United States Patent [19]

Erickson et al.

[11] **3,826,433**

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[54] **PROCESS FOR REMOVING BARK FROM WOOD CHIPS**

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[52] **U.S. Cl.** **241/14,** 241/23, 241/24

[51] **Int. Cl.** **B02c 21/00**

[58] **Field of Search** 241/3, 14, 23, 24, 25, 241/28, 29, 30

[56] **References Cited**

UNITED STATES PATENTS

2,973,152	2/1961	Owens	241/14 X
3,070,318	12/1962	Blanchard	241/14
3,254,847	6/1966	Brandt et al.	241/24
3,337,139	8/1967	Lloyd et al.	241/24 X

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[57] **ABSTRACT**

A process to remove the bark from wood chips by breaking the bond between the bark and wood fractions followed by segregation of the bark particles from the clean wood chips. The process includes the steps of: steaming the wood chip mass to weaken the bark-wood bond and render the bark tacky; mechanically compressing the chips to partially break the bond between the bark and wood and to break a portion of the bark fraction into smaller particles; removing these particles, some of which adhere to the compressing medium, from further processing; subjecting the partially beneficiated chips to unique abrasion or milling processes to fragmentize the remaining bark; and segregating the resulting clean wood chips from the fragmented bark. The sequence of steps may be varied and the bark is removed from processing at different stages.

10 Claims, 3 Drawing Figures

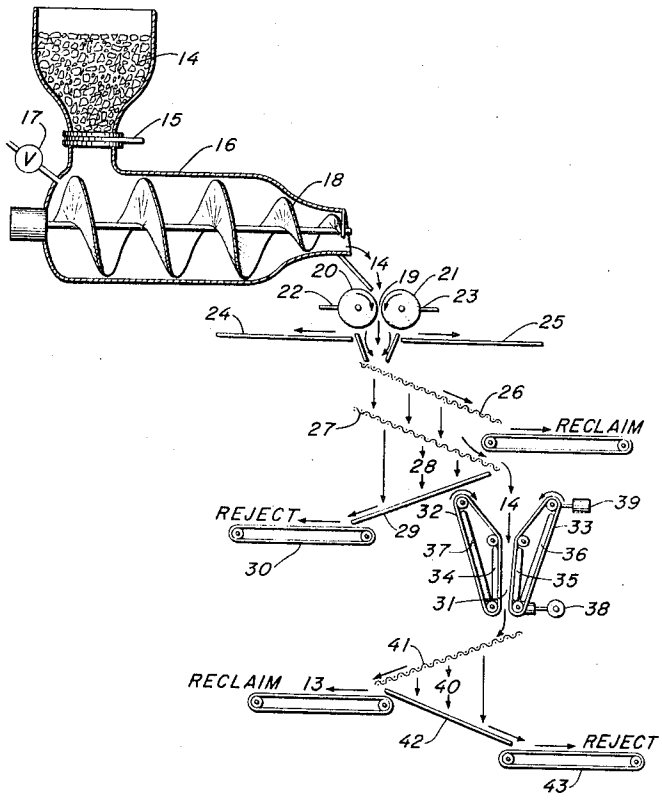


FIG. 1

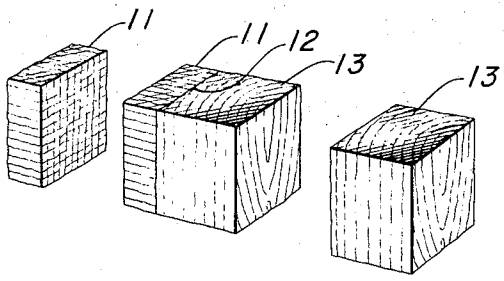


FIG. 2

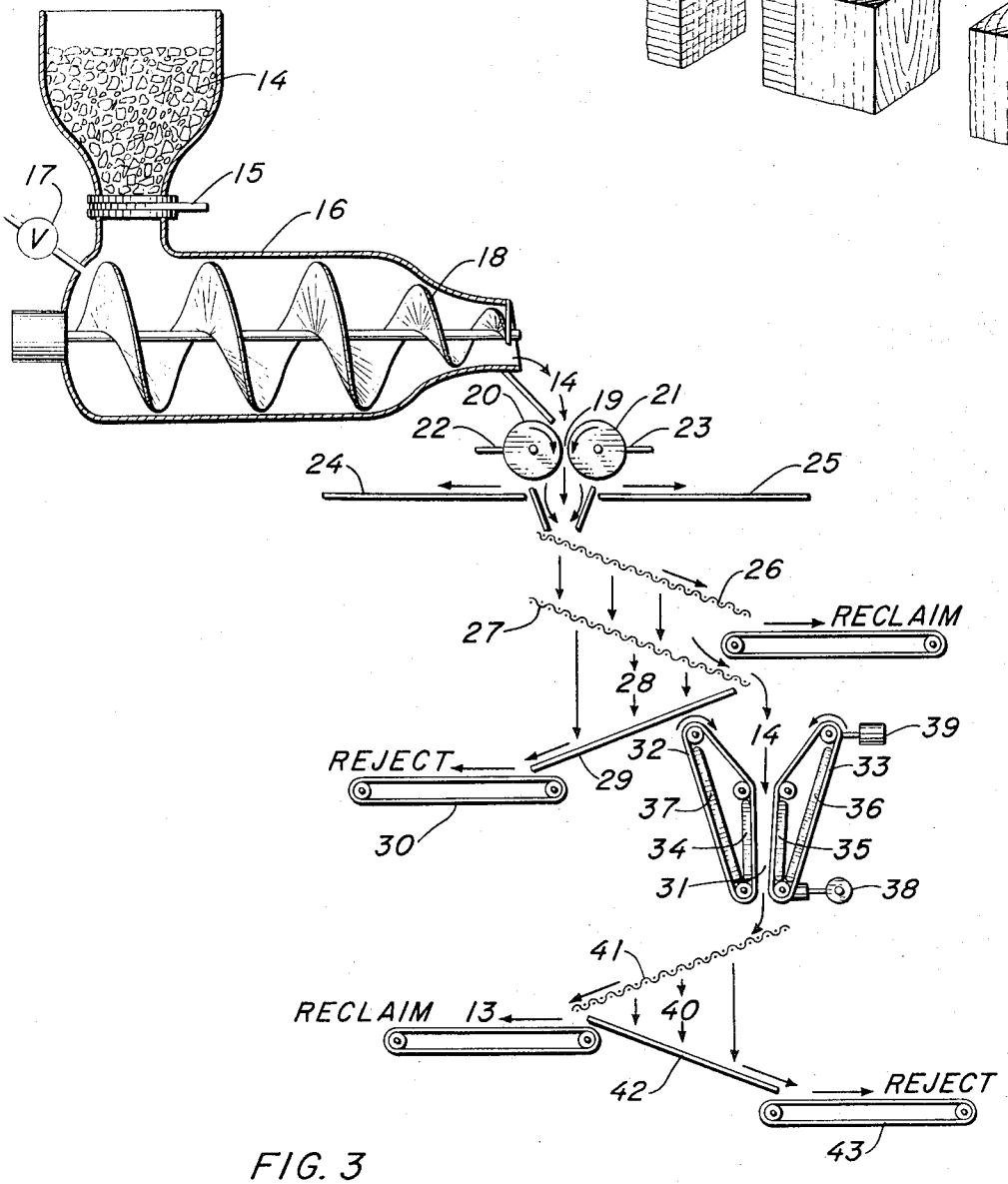
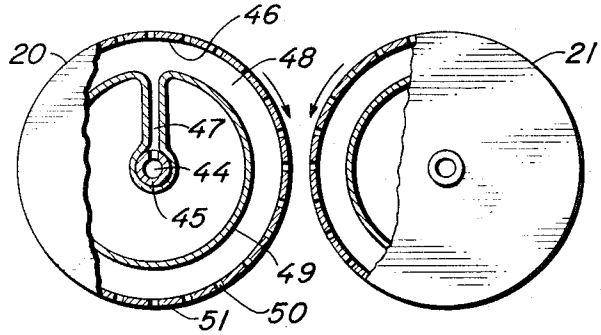


FIG. 3



PROCESS FOR REMOVING BARK FROM WOOD CHIPS

A nonexclusive, irrevocable, royalty-free license in the invention herein described, throughout the world for all purposes of the United States Government, with power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates to the removal of bark from an unbarked wood chip mass. More particularly, the steps of steaming, mechanical compression, abrading or mechanical milling, and screening, are employed to render wood chips substantially bark-free. The process is particularly adapted for use on logging residue which has heretofore been regarded as waste.

2. Description of Prior Art:

It is currently estimated that up to 40 percent of our national pulpwood requirements could be satisfied by effectively utilizing wood residue that is left in the forest following logging operations. This waste is caused by the difficulty of round-wood debarking in the field coupled with the requirement of a 3 percent or less bark content for most pulping processes. Bark percentages of many whole-tree chips exceed 20 percent. The bark content of topwood chips is often 18 to 31 percent higher than that found in bolewood chips. Unbarked residue may originate from saw mills, low-value stands, or material left in the woods after logging. The process disclosed provides a means of recovering the usable fiber from such residue that is normally considered waste. The process is effective wherever adequate means of debarking prior to chipping does not exist.

Our process incorporates the partially successful method of compression debarking that is disclosed in U.S. Pat. No. 3,070,318 (Blanchard). That patent discloses a nip action between two opposed rolls to compress most of the wood and bark to a size substantially smaller than their free state. The corky or flaky outer bark is crushed for reject screening and the tacky inner bark adheres to the rolls and is doctored off to rejects, thus leaving the "cleaner" wood of the chips for pulping. U.S. Pat. No. 3,070,318 employs only compression and screening and is but partially effective. Our invention is distinguished in that it employs steaming, abrading, and screening steps in conjunction with compression debarking.

Steaming prior to compression debarking improves bark removal significantly. Nearly complete beneficiation is obtained with added abrasion and screening. This represents removal of up to 40 percent more bark, depending on the tree species, than obtained by simple compression debarking alone.

The method described herein is versatile, allowing varied arrangements of the steps to meet species and seasonal variations. For example, steaming is not necessary for all species and could be omitted when processing these species without reducing bark removal efficiency. In some other species, at certain times of the year, it was found that prescreening the incoming chipped material rendered wood fractions in the larger sized chips that were suitable for immediate pulping. Thus, only a portion of the incoming chips required complete processing. Numerous other combinations or

variations are possible within the limits of the process described.

SUMMARY OF THE INVENTION

A process is provided to effectively debark wood chips to render them substantially bark-free and thereby suitable for most pulping operations.

The debarking process includes steaming of the unbarked wood chip mass until the bond between the bark and wood is weakened and the bark fraction becomes tacky. Low pressure steaming for a short period of time is all that is required. The steamed chips are then mechanically compressed to partially crush the bark portion and break it into smaller pieces. This may best be accomplished by feeding the chips between two closely opposed moving surfaces. Some of the bark, because of the increased tackiness previously imparted, will adhere to the compressing medium. That bark is scraped off and directed away from further processing. After screening to remove the small, broken bark particles that failed to adhere to the compressing medium, the recovered wood chips, now partially beneficiated, are subjected to unique abrasion or milling processes which crumble the remaining bark, already made more friable by the previous steps into fragments small enough to be segregated from the wood chips by subsequent screening or other known segregation methods.

The abrasion can be accomplished by directing the chips between two continuously moving, substantially parallel surfaces so disposed to one another as to catch and hold the chips, while at the same time oscillating one of the surfaces in a direction transverse to its continuously moving direction. This creates a frictional action that crumbles or fragmentizes the bark as the chip mass moves along between the surfaces. Other methods for abrading and fragmentizing the bark include rod, ball, and hammer type mechanical milling with specialized milling media designed particularly for processing wood chips.

Accordingly, an object of the invention is a process whereby residue wood, in an unbarked state, can be debarked and cleaned to stringent pulpmill specifications thus utilizing wood wastes to accord with current national policy of preserving our wood resources and minimize the adverse environmental impact of logging operations. Another object of the invention is a process that combines chip steaming, mechanical compression, chip abrasion or mechanical milling, and screening, in varying sequences, to render an unbarked chip mass substantially bark-free. A further object is the provision of a unique abrasion process to crumble the bark fraction in wood chips into small particles to facilitate subsequent removal while the wood fraction retains its original size.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a representation of the various fractions in a single unbarked wood chip.

FIG. 2 is a diagrammatic representation of the preferred embodiment of the inventive process.

FIG. 3 depicts a possible variation in the rollers used during the mechanical compression step.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawing, in FIG.

1, bark fraction 11 of a chip varies considerably in nature between and within species. Bark 11 itself is usually comprised of two or three fractions: inner bark which is usually soft and tacky; outer bark with a corky characteristic; and, in some species such as jack pine, a hard flaky or scaly outer bark. Bond 12 between bark 11 and wood fraction 13 is usually weakened to some degree or completely broken during chipping action. The amount of breakage of bond 12 varies, by season of the year and species. With a few species during the dormant season 60 percent or more of the bark by weight may adhere to the wood fraction after chipping. With nearly all species during the growing season there is usually less than 10 percent bark adherence.

As shown in FIG. 2, the unbarked chip mass 14 is delivered by suitable means 15 to a steaming area, here depicted as vessel 16. Means for controlling the steam environment within vessel 16 is provided here by pressure regulator 17. It has been found that low pressure steaming for a short period of time is most satisfactory. For example, steam pressures may range from 0 to 50 p.s.i.g. while the steaming time may vary from a few seconds to a total of 15 minutes. Preferably, we have found that 2 to 5 minutes of steaming at pressures ranging from 2 to 15 p.s.i.g. significantly improves later bark removal in most operations. The steaming operation may be performed by either batch or continuous flow process with the latter preferred for production reasons. Screw feed 18 carries the steamed chip mass 14 to the mechanical compression area.

The chip mass 14 enters nip 19 between two opposed rolls 20 and 21 having oppositely rotating, closely opposed surfaces converging toward one another at the top and away from one another at the bottom and having a nip setting substantially smaller than the thickness of the wood chips, or bark particles. Such a setting will tend to draw the chips between the opposed rolls 20 and 21 thus compressing them. Two basic effects occur during this compression process: first, bark 11 is compressed and partially crushed causing some of it to be broken off into smaller particles; and second, some of it will adhere to rolls 20 and 21 and be scraped off by doctors 22 and 23 and thence diverted from remaining processing by deflectors 24 and 25. The wood fraction 13 of the chips, due to their superior strength properties as compared with the bark, will remain intact and return close to their original shape. Some wood will be lost with the bark particles and will go to reject; however, most of the wood and bark that is not doctored from the rolls will pass over or through large mesh screening 26. The larger wood chips that pass over the screen are essentially bark-free and are reclaimed ready for the pulping process. The smaller material, consisting of bark and wood chips that fall through screening 26, pass over or through smaller mesh screening 27. Fines 28 which are comprised mostly of small bark pieces broken down during compression debarking are delivered to reject conveyor 30 by deflector 29. The remaining chip mass 14 that passes over screening 27 is subjected to a unique abrasion process in zone 31.

Preferably, zone 31 is formed as the area between two, continuously moving surfaces, here belts 32 and 33. Such surfaces may consist of either similar or dissimilar materials. Belts 32 and 33 are moving in opposite directions in such manner as to converge toward one another at one end and away from one another at the opposite end of process zone 31. Additionally the width between the surfaces of belts 32 and 33, within the narrow section of the zone, is smaller than the thickness of the wood chips. It has been found, for all practical purposes, that the belts may be positioned flat against one another in the narrow section of the zone. The direction of movement and the setting between the moving belts is such that the individual chips of the wood chip mass 14 are caught and held between the belt surfaces and moved downwardly in FIG. 2, through the process zone at the speed of the moving belts. The belts are backed up in the narrow section of the process zone 31 by plates 34 and 35.

The abrasive action occurs when one belt frame 36 is oscillated in a direction transverse to the directional movement of belts 32 and 33 while the other belt frame 37 is held stationary. Oscillation of frame 36 may be produced by a linear actuator 38 attached to frame 36 which swings back and forth on shaft 39 in a direction substantially transverse to the downward movement of the belts. The action caused is quite similar to rubbing ones hands together. The frictional action occuring in process zone 31 abrades the bark fraction 11, already made friable by the previous process steps, and crumbles it into small, fine particles 40 whereas the wood fractions 13 of the chips remains essentially in their original form.

It is noted that varying degrees of abrasion are possible by using belts having dissimilar surfaces. Operating the individual belts at different speeds can also increase the abrasive action by causing the chips to "tumble" as they move down through the process zone between the belt surfaces, thus increasing the frictional action involved.

Segregation of the resulting classified elements occurs as the mass is deposited on inclined screen 41. Bark fines 40 are directed away to rejects conveyor 43 by deflector 42 and the clean wood fractions 13 come off screen 41 and are reclaimed for the pulping process.

The abrasion process is not limited to the preferred methodology described herein but may be performed by other suitable means. For example, a cylindrical drum with internal hammers can fragmentize the bark through impaction as it revolves. A ball mill tumbler has also been used successfully to softly and randomly abrade the bark into smaller fragments by utilizing special milling medias. Numerous other mechanical milling techniques may also come to mind.

A variation of the process described includes heating of the opposed compression rolls 20 and 21, either internally or externally, to improve the compression debarking step already disclosed. Heating of the compression rolls causes more bark to adhere to them. FIG. 3 is described simply as the action of a steam iron. Roll 20 is depicted to demonstrate the heating technique.

Live steam, at varying pressures, can be carried to chamber 44 through shaft 45 that rotates opposed roll 20. The steam is directed to the inner surface 46 of roll 20 through channel 47. A close clearance 48, maintained between steam shield 49 and inner surface 46 of roll 20, is used to carry the steam around the entire inner surface of the roll. Exit holes 50 allow the steam to eject directly to the outer surfaces 51 of roll 20. The ejecting steam also attacks the wood chip mass 14 to render the bark 11 tacky to ensure better adherence to opposed rolls 20 and 21 from which it is doctored

away. Exit holes **50** are suitably cleaned by alternating steam with high pressure hot water. Obviously several alternative methods are available to heat the opposed rolls with similar effectiveness. Of importance is the discovery that heated surfaces provide a significant improvement over past technology.

The invention provides a process that assures maximum bark removal from unbarked wood chips to render such wood chips substantially bark-free. The steps can be varied to ensure maximum effectiveness depending on species and seasonal variations in the raw inputs.

Having thus disclosed our invention we claim:

1. A process for removing the bark from wood chips in an unbarked wood chip mass, comprising the steps of:

a. steaming said chips at a low pressure to render the bark fraction tacky and weaken the wood-bark bond,

b. mechanically compressing said chips between two closely opposed, oppositely rotating surfaces to crush and partially break said bark fraction into smaller particles, a portion of said particles adhering to said rotating surfaces,

c. removing said broken bark by

1. scraping said adhering particles from said rotating surfaces, and

2. screening the remaining particles from the chips,

d. abrading said chips to fragmentize any remaining bark, and

e. segregating said fragmentized bark from the resulting clean wood chips.

2. The process of claim **1** wherein said chips are steamed for a period of from a few seconds to 15 minutes at pressures of from 0 to 50 p.s.i.g.

3. The process of claim **1** wherein said chips are abraded by mechanical milling.

4. The process of claim **1** wherein said chips are abraded by being transported between two continuously moving, substantially parallel surfaces, one of said surfaces being oscillated in a direction transverse to its continuously moving direction.

5. The process of claim **4** wherein said chips are abraded by

a. directing them into a process zone formed between two continuously moving, substantially parallel surfaces, each of said surfaces moving in opposite directions so as to converge toward one another at one end and away from one another at the opposite end of said process zone, said surfaces being so disposed to one another as to catch and hold said chips and transport them through said process zone, and

b. oscillating one of said moving surfaces in a direction transverse to its continuously moving direction to fragmentize any remaining bark as said chips are transported through said process zone.

6. In a process for removing the bark from wood chips in an unbarked wood chip mass utilizing mechanical compression of the wood chips between two moving surfaces to crush the bark, and including separation of the crushed bark from the wood, the combination with said mechanical compression and separation of the following steps:

a. steaming said chips at a low pressure to render the bark fraction tacky and weaken the wood-bark bond prior to said mechanical compression and separation,

b. abrading said chips, following said mechanical compression and separation, by mechanical milling to fragmentize any remaining bark, and

c. segregating said fragmentized bark from the resulting clean wood chips.

7. The process of claim **6** wherein said chips are steamed for a period of from a few seconds to 15 minutes at pressures of from 0 to 50 p.s.i.g.

8. In a process for removing the bark from wood chips in an unbarked wood chip mass utilizing mechanical compression of the wood chips between two moving surfaces to crush the bark, and including separation of the crushed bark from the wood, the combination with said mechanical compression and separation of the following steps:

a. steaming said chips at a low pressure to render the bark fraction tacky and weaken the wood-bark bond prior to said mechanical compression and separation,

b. abrading said chips, following said mechanical compression and separation, by

1. directing them into a process zone formed between two continuously moving, substantially parallel surfaces, each of said surfaces moving in opposite directions so as to converge toward one another at one end and away from one another at the opposite end of said process zone, said surfaces being so disposed to one another as to catch and hold said chips and transport them through said process zone,

2. oscillating one of said moving surfaces in a direction transverse to its continuously moving direction to fragmentize any remaining bark as said chips are transported through said process zone, and

c. segregating said fragmentized bark from the resulting clean wood chips.

9. The process of claim **8** wherein said chips are steamed for a period of from a few seconds to 15 minutes at pressure of from 0 to 50 p.s.i.g.

10. The process of claim **8** wherein said two moving surfaces are heated to increase bark adherence during mechanical compression.

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