in greater detail and with particular reference to the drawings:

In the illustrated embodiment, the herein described apparatus includes a tank **10** divided by transverse partitions **12**, **14** into a number of chambers **16**, **18**, **20**, all connected in series. An aqueous slurry or suspension of the fibrous material to be cleaned and washed is introduced into the first of these chambers by suitable means, as through conduit **22** provided with valve **23**. It then passes through the chambers in sequence, flowing over the tops of partitions **12**, **14** which are at a substantially lower level than the top of the tank, and is discharged through an overflow conduit **24**, the flow through which is controlled by valve **25**.

Although the fiber suspension introduced into the apparatus may be derived from a variety of sources and treatments, it preferably comprises a suspension prepared by reducing newspapers, magazines, or other waste paper; suspending the reduced product in an aqueous medium to form a suspension; and treating the suspension with a suitable chemical agent such as a detergent or alkaline material for breaking the bond between the foreign particles and the fibers.

Chambers **16**, **18**, **20** contain rotor assemblies **26**, **28**, **30** respectively, the construction of which may be substantially identical. Thus rotor **26** comprises a hollow cylinder mounted on stub shafts **32**, **34**.

Shaft **32** is fixed to rotor **26** and is journalled in bearing **36**. It is driven at the selected operating speed through belt **40** from motor **42**. Rotor units **28**, **30** are driven from the same power source through belts **44**, **46**.

Shaft **34** is stationary so that rotor **26** turns freely about it. It is mounted in flange **48** and is hollow forming a conduit communicating with another conduit **50**. Where, as illustrated, there are a number of washing chambers in series with each other, similar conduits **52**, **54** are provided emanating from the rotor in each chamber and communicating with conduit **50** the flow through which is controlled by valve **51**.

The periphery of rotor **26** is formed with a plurality of spaced, radial ports **56** which are covered over with a copper screen **58** or other reticular member. The mesh size of the screen is such as to pass the fine particles of ink, filler or other foreign material present in the suspension, but to restrain the fibers.

Agitating means are mounted on the rotor for vigorously agitating the suspension contained in the chamber. Such means may comprise a plurality of angularly formed blades **60** mounted at spaced intervals longitudinally of the rotor by means of bolts **62**. Spacing elements **64** preferably are included in the assembly to separate the blades from the periphery of the rotor. As a consequence, a flow of liquid is induced between the blades and the rotor surface which continuously washes the latter free of fiber particles which otherwise might accumulate thereon and plug screen **58**.

Cooperating with blades **60** on rotor **26** are lower and upper arcuate plates **66**, **68**. These are concentric with the rotor and form, in effect, segments of a pump housing in which blades **60** act as impellers, creating a fluid flow in a clockwise direction as indicated by the arrows of FIG. 2.

Plate **66** may be welded between partition **12** and the bottom of tank **10**. Plate **68** is preferably formed as a segment of a vertical plate **70** which serves also as a baffle to divide the flow of fluid. Thus while the major proportion of the fluid suspension travels in a circular path with the rotor, a minor but substantial proportion of it is directed upwardly by the baffle so that it passes over the top of partition **12** into the next washing chamber.

The turbulence in the suspension produced by the action of blades **60** is materially augmented by fluid jet assemblies directed toward the region below the rotor. There preferably are two such jet assemblies: an upper assembly fed, for example, with a mixture of air and water through a conduit **72** in which are mounted a plurality of jet nozzles **74**, and a lower assembly including a conduit **76** provided with spaced nozzles **77**, which may be identical in construction with nozzles **74**. Both of these assemblies direct fluid at high velocity to the region below the rotor, causing a condition of great turbulence which effectively dislodges the small foreign particles from the fibers.

Although the jet nozzles may assume a diversity of configurations, a configuration such as that illustrated in FIGS. 4 and 5 is preferred. Thus each nozzle may comprise a threaded section **78**, a nut section **80** and a nozzle section **82**. The latter is so formed that the stream of fluid passing through the body of the nozzle strikes the flat, angled undersurface **84** of the nozzle head and is converted to a flat stream of considerable velocity.

Operation

The operation of the herein described fiber washing apparatus is as follows:

A waste paper slurry which may or may not first have been subjected to a chemical treatment for loosening the particles of ink and clay or other filler present in the paper is introduced into chamber **16** at a controlled rate

of flow. Cylindrical rotors 26, 28, 30 are driven at a uniform rate by motor 42. Thereupon a vigorous agitation of the suspension occurs, induced by the pumping action of angled blades 60 within housing segments 66, 68.

At the same time, the jet action of the fluid streams discharged from conduits 72, 76 through nozzles 74, 77 augments the turbulent condition. As a consequence the small particles of ink and size effectively are washed off the fibers. Also, the accumulation of a fibrous deposit on the surface of the rotor is prevented by the effect of the jet streams acting through the spacing present between blades 60 and the surface of the rotor.

Valve 51 is so adjusted that a gravitational flow of liquid occurs through screen 58, ports 56, the hollow interior of cylindrical rotor 26, conduit 34 and conduit 50. This flow carries with it the small particles of ink and size, leaving behind the fibers.

As rotor 26 revolves, the fluid flow induced thereby is divided by baffle 70 so that a major proportion, for example about ¾ of the suspension, is carried around beneath housing segment 68, and a minor but substantial proportion, for example, about ¼ of it, passes upwardly between baffle 70 and partition 12. It thereupon passes over the top of the partition and into chamber 18 where it is further treated by the action of rotor 28 which has an action similar to that of rotor 26.

The suspension processed in chamber 18 may be passed to chamber 20 and processed in a similar manner, there being as many chambers connected in series with each other as may be required for effective treatment of the fiber. The overflow from the final chamber passes out through discharge conduit 24. The adjustment of valve 25 in this conduit is correlated with that of valve 23 in feed conduit 22 and valve 51 in discharge conduit 50 so that the fluid in the treating tank is maintained at working level at all times.

Thus it will be apparent that by the present invention I have provided method and apparatus for washing fibrous material to free it from small particles of foreign matter such as ink and filler. The apparatus is operable at a high production rate and is not subject to plugging by the fibrous material, which has been a serious deficiency of washing units of the prior art. Also, it separates the foreign particles from the fibers with minimum loss of fiber fines. Still further, a fibrous product is obtained in high yield, substantially free of ink and filler and well suited for use as a raw material in various papermaking procedures.

It is to be understood that the form of my invention herein shown and described is to be taken as a preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. Fiber washing apparatus comprising a chamber, means for introducing into the chamber an aqueous suspension of fibers and foreign particles, a hollow rotor mounted for rotation within the chamber, suspension-agitating means mounted on the periphery of the rotor, a plurality of ports opening out on the periphery of the rotor and communicating with the hollow interior thereof, conduit means connected to the hollow interior of the rotor, filter means positioned across the ports dimensioned to pass the foreign particles to the conduit means while retaining the fibers, means adjacent the rotor providing a fluid jet directed substantially tangent to the rotor, and discharge means in the chamber for discharging the washed suspension therefrom.

2. The fiber washing apparatus of claim 1 wherein the suspension-agitating means and the fluid jet providing means comprise a plurality of blades placed longitudinally of the rotor a spaced distance from the periphery thereof.

3. Fiber washing apparatus comprising a chamber, means for introducing into the chamber an aqueous suspension of fibers and foreign particles, a hollow rotor mounted for rotation within the chamber, a plurality of longitudinal blades mounted a spaced distance from the periphery of the rotor and serving to agitate the suspension with the rotation thereof, jet means positioned for directing a fluid jet stream substantially tangent to the rotor thereby separating the foreign particles from the fibers and washing the fibers away from the rotor, a plurality of ports opening out on the periphery of the rotor and communicating with the hollow interior thereof, conduit means connected to the hollow interior of the rotor, filter means positioned across the ports and dimensioned to pass the foreign particles to the conduit means while retaining the fibers, and discharge means communicating with chamber for removing the washed fiber suspension therefrom.

4. Fiber washing apparatus comprising a chamber, means for introducing into the chamber an aqueous suspension of fibers and foreign particles, a hollow rotor mounted for rotation within the chamber, a plurality of spaced parallel blades mounted on the periphery of the rotor longitudinally thereof for agitating the suspension, arcuate plates spaced from the periphery of the rotor and concentric therewith, fluid jet means positioned for directing a fluid stream to the area between the plates substantially tangent to the rotor, thereby separating the foreign particles from the fibers and washing the fibers away from the rotor, a plurality of ports opening out on the periphery of the rotor and communicating with the hollow interior thereof, conduit means connected to the hollow interior of the rotor, filter means positioned across the ports dimensioned to pass the foreign particles to the conduit means and to retain the fibers, and discharge means for removing the washed suspension of fibers from the chamber.

5. Fiber washing apparatus comprising a tank; a plurality of chambers placed side by side within the tank and separated from each other by partitions having a height less than that of the tank; means for introducing an aqueous suspension of fibers and foreign particles into one end chamber of the tank; in each chamber a suspension-cleaning assembly including a rotatably mounted hollow cylinder, suspension-agitating means mounted on the periphery of the cylinder, means adjacent the cylinder providing a fluid jet directed substantially tangent to the cylinder, a plurality of ports opening out on the periphery of the cylinder and communicating with the hollow interior thereof, conduit means connected to the hollow interior of the cylinder, and filter means positioned across the ports dimensioned to pass the foreign particles to the conduit means and to retain the fibers; and discharge means for removing the washed suspension from the last succeeding chamber; the means for introducing the suspension into the tank being coordinated with the discharge means and the filter means so that a portion of the fibrous suspension passes over the partitions separating the chambers successively for further processing in each chamber and the remaining portion of the fibrous suspension is recycled through the preceding chamber.

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