July 23, 1968 J. M. BLACKFORD 3,393,634

METHOD AND APPARATUS FOR LOOSENING FIBERS OF WOOD CHIPS

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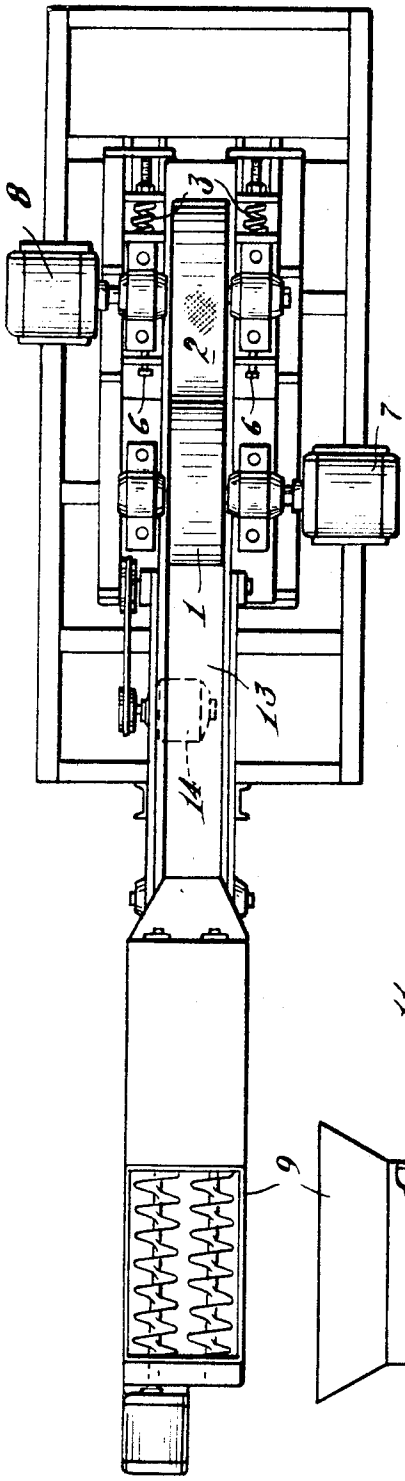


Fig. 1

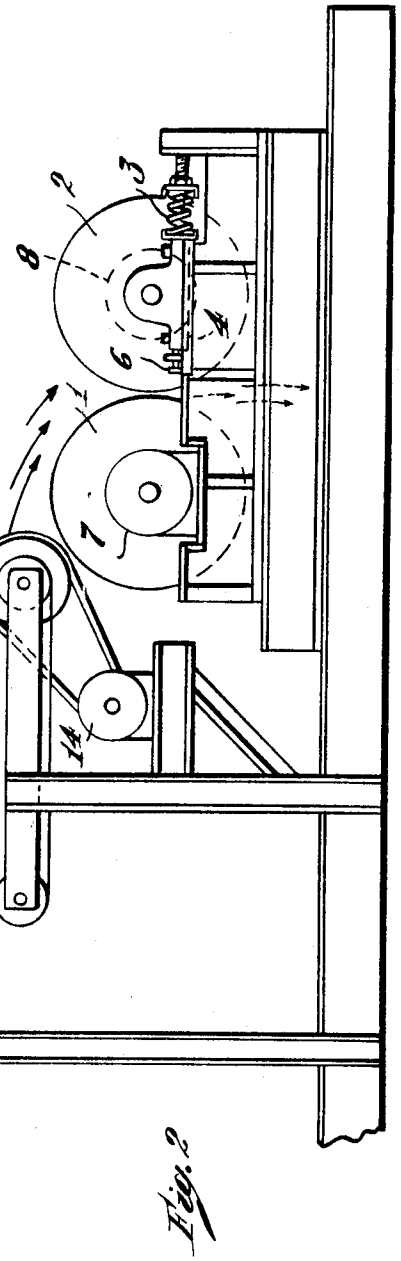


Fig. 2

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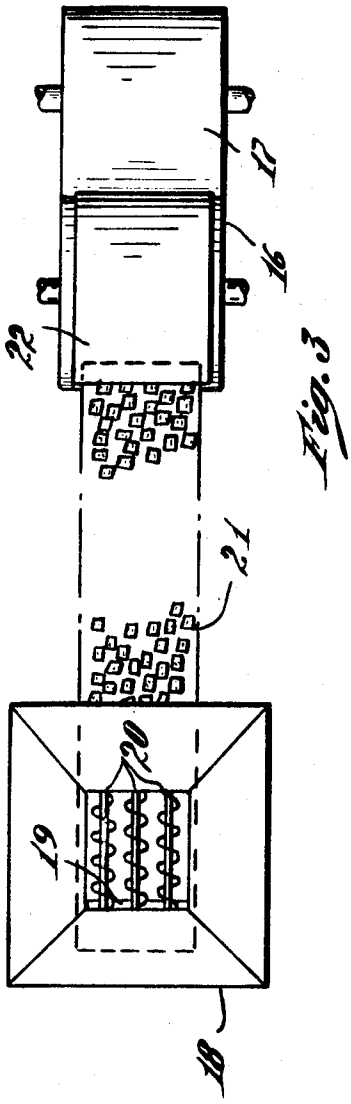


Fig. 3

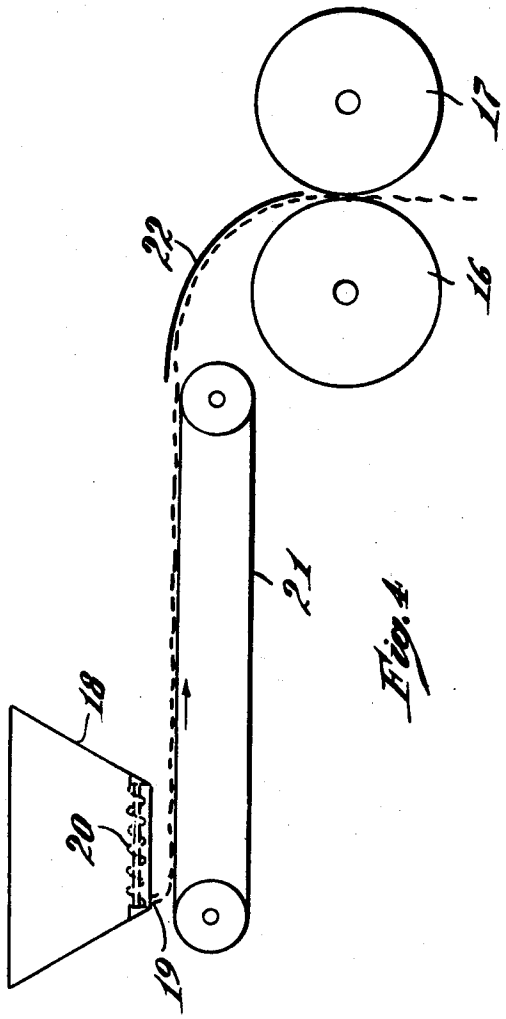


Fig. 4

United States Patent Office 3,393,634 Patented July 23, 1968

3,393,634

METHOD AND APPARATUS FOR LOOSENING FIBERS AND WOOD CHIPS

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Continuation-in-part of application Ser. No. 296,254, July 19, 1963. This application Jan. 7, 1965, Ser. No. 424,067

2 Claims. (Cl. 100—39)

This application is a continuation-in-part of application Ser. No. 296,254, filed July 19, 1963, and now abandoned.

Most commercial wood pulp is made by chemical pulping. The wood, in log or bolt form, is fed into a chipper, a large disk with knives, which reduces the wood to small pieces called chips. The chips are fed into a chemical retort or digester and chemicals are introduced under predetermined temperature and pressure conditions to cook out the undesired fraction of the wood (lignin, etc.) leaving the desired fraction (cellulose) intact. This cooking action results in pulp which is subsequently made into paper.

An average chip is about ¾" lengthwise of the fiber, about ¾" in one transverse dimension and about 3/16" in the other transverse dimension. Thus the chips have a small thickness compared to their other dimensions. To obtain uniform action in the digester the chips should all be of the same size but there is considerable variation in size in any batch of chips however carefully made. Some will be larger than average and some will be smaller. For example chips larger than 1" in length have from two to four times as much wood volume per unit of surface area as chips which are smaller than ½" in length. If the cook is adjusted for the average chips the larger chips are not fully cooked, leaving impurities in the pulp, and the smaller chips are overcooked, destroying some of the useful cellulose.

Objects of the present invention are to loosen the fibers of the chips so that the cooking liquid can penetrate the chips and affect the lignin uniformly throughout the chips irrespective of their size, thereby obtaining faster cooking, more uniform pulp, no uncooked shives, increasing the yield of pulp, and to render the moisture content of the chips more uniform.

In one aspect the present invention involves apparatus comprising a pair of opposed rolls with a space therebetween together with means for rotating the rolls in opposite directions so that their opposing surfaces approach each other in the crotch between the rolls at approximately the same linear velocity, and means for feeding chips into the crotch edgewise, the space between the rolls being small enough to compress the chips to a small fraction of their original thickness and large enough not to damage the fibers of the chips substantially, thereby to loosen the fibers of the chips and render the chips more porous. Preferably the space between the rolls is small enough to compress the chips to at least approximately one-fifth of their original thickness and large enough to compress the chips to not more than approximately one-tenth of their original thickness. The space should be between approximately one-hundredth and five-hundredth inch. The surfaces of the rolls should be hard and unyielding and at least one of the rolls should be knurled or otherwise roughened to feed the chips between the rolls.

In another aspect the invention involves a method which comprises subjecting the chips to pressure transversely of their thickness to compress them to at least approximately one-fifth of their original thickness but not more than approximately one-tenth of their original thickness and then releasing the pressure to permit the chips to expand approximately to their original shape, whereby

the fibers of the chips are loosened and the porosity of the chips is increased without damaging the fibers substantially.

For the purpose of illustration a typical embodiment of the apparatus is shown in the accompanying drawings in which

FIG. 1 is a top plan view;

FIG. 2 is a side view;

FIG. 3 is a plan view of a modification; and

FIG. 4 is a side view of the modification.

The particular embodiment of the invention shown in FIGS. 1 and 2 comprises two rolls **1** and **2** for compressing chips therebetween. The rolls are positioned with a small space therebetween as aforesaid. The position of roll **1** is fixed and roll **2** is yieldingly held in position by means of springs **3**, the bearings for the roll **2** sliding in a guide **4** against stops **6**. The springs **3** are strong enough to hold the roll in position except when large objects pass between the rolls. Roll **1** is driven by motor **7** and roll **2** is driven by motor **8**, the two rolls preferably being driven at substantially the same speed.

Chips are fed to the rolls through a hopper **9**, a worm feed **11**, a chute **12** and a conveyor belt **13** driven by a motor **14**. The velocity of the conveyor **13** should be less than that of the rolls **1** and **2**. Thus chips are fed between the rolls uniformly and are compressed uniformly. As the chips fall on the conveyor **13** they naturally tend to lie flatwise and the rate of feed from hopper **9** is regulated approximately to cover the belt with chips in substantially non-overlapping relation. Thus the chips are projected into the nip between rolls **1** and **2** edgewise as indicated by the arrows in FIG. 2, it being understood that the belt is driven at a speed sufficient to project the chips as indicated. The thicker chips are compressed more than the thinner chips and are therefore opened up more. Thus the treating liquor can reach the interior of all of the chips, both large and small, approximately uniformly so that all of the chips are treated substantially uniformly irrespective of their size.

The modification shown in FIGS. 3 and 4 is like the embodiment shown in FIGS. 1 and 2 in that it comprises compression rolls **16** and **17**, a hopper **18** having a narrow elongate outlet **19**, feed screws **20** and a conveyor belt **21**, the rate of feed from hopper **18** being regulated approximately to cover the belt with chips in substantially non-overlapping relation. The modification also has a curved deflector **22** to assist in directing the chips edgewise into the nip between rolls **16** and **17**.

This invention affords the following advantages over the prior art: Faster cooking is possible because the cooking liquor penetrates the chips more rapidly, which is particularly important in continuous pulping processes; the resulting pulp is more uniform because all of the chips, large and small, expose about the same reaction area per unit of volume, thereby minimizing undercooking and overcooking; there are virtually no uncooked shives in the resulting pulp because the aforesaid compression breaks up the knots in the chips; the yield of pulp is higher because the chips are cooked uniformly throughout; the quality of te pulp is higher because undercooking and overcooking is substantially eliminated; and the resulting pulp is more uniform in quality because the moisture content of the chips is more uniform. If the chips have excess moisture it is squeezed out in the aforesaid compression between the rolls. With the moisture content uniform, the liquor concentration can be the same for all cooking to get identical results, this being particularly important where the cooking is continuous. The moisture content is preferably between 40% and 55%. Within this range the chips are quite resilient under compression and after compression they quickly expand to substantially their original

size. If the moisture content be reduced below the aforesaid range the chips lose resiliency and the compression of the rolls causes more fiber damage and less opening up like a sponge.

By the present invention chips may be prepared properly for chemical cooking which is quite sensitive to compressive bruising action.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims. For example the invention is applicable not only to chemical pulping but also to so-called semichemical pulping in which the wood is only partially cooked to soften it and is then mechanically reduced to wood fiber.

I claim:

1. For treating wood chips which have a small thickness compared to their other dimensions and in which the fibers extend edgewise, the method which comprises continuously feeding the chips along a predetermined path and, as the chips pass a predetermined location along said path, momentarily compressing the chips transversely of their thickness to at least approximately one-fifth of their original thickness but not more than approximately one-tenth of their original thickness and then releasing the pressure to permit the chips to expand approximately to their original shape, whereby the fibers of the chips are loosened and the porosity of the chips is increased without damaging the fibers substantially.

2. The method of treating wood chips according to claim 1 wherein the chips are compressed in substantially non-overlapping relation.

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