July 15, 1930. R. D. KEHOE 1,770,409

METHOD AND APPARATUS FOR DRYING PULP

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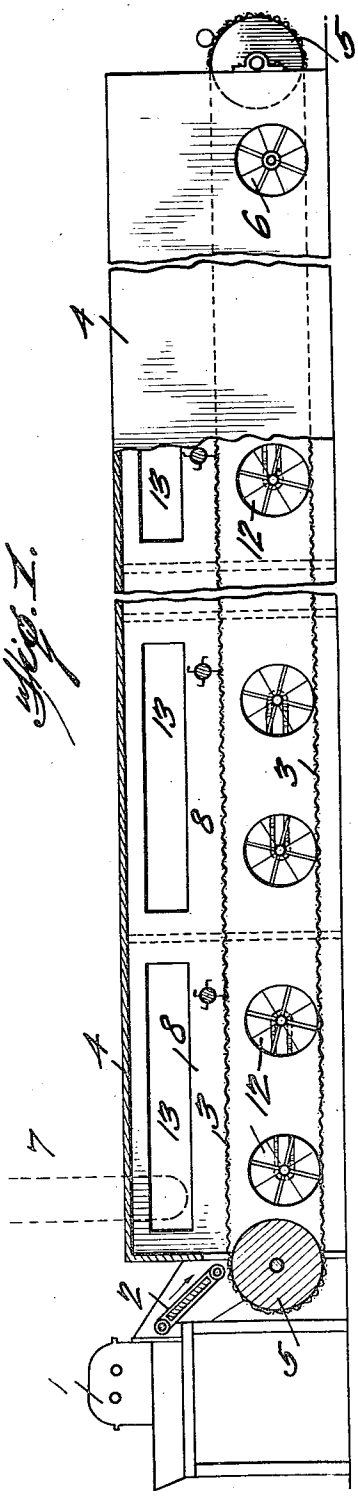


Fig. 1.

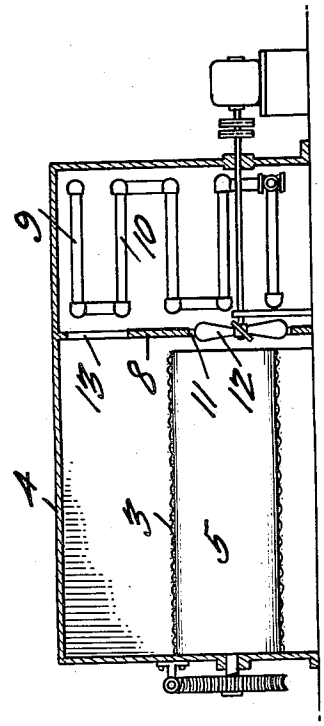


Fig. 3.

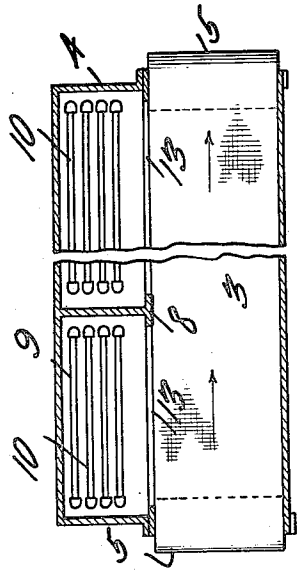


Fig. 2.

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METHOD AND APPARATUS FOR DRYING PULP

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This invention relates to a method and apparatus for drying pulp and more particularly wood pulp.

Wood pulp has been ordinarily shipped in wet condition with the known disadvantages of the additional weight of the water content, to say nothing of the fact that the wet pulp is extremely liable to discoloration and freezing. To obviate these disadvantages, attempts have been made to dry the pulp before shipment, and in attempting to provide an adequate drying, the peculiar conditions of the wet pulp have necessitated methods and apparatus for the handling of pulp which have proven expensive to operate, and which tend to the production of a disadvantageous deterioration in the pulp itself.

It is recognized that the wet pulp contains approximately from one to six per cent of pulp solids, and any attempt to drive off this proportional quantity of liquid by heat would require such an extended application of the heat as to result in a serious deterioration of the pulp. It is, therefore, essential that the larger proportion of the water content be expressed from the liquid pulp in a mechanical way before subjecting the pulp to the action of heat for the final drying, and various methods looking to this mechanical separation have been proposed. The liquid pulp has been subjected to a pressing action between rolls which will effectively express a large proportion of the liquid content, but this means of accomplishing the result is objectionable, primarily because the pulp as delivered from the rolls is in the form of a web or layer which is so compact that the fibers become torn, and in order to dry the pulp by the action of heat, the application of heat must be to such a degree or for such a time as will seriously affect the pulp proper.

To avoid this, it is proposed to shred or finely divide the pulp from this layer form before subjecting it to the action of the drier. This shredding division of the pulp has proven a very serious problem, for the reason that incident to the irregular arrangement of the fibers of the pulp when in layer form, it is almost impossible to divide the pulp into the necessarily fine divisions without breaking down the pulp fibers and thus producing a materially inferior article.

The present invention is directed to a method wherein a large proportion of the water content of the pulp is removed in the final process without forming the pulp into a layer or compact mass and without in any way affecting the fibers of the pulp proper, the pulp being delivered to the drier in a more or less loose or flocculent form, to thereby permit a thorough searching by a degree of heat which will not injuriously affect the pulp.

To fully appreciate the importance of drying the pulp in its original state as it comes from the slush tank, it may be stated that, due to the action of the dehydrator on the pulp in removing the water content, together with the nature of the product, the pulp is delivered from the dehydrator in small separated broken chunks or ball-like portions. This is due to removal of a large portion of the water content which tends to open up the pulp portions and make them somewhat flocculent when free of the action of the pulping mechanism. Being in this condition, that is, loose separated somewhat flocculent condition, the chunks or ball-like portions are more susceptible to the action of the heat in the drier, in that being in an uncompressed state, the heat readily passes around and in intimate contact with the individual fibers. The fibers, therefore, become extended under the drying influence of the heat and their original and natural length and condition is maintained.

The improved method, therefore, consists in delivering the liquid pulp to a centrifugal separator of known or approved type in which a very large proportion of the water content is separated from the pulp proper by centrifugal action, the pulp proper incident to the centrifugal action being delivered from the separator in separated small broken chunks or ball-like portions and in a somewhat fluffy, flocculent condition with a complete avoidance of any compact massed formation. The pulp in this semi-dry condition is delivered onto an endless conveyor moving through a drier and subjected during its passage through the drier to the action of heat to thereby abstract substantially the full mois-

ture content of the pulp and enlarge its flocculent form and in no way affecting the fibers.

In specific connection with the heating step, it is proposed to admit a volume of fresh air at the end of the drier opposite the entrance of the pulp and provide means for withdrawing this air from the drier at the end at which the pulp is admitted. At different points lengthwise the drier, parts of this fresh air body are withdrawn laterally and subjected to the action of a heater, and after being heated carried downwardly through the pulp on the conveyor to abstract the moisture from the pulp. The degree of heat to which the pulp is subjected and the arrangement of this heat degree is an important feature of the present invention, for by reason of the control of the heating units it is proposed that the heat to which the pulp is subjected at its entrance to the drier is gradually increased at the successive heating units to a point some distance from the entrance end of the drier, beyond which the heat is gradually decreased. This control of the heat is important for it is to be understood that a heat degree sufficient to abstract a considerable proportion of the moisture of the pulp mass would, if applied to the pulp when substantially dry, that is, at the exit end of the heater, seriously affect the fibers of the pulp and tend to char or weaken such fibers with the result of producing a deteriorated product. With the heat of maximum degree, however, utilized to affect the pulp while said pulp is charged with a proportionally large moisture content, the fibers are protected by this moisture content from the disadvantageous effect of the heat, hence the heating step in the proposed method and apparatus is to initially subject the pulp at the entrant end of the heater to a degree of heat which will abstract a proportion of the moisture content of the pulp, and gradually increase this heat to a point at which the larger proportion of the water content has been withdrawn, following which the heat is gradually reduced in order to avoid affecting the fibers while at the same time maintaining sufficient heat to take care of any remaining moisture.

The pulp when delivered is in a dry, flocculent state, presenting in effect comparatively small hollow cylindrical-like particles more or less uniform in size and thoroughly dry.

The method is carried out in the improved apparatus illustrated in the accompanying drawings, in which:

Figure 1 is a view in side elevation of the improved apparatus.

Figure 2 is a longitudinal vertical section through the same.

Figure 3 is a transverse section through the drier.

The apparatus includes a centrifugal separator 1 which may be of any approved type and to which the liquid pulp is delivered, and in which a very large proportion of the water content of the pulp is removed by the centrifugal action. A chute 2 receives the flocculent pulp from the centrifugal separator, delivering it by gravity onto the conveyor 3 of the drier 4. The drier is in the form of an elongated closure through which the conveyor, provided as an endless body arranged for travel over rollers 5 mounted in the ends of the drier, is adapted to travel.

At the exit end, the drier is provided with a fresh air inlet 6 below the path of travel of the pulp, the drier being formed at the pulp inlet with a stack or other outlet 7. If desired, fans or the like may be employed at the inlet and outlet 6 and 7 to assist in the travel longitudinally of the drier of an air column of fresh air continuously moving in a direction opposite to the direction of travel of the pulp.

Arranged at one side of the conveyor chamber of the drier and separated therefrom by a partition 8 is a series of heating units 9. These heating units are identical except in the degree of heat and preferably comprise heating means, such as a pipe coil 10, to which live steam may be admitted to preserve the coil at the desired degree of heat. In the partition 8 in line with each heating unit are air inlet openings 11 having suction fans 12 arranged therein, and above the path of travel of the pulp, the partition of each heating unit is formed with heated air outlets 13. The degree of heat of the respective heating units varies one from the other, the heat of the first unit at the pulp inlet end of the drier being somewhat less than the succeeding several units toward the center of the drier, each of such units being of progressively increasing temperature to a point some distance from the entrant end of the drier. At this point in the drier, the heat effect is this at the maximum, the heat thereafter being progressively and gradually decreased in heating effect until at the pulp outlet end of the drier the heating effect is at the minimum.

As the pulp is fed through the machine, a portion of the air current is withdrawn at each heating unit, passed through the heater in such unit, and brought to the temperature of the unit and then delivered onto the pulp on the conveyor, the heated air passing through the flocculent mass of pulp and into the constantly moving air stream below such pulp mass. The moisture abstracted by the heated air current is delivered to the constantly moving longitudinally traveling air stream so that at the succeeding heating unit the air withdrawn from the air stream for heating is of the lighter portions of such air stream, that is, portions least charged with moisture. Thus the heated air currents at each heating unit abstracts moisture from the pulp in proportion to the temperature of such heated medium, delivers the contained

moisture to the longitudinally traveling air stream below the pulp and is reheated at the next heating unit for a further continuous effect on the pulp.

Under the method and apparatus described, the pulp is initially relieved of the larger proportion of its water content in a simple and expeditious manner without requiring either the expensive operation of pressing and subsequent shredding operation, and without forming the pulp into a compact mass from which it is difficult to abstract the moisture by heating. As a result of the centrifugal separation, the pulp is left in a fluffy, flocculent mass and is delivered without handling directly onto the conveyor for the heater. This the mechanical separation and the separation of the action of heat are immediately successive without in any way changing or affecting the fibers of the pulp. Thus the pulp as finally delivered in a dry condition has its fibers preserved in their original relation and hence the full strength of the pulp is maintained under any and all conditions.

What I claim to be new is:

1. A method of treating pulp while maintaining the normal integrity of its fibers, consisting in subjecting the liquid pulp to dehydration by centrifugal action to simultaneously remove a considerable portion of the water content of the pulp and form the dehydrated pulp into a fluffy, flocculent mass without affecting the normal integrity of the fibers, and while the pulp is in a dehydrated and flocculent condition, subjecting such to a drying action wherein the heat is gradually increased initially and subsequently gradually decreased.

2. An apparatus for the treatment of pulp without affecting the normal integrity of the fibers of the pulp, comprising a dehydrator in which the liquid pulp is subjected to partial dehydration and simultaneously broken up into relatively small fluffy, flocculent masses without affecting the normal integrity of the fibers of the pulp, a drier to which the pulp in the partially dehydrated, fluffy, flocculent form is delivered immediately from the dehydrator, means in the drier for conveying the pulp so delivered longitudinally of the drier, and a plurality of independent heating means arranged in the drier to dry the pulp during its travel longitudinally of the drier, said heating means presenting areas of gradually increased heat for a portion of the length of the pulp travel and areas of gradually decreasing heat for the remaining length of pulp travel.

3. The method of drying pulp which consists in moving pulp in more or less loose form in one direction in a confined area, directing a current of air longitudinally of such confined area below and in a direction opposite the travel of the pulp, and periodically withdrawing part of the air of such current for heating at different stages in the travel of the pulp, the successive heating of the withdrawn air being increased throughout a portion of the length of the travel of the pulp and decreased throughout the remaining length of travel of the pulp, the air heated at each successive stage being returned to the longitudinal current after passing through the pulp, said longitudinal current serving as a moisture vehicle for the moisture driven from the pulp by the heated portions of the air.

4. The method of drying pulp, consisting in moving pulp in more or less loose form in one direction in a confined area, directing a current of air under pressure lengthwise such area and path of pulp travel and in a direction opposite to the travel of the pulp, withdrawing portions of air of such current at successive points throughout and laterally of such current flow, subjecting such withdrawn portions of the air to successively increasing and then successively decreasing degrees of heat in sequence, and finally directing such heated portions through the pulp and into the lengthwise-traveling air current.

5. A method of treating pulp while maintaining the normal integrity of its fibers, consisting in subjecting the liquid pulp to dehydration by centrifugal action to simultaneously remove a considerable portion of the water content of the pulp and form the dehydrated pulp into a fluffy, flocculent mass without affecting the normal integrity of the fibers, and while the pulp is in a dehydrated and flocculent condition, subjecting such to a drying action, wherein the pulp is subjected to a current of air moving in opposition to the direction of movement and below the pulp, with such air periodically and successively subjected to a gradually increased heat and a gradually decreased heat in sequence, with the heated air following each period of auxiliary heating being passed through the pulp and into the constantly flowing stream of air below the pulp.

In testimony whereof I affix my signature.

RICHARD D. KEHOE.