

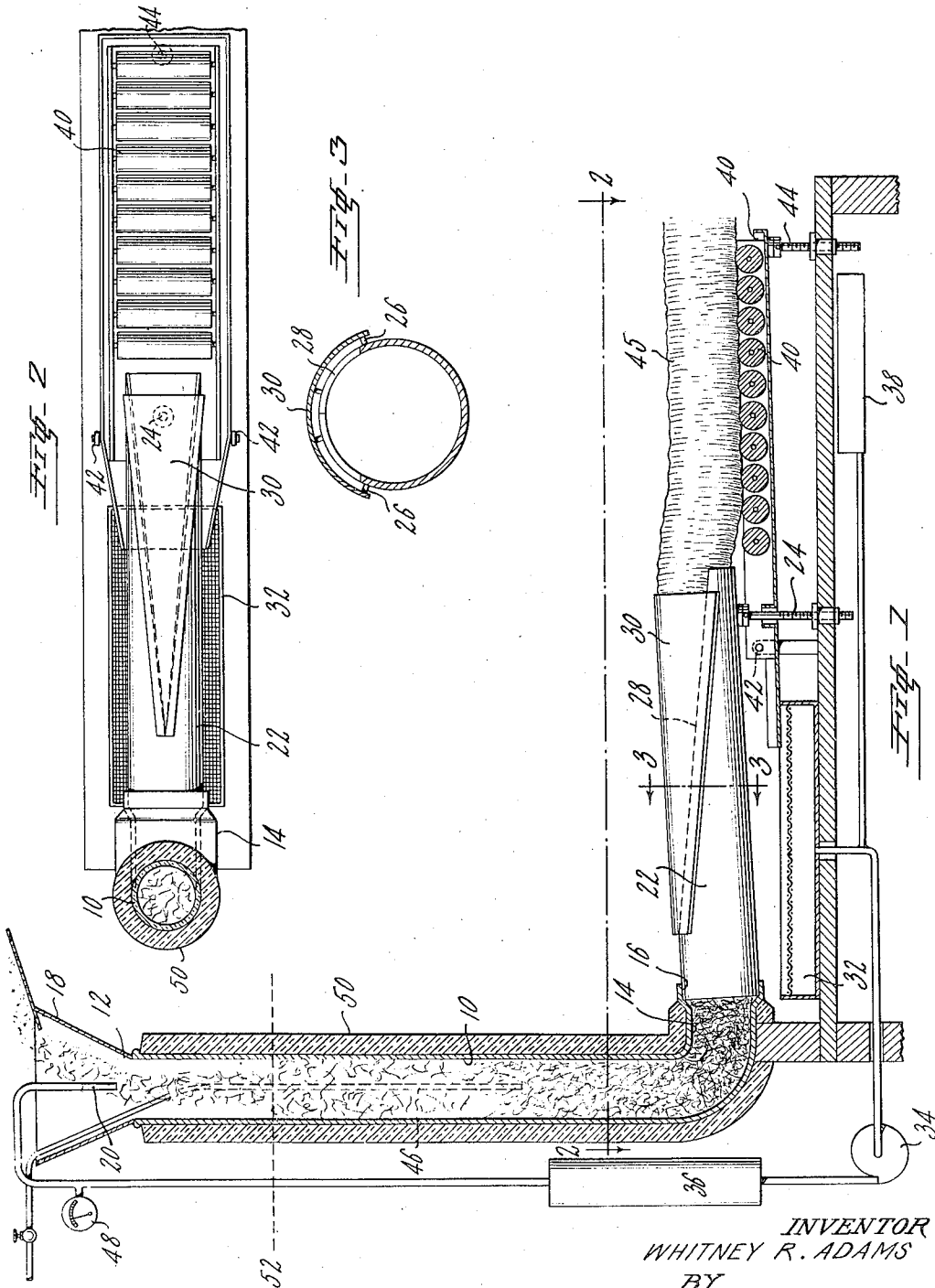
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FIBER TREATMENT

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FIBER TREATMENT

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This invention relates to the continuous treatment of fibrous material with liquid reagents.

In many industrial processes it is necessary to treat various kinds of fibers and fibrous materials with various liquid reagents to remove impurities or undesired substances, or to give desired properties to the fibers. For example, wool fibers may be scoured, washed, bleached, or dyed by exposing the fibers for various lengths of time to various liquids. In the preparation of cotton fibers or of woven gauze for surgical dressings and articles for personal hygiene, the cotton or gauze is separately boiled, bleached, scoured and washed by prolonged exposure to various liquids. Rag waste and other fibers and fibrous articles may require similar liquid treatment. This has customarily been done by a batch process.

For example, in the preparation of cotton fibers for surgical dressings and articles for personal hygiene, in order to make the cotton absorbent, the natural cotton fibers are boiled or scoured in a hot solution which may contain about 1.5% sodium hydroxide and about 0.5% soap. This treatment is ordinarily carried out in a kier or tank which is loaded with the loose fibers; the liquid reagent is circulated through the kier for the necessary period of time; which is unduly long; the kier is drained and thereafter the treated fibers are unloaded from the kier. In order to make the process economically feasible the kiers are usually large and may hold as much as 5,000 pounds of cotton. These large kiers have two important disadvantages; the time required to load and unload the cotton which ordinarily involves a large amount of hand work, and the time required to circulate the liquid in contact with all of the fibers to produce the desired treatment of the entire batch. Small masses of cotton fibers can be boiled or scoured in a very brief period of time if exposed loosely in a relatively large quantity of liquid reagent, but heretofore it has proved impractical to do this on a commercial scale.

This invention has for one of its objects the provision of an improved method and improved apparatus for continuously and rapidly treating fibrous articles including textile fabrics and loose fibers, by which is meant separate fibers not mechanically joined or united as by spinning, weaving, binding, felting or the like. Such loose fibers may be pressed together in various degrees of compactness. Specifically it is an object of the invention to provide a treating device through which the material can be continuously passed and in which all of the fibers

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rapidly come in contact with relatively large quantities of the reagent, so that the treating process is quickly accomplished.

The accompanying drawings show one form of apparatus embodying the invention.

In these drawings,

Fig. 1 is an elevation, partly in section, of a fiber or cloth treating apparatus;

Fig. 2 is a plan, partly in section, on the line 2—2 of Fig. 1; and

Fig. 3 is a vertical section of a discharge conduit being taken on the line 3—3 of Fig. 1.

The apparatus will be described, merely for example, as used in the scouring of loose fibers such as cotton, although it is to be understood that it is well adapted to other treatments of other fibrous materials, including fabric, especially in continuous lengths of fabric in the rope.

Referring to the drawings, a conduit 10 having a portion which extends through a vertical height and which is preferably, but not necessarily, vertically disposed, has an inlet 12 at its upper end and a horizontal portion 14 at its lower end terminating in an outlet 16. Preferably the cross-section of the outlet is slightly larger than the cross-section of the principal conduit 10, 14. Preferably the cross-section of the conduit is round, as shown in Fig. 2, as this facilitates manufacture. The inlet may be provided with funnel 18 or any other suitable means by which loose fibers may be fed continuously into the conduit. A pipe 20 continuously discharges liquid reagent into the main conduit.

A substantially horizontal discharge conduit 22 is connected to the discharge orifice or outlet 16 and forms a means for delivering the treated cotton to a conveyor as well as means for regulating the flow of cotton and liquid from the orifice 16. The inclination of the conduit 22 may be regulated and fixed by a suitable screw 24. The conduit 22 is arranged to convey cotton from the outlet 16 and to permit the free flow of liquid reagent from the treating conduit except as this flow may be restrained by the inherent resistance to flow provided by the fibers themselves. To this end the conduit is provided with a pair of openings 26 extending substantially entirely along its length. These openings can be readily effected by cutting a V-shaped notch 28 in the upper portion of the conduit 22 enclosing this notch with a spaced cover 30, the space between the cover and the conduit providing the openings 26 referred to. Liquid flowing from the openings 26 collects in a screened catch basin 32 from which it flows to a pump 34 which delivers the

reagent through a heat exchanger 36 to the pipe 20. A make-up tank 38 may be connected to the inlet of the pump to supply the quantity of liquid removed by the wet cotton discharged from the apparatus.

A roller conveyor 40 receives the mass of fibers discharged from the conduit 22 and conveys them away for further processing. One end of the conveyor is mounted on a pivot 42 and the height of the other end of the conveyor can be regulated by the screw 44 to effect the desired inclination of the conveyor. While the conveyor is substantially horizontal, it may be inclined as desired to offer resistance to the discharge of fibers from the conduit 22 and hence regulate the resistance to the discharge of fibers from the opening 16.

If desired a steam lance 46 may be used to preheat the cotton fibers when the apparatus is started. A thermometer 48 indicates the temperature of the reagent being fed to the treating conduit. The conduit may be surrounded by insulation 50 to conserve heat.

When the apparatus is started, cotton is fed into the inlet 12 and allowed to collect at the bottom of the conduit in and near the horizontal portion 14. The liquid reagent is then turned on in the pipe 20 and this packs the cotton in the lower part of the conduit to plug the outlet. This restricts the flow of liquid from the outlet so that the height of liquid builds up behind the plug, that is, in the part of the conduit on the opposite side of the plug from the opening, until the liquid reaches some point near the upper end of the conduit represented by the line 52. Above the plugged outlet the cotton is progressively looser, as indicated in the drawing. When the hydrostatic head of the liquid behind the packed cotton reaches the desired value, the liquid forces the compacted cotton fibers from the outlet 16 in the form of a tightly compressed plug or worm. This worm expands slightly as it leaves the outlet 16 filling the cross-section of the conduit 22. This permits the fibers to be pushed out of the outlet readily, but the cross-section of the conduit 22 is such as to offer continued resistance to the flow of fibers through the conduit and hence from the outlet 16. This resistance can be regulated by adjusting the inclination of the conduit 22 and can be further regulated by adjusting the inclination of the conveyor 40. The resistance offered to the flow of fibers from the outlet 16, as adjusted by the inclination of the conduit 22 and conveyor 40, determines the degree to which the fibers will be packed by the hydrostatic head of the liquid in the conduit 10 and this determines the speed at which the fibers will flow from the conduit as well as the speed with which liquid will flow through the fibers. Thus the inclination of the conduit, the inclination of the conveyor, and the rate of feed of cotton and liquid are all adjusted to provide the desired exposure of the individual cotton fibers to the liquid reagent.

The liquid flows freely from the conduit 22 through the outlets 26 and thus flows unrestrictedly from the treating conduit except for the inherent resistance of the fibers themselves. The used reagent flows to the catch basin 32 to be re-circulated through the treating conduit. The temperature of the reagent is maintained substantially at the boiling point of water by the heat exchanger. Since the liquid flows through the conduit much faster than the fiber, all of the fiber in the conduit is exposed to a large mass

of liquid substantially at the boiling point which effectively scours the fiber and removes all undesired substances.

It will thus be seen that the fiber is fed continuously through the apparatus, that no manual loading or unloading of the apparatus is required, and that the liquid rapidly circulates through all of the fiber being treated.

It has been found that this method and apparatus saves important amounts of time in the treatment of loose cotton fibers. For example, a kier might require approximately 3 hours to load 5,000 pounds of cotton fibers, ½ hour to fill with reagent, 2 hours for preliminary heating to boiling point, 3 hours to boil, 2 hours to drain and 2 hours to unload; a total of 12½ hours for 5,000 pounds of cotton, or a treating capacity of approximately 400 pounds per hour, but requiring an elapsed time of 12½ hours before any cotton is available. The apparatus of my invention eliminates the loading and unloading entirely, and makes possible effective treatment of the fibers in a few minutes. In my apparatus an increment of cotton will be completely processed in about 10 minutes, this being made possible both by the continuous nature of the apparatus and the relatively high speed of the reagent circulating through the apparatus. Preferably the reagent is circulated at the rate of about 70 pounds of liquid for 1 pound of cotton fibers. As a result, cotton fiber can be run through an 18 inch diameter apparatus of my invention at a uniform rate of 1,000 pounds per hour, providing two and one-half times the capacity of the kier.

When the apparatus is used to treat textile fabric, the fabric is run into the throat or funnel 18 in the form of a continuous rope. This collects at the bottom of the pipe and is packed by the head of liquid reagent as the fabric is slowly extruded from the pipe 22 in the form of a continuous packed worm. The end of this worm initially can be fed into any desired processing apparatus and the rope of cloth is continuously withdrawn from the worm on the conveyor 40, after the well known manner of handling continuous ropes of fabric.

I claim as my invention:

1. A continuous process of treating loose fiber with a liquid reagent which consists in forming a self-sustaining plug of loose fibers in a conduit having an outlet, continuously supplying reagent to the conduit behind the plug and maintaining sufficient pressure of the reagent behind the plug to eject the plug progressively from the conduit, the reagent being supplied at sufficient volumetric rate to flow the reagent thru the plug at substantial linear velocity while the plug is being ejected, and continuously rebuilding the plug by supplying loose fibers to the reagent substantially at the rate the fibers are ejected in the plug, whereby reagent carries fibers to the existing plug and deposits them thereon.

2. A continuous process of treating loose fiber with a liquid reagent which consists in forming a self-sustaining plug of loose fibers in a conduit having an outlet, continuously supplying reagent to the conduit behind the plug and maintaining sufficient pressure of the reagent behind the plug to eject the plug progressively from the conduit, the reagent being supplied at sufficient volumetric rate to flow the reagent substantially throughout the cross section of the plug at substantial linear velocity while the plug is being ejected, and continuously rebuilding the plug by supplying loose fibers to the reagent substantially at the

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rate the fibers are ejected in the plug, whereby reagent carries fibers to the existing plug and deposits them thereon.

3. A continuous process of treating loose fiber with liquid reagent which consists in forming a self-sustaining plug of loose fibers in a conduit, continuously maintaining a hydrostatic head of liquid above the plug sufficient to eject the plug progressively from the conduit, continuously supplying liquid to the conduit at a volumetric rate sufficient to flow the reagent thru the plug at substantial linear velocity while the plug is being ejected, and continuously rebuilding the plug by supplying loose fibers to the reagent substantially at the rate the fibers are ejected in the plug, whereby reagent carries fibers to the existing plug and deposits them thereon.

4. Apparatus for continuously treating loose fibers comprising in combination a conduit of substantially uniform cross section including a substantially horizontal portion having a horizontally discharging outlet and a portion extending through a vertical height above the level of the outlet, means for continuously supplying liquid reagent and loose fibers to the vertically extending portion to form and hold in the horizontal portion a compacted plug of fibers filling the cross section of the conduit, said conduit being imperforate to confine discharge of liquid from the conduit to the outlet with the plug, and means for controlling the level of liquid in the conduit by controlling movement of the plug away from the outlet including a substantially horizontal trough operatively associated with the horizontal portion and having imperforate bottom and sides for receiving and holding intact a substantial portion of the periphery of a substantial length of the plug discharged from the outlet, said trough being constructed and arranged to convey the plug continuously away from the outlet in a substantially horizontal direction and being thereby adapted frictionally to resist movement of the plug along the trough and away from the outlet due to the weight of the plug and means for adjusting the inclination of the trough to adjust the resistance offered by the trough to movement of the plug away from the outlet.

5. Apparatus for continuously treating loose fibers comprising in combination a conduit of substantially uniform cross section including a substantially horizontal portion having a horizontally discharging outlet and a portion extending through a vertical height above the level of the outlet, means for continuously supplying liquid reagent and loose fibers to the vertically extending portion to form and hold in the horizontal

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portion a compacted plug of fibers filling the cross section of the conduit, said conduit being imperforate to confine discharge of liquid from the conduit to the outlet with the plug, and means for controlling the level of liquid in the conduit by controlling movement of the plug away from the outlet including a substantially horizontal support operatively associated with the horizontal portion and adapted to receive and hold intact a substantial length of the plug discharged from the outlet, a substantially horizontal conveyor operatively associated with the support for receiving the plug at the end of the support away from the outlet, and means for regulating the inclination of the conveyor to regulate the gravitational resistance to movement of the plug from the support.

6. Apparatus for continuously treating loose fibers comprising in combination a conduit of substantially uniform cross section including a substantially horizontal portion having a horizontally discharging outlet and a portion extending through a vertical height above the level of the outlet, means for continuously supplying liquid reagent and loose fibers to the vertically extending portion at the conduit to form and hold in the horizontal portion a compacted plug of fibers filling the cross section of the conduit, said conduit being imperforate to confine discharge of liquid from the conduit to the outlet with the plug, the plug being adapted to be progressively ejected from the conduit by pressure of liquid in the vertically extending portion, a conveyor operatively associated with the conduit for receiving the plug discharged from the conduit and for conveying the plug away from the conduit, said conveyor being adapted to control the ejection of the plug from the conduit, and means for varying the rate of movement of the plug over said conveyor.

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