Aug. 27, 1963 T. P. HANSON 3,101,757

APPARATUS AND METHOD OF DEBARKING PULP WOOD UTILIZING LIQUIFIED GASSES

Filed April 24, 1961 2 Sheets-Sheet 1

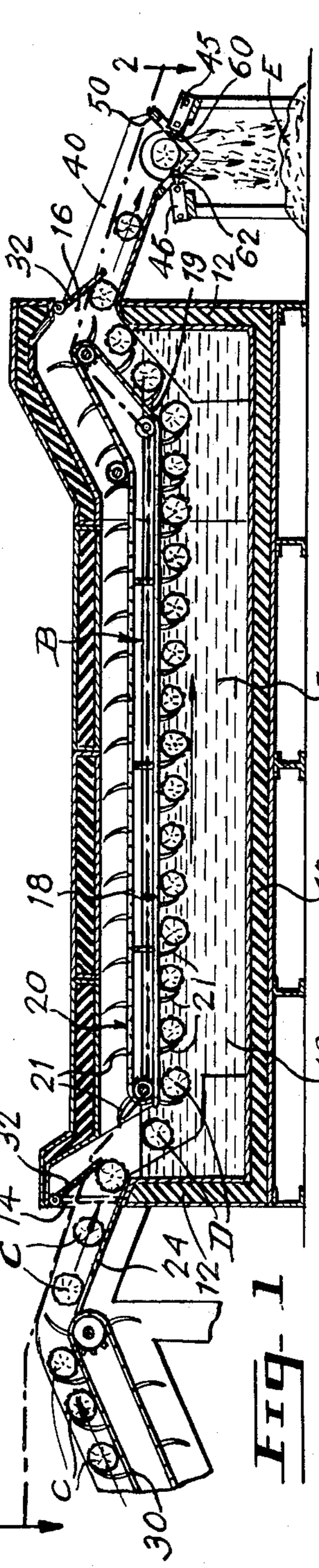

Fig. 1

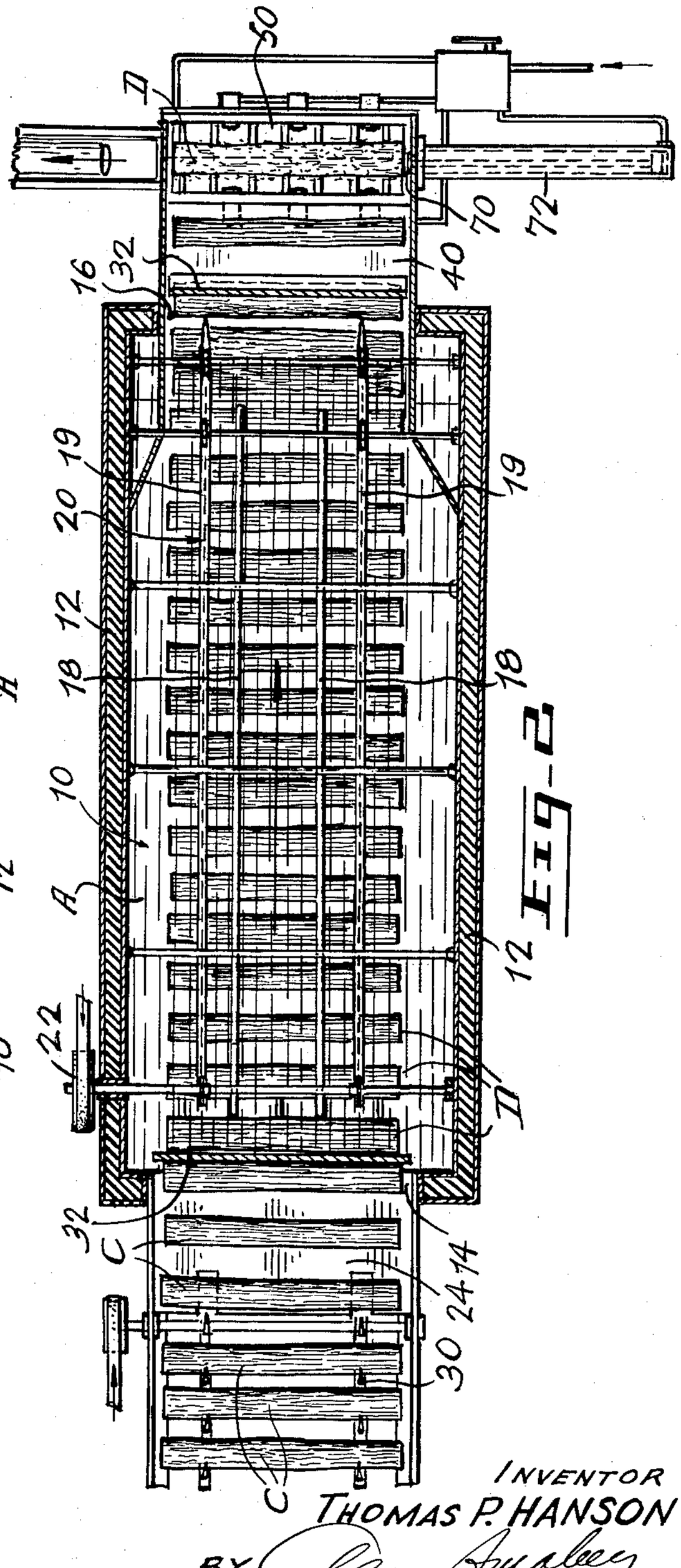

Fig. 2

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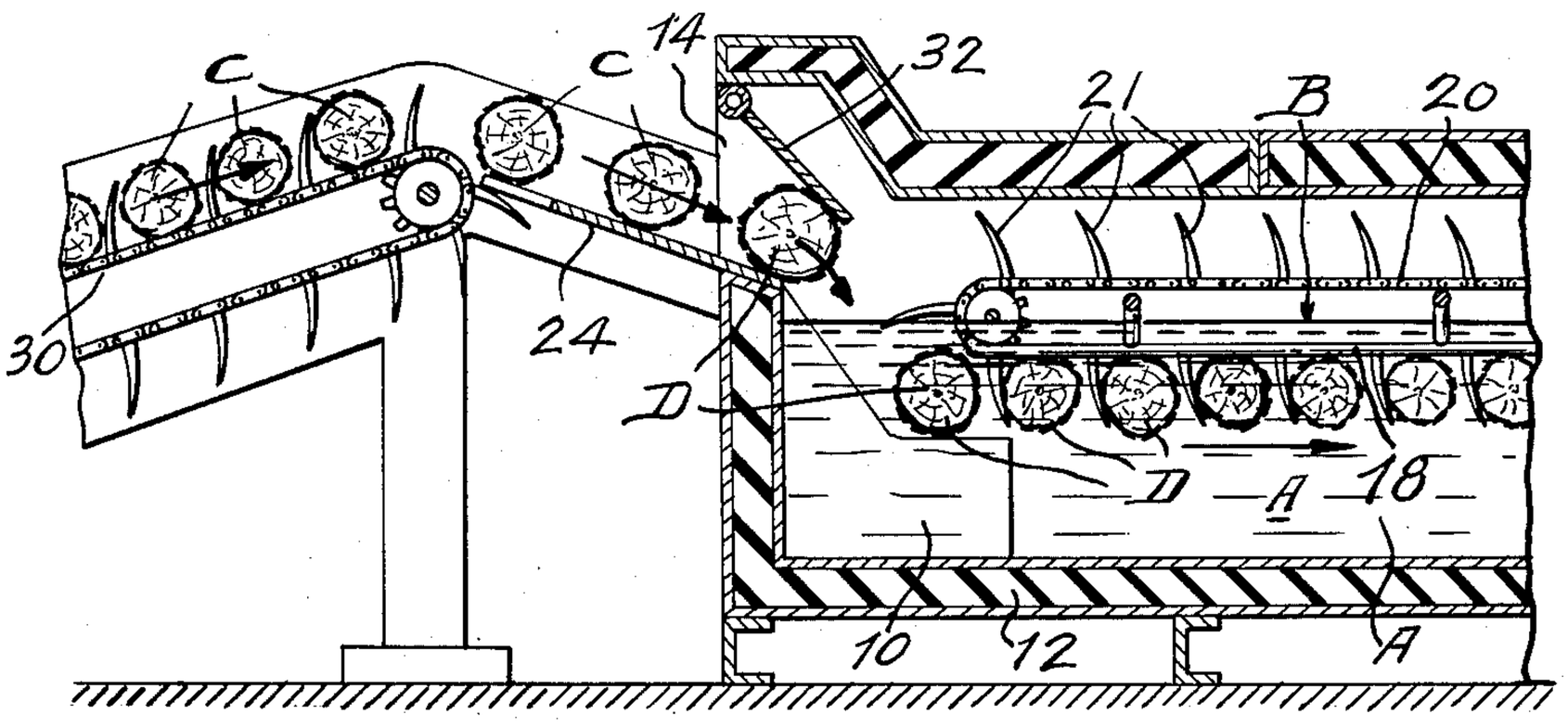

Fig. 3

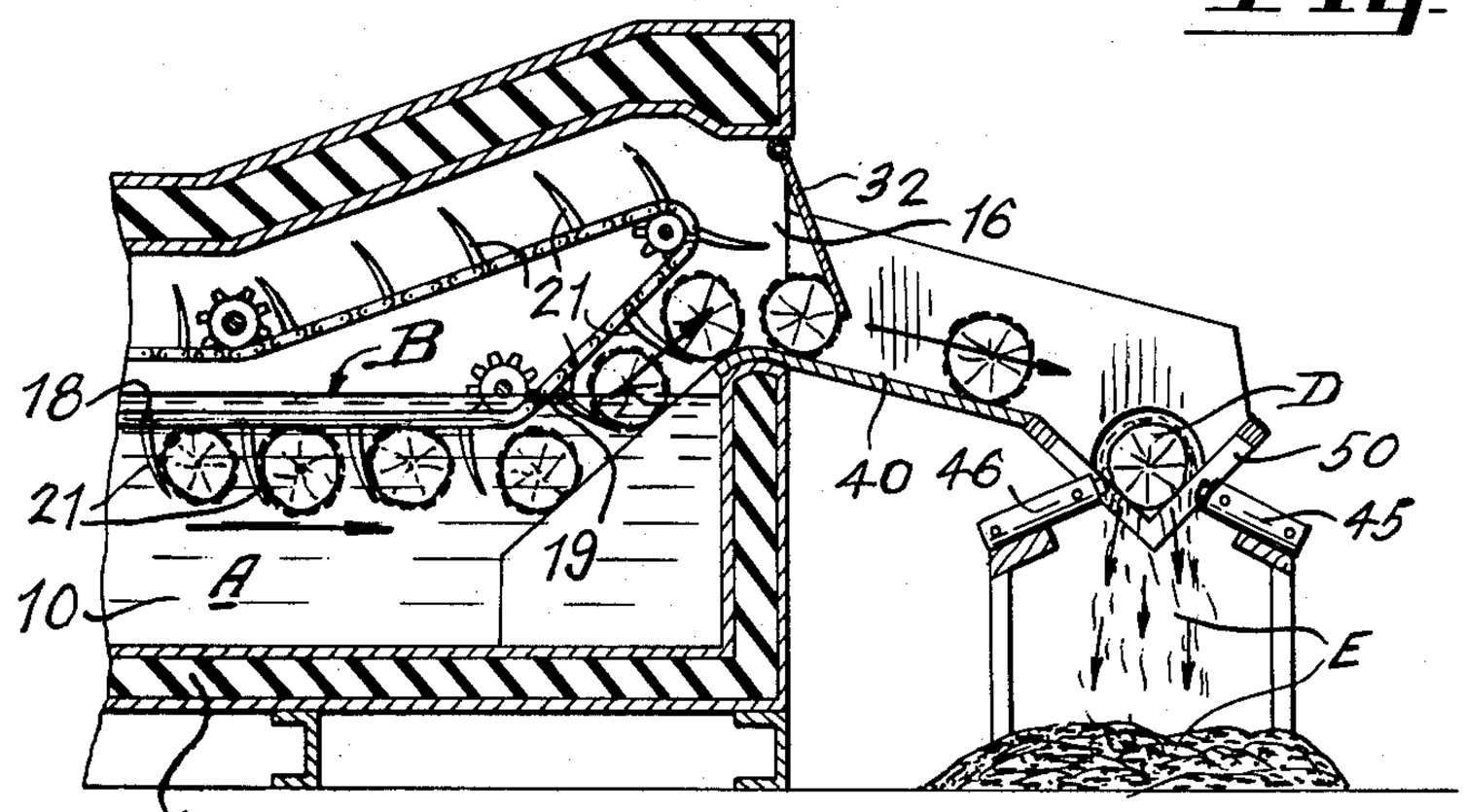

Fig. 4

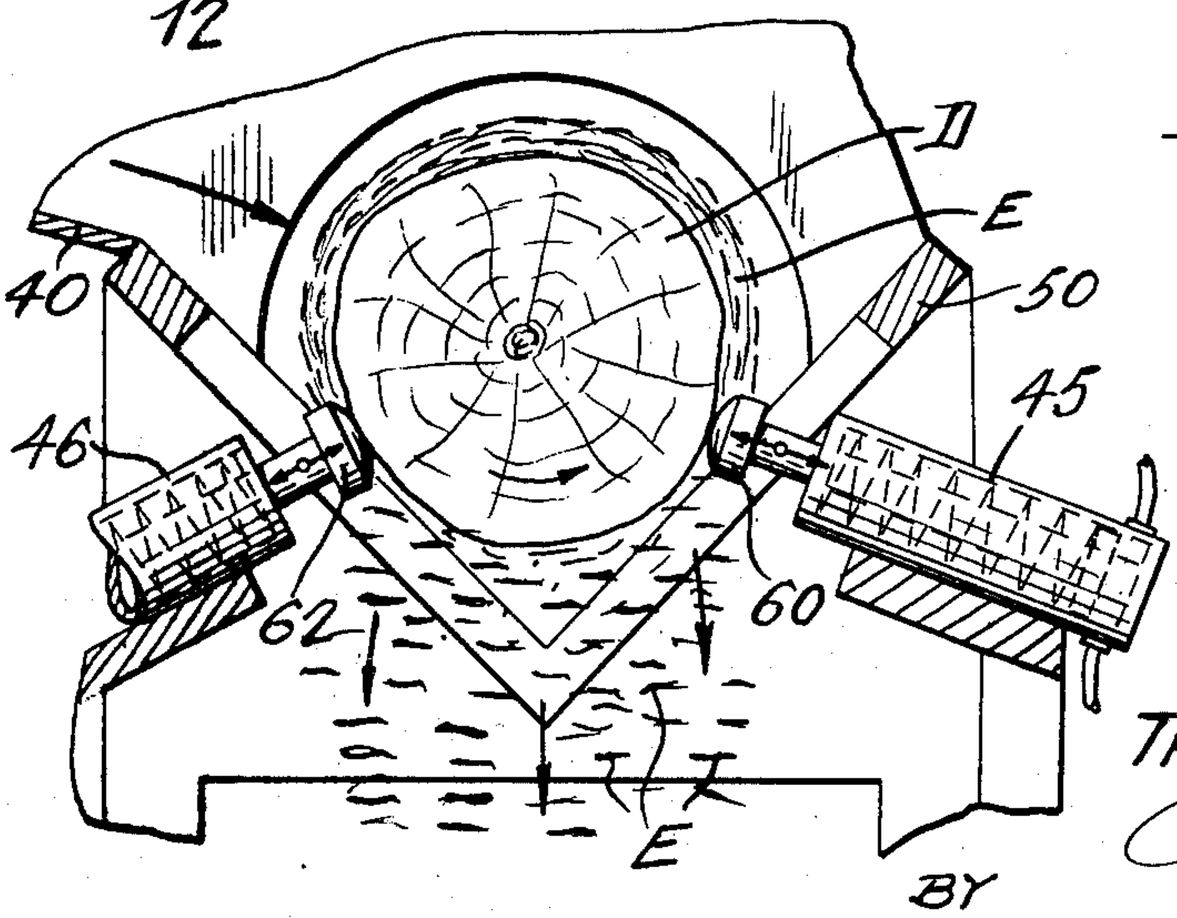

Fig. 5

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APPARATUS AND METHOD OF DEBARKING PULP WOOD UTILIZING LIQUIFIED GASSES

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The present invention relates to an improved method of debarking wood and particularly pulpwood as used in the paper-making industry.

As is well known, a prime requirement of quality in the production of pulp in the paper-making industries is that the pulpwood be as completely free of bark as possible.

Accordingly, the removal of this bark is an essential and important operation and there are at present many types of apparatus available for this purpose, for example barking drums, hydraulic barkers, chain-type barkers and so on, all of which operate on the general principle that the bark is to be loosened and removed by friction, hydraulic pressure or abrasion.

It has also been established in the industry that there are certain problems involved in the barking of pulpwood which require special consideration, for example certain hardwoods are more difficult to bark than others, dry woods are harder to bark than wet wood, and frozen bark is almost impossible to bark without prior treatment.

The present invention aims to provide a method of debarking wood of all types, and particularly pulpwood, which is not affected by any of the problems mentioned above and will effectively and quickly debark any type of hard or soft wood, dry or wet, frozen or unfrozen, leaving a clean surface without any damage to the wood itself.

This is accomplished by subjecting the wood to be debarked to a sharp freezing operation whereby the bark down to at least the outer cambium layer is frozen to a brittle glass-like state where it can be effectively shattered by an impact or blow clearing it from the log exterior. In accordance with a preferred means of carrying out the present invention, this is accomplished by totally immersing the bark-covered log in a bath of liquified gas having a temperature of say from about —180° C. to about —200° C. for a period of from about 10 to 60 seconds, depending on the type of wood. The log with the bark sharply frozen as described is then withdrawn from the bath and subjected to a series of sharp impacts shattering the bark which breaks in glass-like particles clear of the log, leaving a smooth unblemished surface.

The present invention also aims to provide an apparatus by means of which this method can be carried out continuously to provide for production debarking as is required in the paper-making industries. This apparatus consists essentially of a main tank or enclosure adapted to contain a sufficient quantity of liquified gas to permit the total immersion of logs, conveyor means adapted to convey logs into, through, and out of the liquified gas, and to an impact or hammer apparatus adapted to shatter the glass-like sharp frozen bark.

Having thus generally described the nature of the invention, particularly reference will be made to the accompanying drawing showing by way of illustration an apparatus by means of which the method of the invention may be carried out in a continuous cycle, and in which:

FIGURE 1 is a side elevation partially in vertical cross section of an apparatus adapted to carry out in a continuous manner the debarking method of the invention.

FIGURE 2 is a view in plan and partially in horizontal cross section of the apparatus shown in FIGURE 1.

FIGURE 3 is an enlarged detail view of the loading end of the apparatus shown in FIGURE 1.

FIGURE 4 is an enlarged detail view of the discharge end of the apparatus shown in FIGURE 1.

FIGURE 5 is an enlarged detail view of the bark shattering impact hammers at the discharge end of the apparatus.

As previously mentioned, the basic concept of the present invention resides in the discovery that bark when subjected to extreme cold, say for example in the neighbourhood of from about —130° C. to about —200° C. or possibly colder, becomes brittle and glass-like to the extent that it can be shattered clear of the wood by impact. The condition of the wood to be barked, i.e. wet, dry, frozen, or the type of wood, i.e. "hard" or "soft" in the general terminology, does not have any bearing on the effective removal of the bark with the present method with the exception that the time of exposure to the freezing medium might be lengthened or shortened according to the type or condition.

In fact, the worst condition of pulpwood, as considered by the prior art, namely "frozen bark" or wood delivered from or resting in the woods during winter, is already partially frozen and therefore is, if anything, more easily treated than relatively warm, previously wet wood looked upon as being the best for efficient barking by the previously known barking methods.

In order to provide the desired freezing action to the bark in accordance with the present method it has been found that this can be accomplished very effectively by immersing the logs in a liquified gas, for example any of the readily available liquified gases, namely nitrogen, oxygen or liquid air is suitable.

As is well known, nitrogen boils at —195.8° C., air at —191° C. and oxygen at —183.0° C., all under the pressure of one atmosphere so that the logs are subjected to an intense quick freezing far beyond anything encountered in nature which results in the bark down to at least the outer cambium layer of the wood being quickly transformed to a hard glass-like consistency which will shatter into relatively small particles when subjected to a blow or impact.

In preliminary experiments using a liquified gas, air for example, and made with most types of the common woods encountered in the pulp industry, it was found that the time cycle of immersion, for best results on standard pulpwood sizes and lengths, ran from about a minimum of 10 seconds to a maximum of about 60 seconds depending on the type of wood. After immersion the wood was withdrawn and subjected to impact as soon as possible, in from about 2 to about 10 seconds in the experiments made. The bark was shattered off cleanly leaving a clear undamaged wood surface following all the contours of the log.

The time for subjecting the test logs to such impacts for maximum results ran from about 15 seconds to about 30 seconds although with more efficient impact-producing apparatus this time could be reduced.

Examination of the test logs immediately after barking revealed that surface temperatures of the wood (after an elapsed time of about 30 seconds to 90 seconds after immersion) ran from about 0° F. to about —75° F. and that these temperatures quickly rose to approximately existing air temperatures which would indicate that the extreme freezing action apparently did not penetrate much beyond the outer cambium layer within the immersion times described.

It was also established that "hardwoods" in general required less immersion time than "soft woods" and, as previously mentioned, "frozen logs" did not require any prior treatment but were just as effectively barked as wet or dry wood in ideal condition.

While it will be understood that the present method can be carried out by any form of apparatus providing means to contain sufficient liquified gas to permit immersion of a log or logs and means to impart a blow or a

series of blows to the frozen bark to release it from the log are provided, a preferred form of apparatus suitable for production debarking is shown in the accompanying drawings.

In these drawings FIGURE 1 shows, somewhat diagrammatically, a main tank or enclosure **10** having suitably insulated walls as indicated at **12** and including a log entrance door **14** and a log discharge door **16**. A sufficient quantity of liquified gas indicated at "A" is maintained within the tank **10** by suitable controls (not illustrated) so that the liquid level indicated at "B" is always above the log guiding rack **18** and the lower run **19** of a continuous conveyor chain **20**. The conveyor chain **20** is shown as being journalled on suitable shafts extending through the side walls of the tank **10** with a drive pulley **22** attached to provide a means of driving the chain.

In the construction illustrated the logs "C" are fed up and into the log entrance door **14** by a ramp or chute **24** to which the logs are continuously fed by a toothed conveyor chain **30**. In view of the nature of the liquified gas the entrance door **14** and discharge door **16** are each provided with a swinging flap or door **32** to reduce temperature losses as much as possible and subsequent vaporization of the liquified gas.

The logs "D" delivered to the liquified gas as shown are caught by the hooks **21** of the chain **20** so as to drag them beneath the surface of the liquid gas against their natural buoyancy and through the length of the tank at a predetermined rate, dependent on the desired immersion time, and to raise them from the liquified gas and discharge them through the discharge door **32**. The logs then pass down a ramp or chute **40** onto a V-shaped grate or bed **50** where they are immediately subjected to a series of rapid hammer-like impacts from opposed batteries **45**, **46** of pneumatically operated reciprocating pistons **60**, **62**. As is shown in FIGURE 5, it is preferred that the pistons **60** are located slightly higher than the pistons **62** so that the impacts will tend to rotate the log "D" as the sharply frozen bark "E" is shattered thus effectively cleaning the entire circumference. As soon as the log is clean, which is accomplished in a matter of seconds, the barked log is pushed clear of the grate **50** by a pneumatically operated piston **70** operating from a cylinder **72** so that the grate **50** is clear for the next log.

As previously mentioned, the apparatus shown is illustrative only of one way in which the method of the invention may be carried out in a continuous cycle suitable for production debarking of pulpwood. While the logs "D" shown are all of approximately the same size and diameter, logs of any size or diameter could be debarked in a similar apparatus with provision being made by supplemental conveyor chains to ensure that they are dragged under and through the liquified gas for the desired freezing action on the bark.

I claim:

1. A method of debarking pulpwood comprising the steps of totally immersing said wood within a liquified gas for a sufficient length of time to reduce the bark on said wood to a hard brittle glass-like state and while in said state subjecting said bark to impact shattering said bark clear of said wood.

2. A method of debarking pulpwood comprising the steps of totally immersing said wood within a liquified gas having a temperature of from about —180° C. to about —200° C. for a period of time from about 10 seconds to about 60 seconds, withdrawing said wood from said liquified gas immersion and subjecting it to impact.

3. A method of debarking pulpwood as claimed in claim 2, wherein said wood is subjected to impact within a time period of from about 2 seconds to about 10 seconds after said liquified gas immersion.

4. A method of debarking pulpwood as claimed in claim 2, wherein the liquified gas is nitrogen.

5. A method of debarking pulpwood as claimed in claim 2, wherein the liquified gas is air.

6. A method of debarking pulpwood as claimed in claim 2, wherein the liquified gas is oxygen.

7. A method of debarking pulpwood logs in a continuous cycle comprising conveying said logs in sequence through a confined area containing a liquified gas while totally immersing said logs beneath the level of said liquid, removing said logs from said confined area in sequence and subjecting the outer surface of each log to a series of impacts shattering the bark therefrom.

8. A method of debarking pulpwood as claimed in claim 7, wherein said liquified gas is nitrogen.

9. A method of continuously debarking pulpwood as claimed in claim 7, wherein said liquified gas is air.

10. A method of continuously debarking pulpwood as claimed in claim 7, wherein said liquified gas is oxygen.

11. An apparatus for the debarking of pulpwood in a continuous cycle, comprising, an insulated container adapted to contain a quantity of liquified gas, log entry and exit ports in said container, conveyor means within said container adapted to engage and convey logs delivered within said log entry port to said log exit port through the length of said container and beneath the surface of said liquified gas, a log-holding grate, conveyor means from said container exit port to said grate, means to impart multiple impacts to the outer surfaces of a log supported on said grate whereby the bark is shattered therefrom, and means to clear barked logs from said grate.

12. An apparatus for the debarking of logs as claimed in claim 11, wherein the conveyor means within said container comprise endless conveyor chains provided with log-engaging hooks.

13. An apparatus for the debarking of logs as claimed in claim 11, wherein the means to impart multiple impacts to said logs comprise opposed batteries of reciprocating piston-cylinder assemblies and means to actuate said pistons.

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