# United States Patent [19]

**Tee**

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[45] **Apr. 22, 1975**


[54] **APPARATUS AND PROCESS FOR TREATING WASTE WOOD**


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[73] Assignee: **Urban Wood & Fiber Products, Inc.**, Madison, Wis.



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[21] Appl. No.: **419,605**

[52] **U.S. Cl.** ..... **241/24**; 241/25; 241/28; 241/79.1; 241/80

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

[58] **Field of Search** ..... 241/15, 24, 25, 28, 29, 241/38, 43, 78, 79, 79.1, 80



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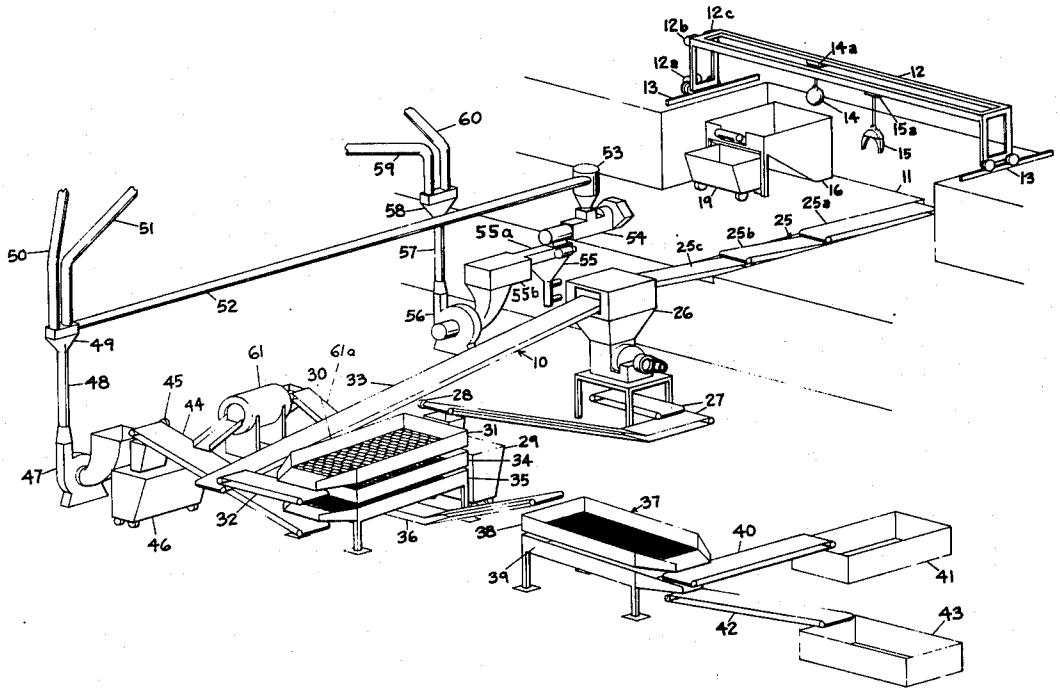
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[57] **ABSTRACT**

Apparatus and process for treating waste wood to produce usable end products. Waste wood received in a dump pit is broken up by a drop weight, and may, if desired, be introduced by a grapple into a flotation tank for separation from intermixed debris that is denser than water. The floating waste wood is then picked up by the grapple and placed on a conveyor for introduction into a hog grinder wherein the waste wood is ground into wood chips. Magnetic material intermixed with the wood chips is separated therefrom by a magnetic pulley conveyor. The chips are then run through a screen separator for separation by size into oversize chips, acceptable chips and undersize chips. The acceptable chips may be stored to await transport to users or may be further processed. Additional processing includes moisturizing the chips in a chip compactor and washing them in a water bath to remove foreign material. Undersize chips may further be separated by size to reclaim usable wood material.


**14 Claims, 2 Drawing Figures**



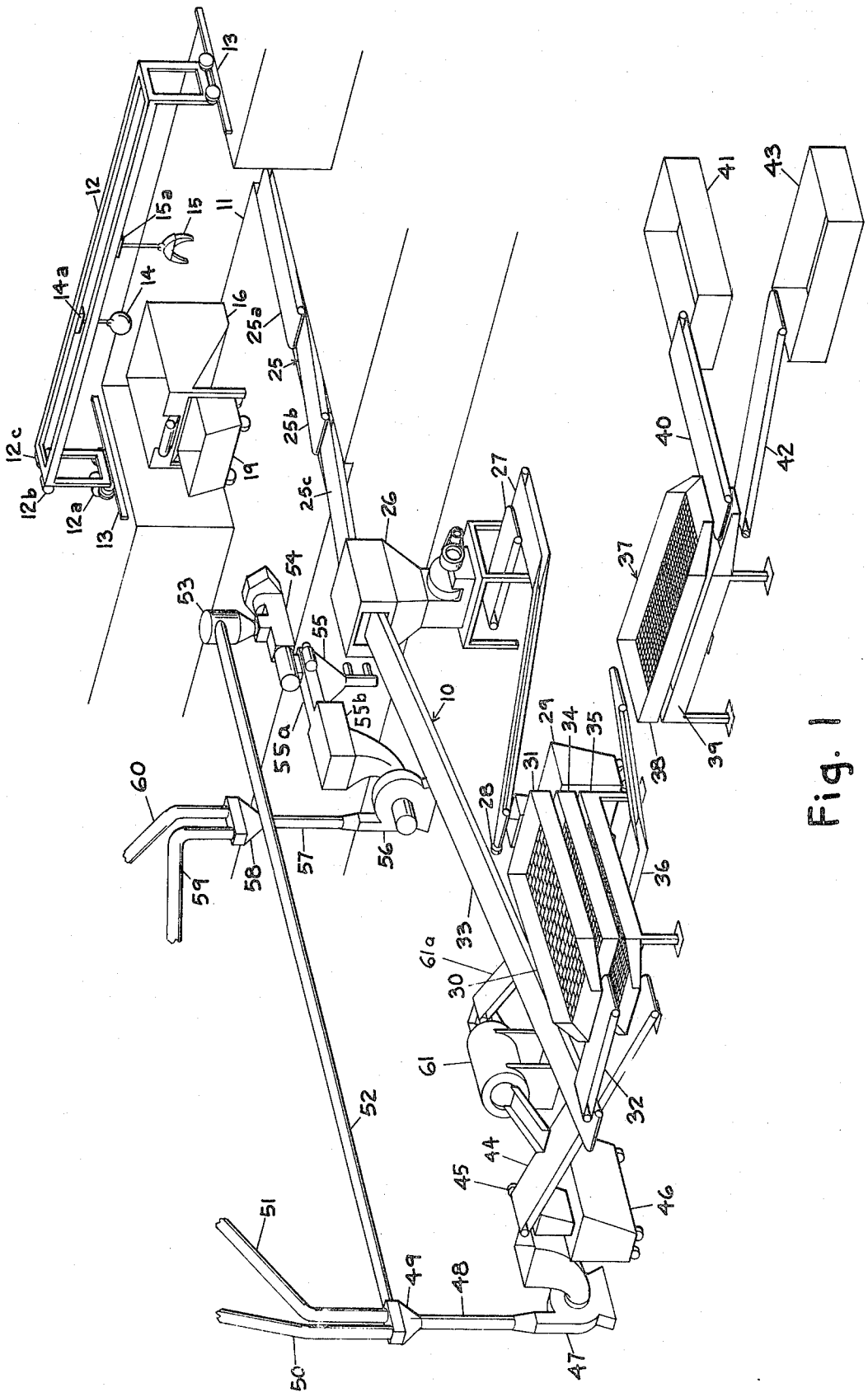

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Fig. 1

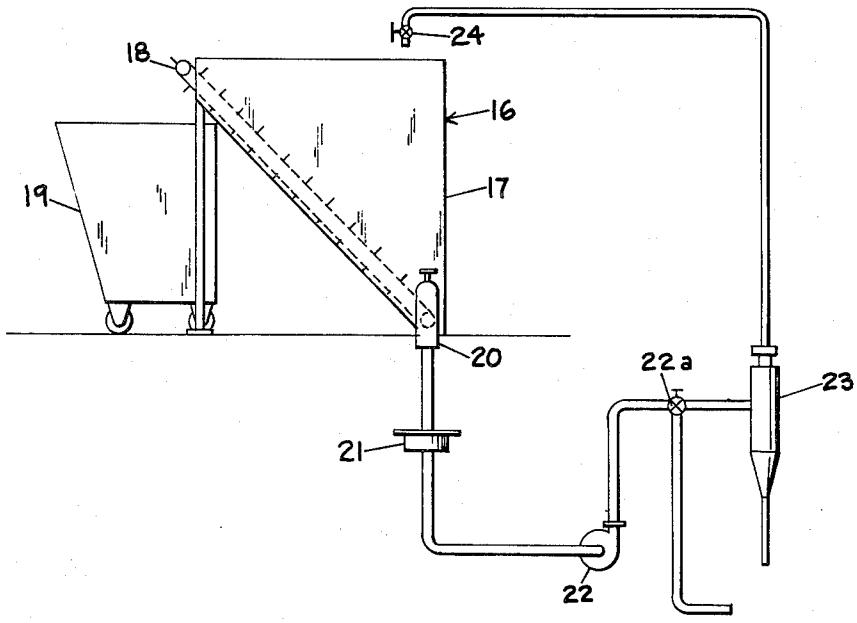



Fig. 2

# APPARATUS AND PROCESS FOR TREATING WASTE WOOD

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to systems for processing waste wood to produce usable particulate wood material, such as chips.

2. Description of the Prior Art

Because of the increased demand for and dwindling supply of virgin wood, efforts have been made to use waste wood in certain applications where virgin wood was formerly used exclusively. Paper pulp and press board are examples of applications where waste wood might be suitable.

Since these applications for waste wood generally require wood chips, the first step in reclaiming the waste wood has customarily been to grind the wood in a hog grinder to produce wood chips. The chips are then conveyed to a screen separator wherein the acceptable sized chips are separated from oversize and undersize chips. Oversize chips are returned to the grinder for further grinding while undersize chips or fines are discarded. The acceptable chips are stored for transport to users. This conventional system is generally limited to the processing of relatively clean waste wood since a high level of foreign material intermixed with the accepted chips cannot be tolerated.

## SUMMARY OF THE INVENTION

I have invented an apparatus and process for treating waste wood which is capable of producing usable wood material from waste wood having a normal moisture content of less than **40%** and which also may be highly contaminated with foreign matter. My waste wood treating apparatus is designed to efficiently and continuously process large quantities of waste wood with a minimum of human labor.

The waste wood treating apparatus has a dump pit wherein waste wood is deposited, and a gantry crane over the pit carrying a drop weight and grapple whereby waste wood can be continuously broken up into smaller pieces that are more readily processed and, if desired, introduced into a sink-float apparatus to separate the waste wood from debris that is denser than water. Waste wood from the receiving area is ground into wood chips in a hog grinder, the wood chips from the grinder are passed through a magnetic separator wherein the chips are separated from magnetic material intermixed therewith, and the chips are then separated into acceptable size chips, oversize chips and undersize chips in a screen separator. The oversize chips are conveyed back to the grinder while the undersize chips or fines are further separated into coarse material which is readily usable, and fine material which may or may not be usable. Acceptable chips may be stored or conveyed to a loading area if they are relatively free from foreign matter, or they may be further processed by passing through a chip compactor and chip conditioner. The comparator and conditioner moisturize the chips to the extent desired, chemically treat the chips for improved storage quality and performance in end products, and wash the chips to remove foreign material. The processed chips may then be stored or conveyed to a loading area for immediate transport.



## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a perspective view of a waste wood treating apparatus embodying the principles of my invention.

FIG. **2** is a somewhat simplified side elevation view of the sink-float apparatus portion of my waste wood treating apparatus.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings wherein like numerals refer to like parts in both views, my waste wood treating apparatus is shown generally at **10** in FIG. **1.**

Waste wood from various sources is collected and transported by trucks or other suitable vehicles, and is dumped into a three sided rectangular dump pit **11,** which serves as a receiving and storage receptacle for the waste wood. Depending the nature of the waste wood, in order to reduce the bulk of the waste wood before transporting it to the location of my treating apparatus, it may be desirable to break up the waste wood using a pre-shredder (not shown) at a site near the source of the waste wood. The three elevated sides of the dump pit **11** allow trucks to easily approach the dump pit and discharge their cargo down into the pit. The dump pit **11** is preferably formed by digging into the side of a hill, but may be formed by filling an area with earth to raise the sides of the dump pit above the level of the surrounding land. The walls of the dump pit **11** will preferably be reinforced with concrete or other suitable material to form adequate retaining walls. One long side of the dump pit **11** is open to allow access to the dump pit from adjacent land which is substantially at the level of the bottom of the dump pit.

A gantry crane **12** extends over the length of the dump pit **11,** and is wheel mounted on a pair of rails **13** which allows the gantry crane to move across the width of the pit. The crane is driven along the rails by a motor **12***a*. A drop weight **14** and a grapple **15** are suspended from the crane **12** and are moved over the length of the crane by a motor **12***b* and a motor **12***c* respectively. Thus the entire pit area is accessible to the drop weight **14** and the grapple **15,** which can both be operated by a single human operator. The drop weight **14** is raised by a motor **14***a* and is dropped from its raised position onto the waste wood in the pit below. The repeated dropping of the drop weight **14** breaks up large pieces of waste wood into smaller pieces that can be more easily processed. The grapple **15** also can be raised and lowered from the gantry crane **12** by a motor **15**a, and is capable of grasping quantities of waste wood and transferring them to other areas within the pit.

The waste wood that is discharged into the dump pit **11** may vary significantly in size, quality and in the amount of contaminating debris intermixed with the wood. Material deposited in the pit will typically consist of such waste wood residues as old pallets, shipping dunnage, old crates, construction wood waste and demolition waste. To rid the waste wood of the heavier debris before further processing, a sinkfloat apparatus **16,** as shown in FIGS. **1** and **2,** may be used. The sink-float apparatus **16** is preferably located in the dump pit **11** so that trucks may unload waste wood directly into the water filled sink-float tank **17,** or so that the tank may be loaded by the grapple **15.** The tank **17** prefera-

bly has three upright sides and a fourth side which slants downwardly and inwardly toward the opposite upright side. A suitable flighted conveyor **18** is mounted on and extends along the slanting side of the tank **17** and conveys sunken debris out of the tank into a scrap cart **19.** The material that is less dense than water, primarily wood, will float on top of the water and be removed by the grapple **15.** Periodically, a timer valve **20** at the bottom of the tank **17** opens up to drain water and suspended debris out of the tank. The water released from the tank **17** is preferably filtered through a vibrating screen **21** to remove the larger particles of debris in suspension, and is then passed by a pump **22** through a two-way **22***a* either into a central cleaner **23** which filters the fine debris out of the water or directly into a sewerage system (not shown), as desired. Water which passes through the central cleaner **23** is returned to the tank **17** by a control valve **24,** which introduces water into the tank to maintain the water level therein. Alternatively, fresh water may be introduced into the tank by the control valve **24** if the water from the tank is passed to sewerage.

A conveyor system **25** runs substantially horizontally through the center of the dump pit **11** and out the open side of the pit. The conveyor system **25** consists preferably of three endless belt conveyors arranged serially so that material deposited on a first conveyor **25***a* will be passed to a second conveyor **25***b* and thence to a third conveyor **25***c*. The second conveyor **25***b* moves at a faster speed than the first conveyor **25***a*, and the third conveyor **25***c* moves faster than the second conveyor **25***b*. Waste wood that has been broken up by the drop weight **14** is picked up by the grapple **15** either directly from the dump pit **11** or from the sink-float apparatus **16,** and is deposited on the first conveyor **25***a*. The conveyor system **25** conveys the broken up waste wood to a hog grinder **26** which grinds the waste wood into wood chips. The purpose of the three varying speed conveyors **25***a*, **25***b*, and **25***c*, is to spread out the waste wood being fed into the hog grinder **26** to prevent overloading of the grinder. The grapple **15** and the conveyor system **25** will be the usual means for conveying waste wood from the dump pit **11** to the hog grinder **26** although the design of the dump pit allows loading of the grinder by a fork lift or other means if desired.

The hog grinder **26** will preferably have adjustable grinding teeth to allow the size of the chips produced by the grinder to be varied. The desired average chip size will depend primarily on the use to which the chips will be put, as for example, particle board, composite fuel logs, or chips for paper pulp. The wood chips from the grinder **26** are deposited on an endless belt conveyor **27** which has a magnetic separator pulley **28** at the discharge end. The magnetic separator pulley **28** attracts any tramp iron or other magnetic debris and pulls this magnetic material around the pulley to the underside of the conveyor **27,** where the magnetic material is pulled out of the influence of the separator pulley **28** by the returning conveyor belt and is deposited into a scrap cart **29.** The wood chips are unaffected by the magnetic field from the separator pulley **28** and, thus separated from magnetic material, fall off the end of the conveyor **27** into a chip separator **30.**

The grinder **26** produces wood chips of varying sizes that may be larger or smaller than the desired chip size. For example, pulp mills generally require an average chip length of ¾ inch, average width of ⅝ inch and ⅛ inch to ½ inch average chip thickness. To provide a means for separating the wood chips from the grinder **26** into acceptable chips, oversize chips, large chips, and undersize chips (fines), the tripledeck chip separator **30** is used. The chip separator **30** has a top coarse screen **31** with 1 ½ inches to **2** inches square openings in the coarse screen mesh which permits acceptable size chips and fines to pass through but retains oversize chips. The oversize chips pass off the coarse screen **31** as the screen is vibrated and are deposited on an endless belt conveyor **32** and thence to another endless belt conveyor **33.** The oversize chips conveyors **32** and **33** convey the oversize chips back into the grinder **26** for further grinding.

A fine screen **34** is mounted in the chip separator **30** underneath the coarse screen **31,** and for retaining pulp sized chips the screen **34** would preferably have mesh openings of ¾ to 1 inch square. Large chips, that is chips larger than the ¾ to 1 inch openings, are retained on the screen **34** and are fed onto an endless belt conveyor **61**a which conveys the large chips into a pin chipper **61,** whereas smaller chips pass through the screen **34** and are received by a third deck screen **35.** The pin chipper **61** reduces the chips into substantially uniform lengths between ¼ to ⅝ inch. The third deck screen **35** has a ¼ inch screen mesh, which retains small acceptable chips. Chips which pass through the third deck screen **35** are considered fines or sawdust. The fines pass from the separator **30** to an endless belt fines conveyor **36** which conveys the fines to a fines separator **37.**

The fines separator **37** is similar in construction to the chip separator **30,** and has an upper screen **38** which permits very fine grade material to pass through and be collected in a lower bin **39,** while coarser grade wood particles in the range of ¼ inch in length are retained on the upper screen **38.** An endless belt conveyor **40** receives the coarser grade material from the upper screen **38** and conveys this material to a storage bin **41.** Similarly, an endless belt conveyor **42** conveys the very fine grade material to another storage bin **43.** The coarser material from the fines separator **37** may be used in such wood products as particle board.

Small acceptable chips coming from the pin chipper **61** and the third deck screen **35** in the chip separator **30** are received by an endless belt conveyor **44.** A magnetic separator pulley **45,** similar to the pulley **28,** is located at the discharge end of the conveyor **44** and pulls off remaining tramp iron and other magnetic material intermixed with the acceptable chips and deposits it in a scrap bin **46.** The acceptable chips are unaffected by the magnetic field from the pulley **45** and are deposited in a blower **47** which blows them into a blow pipe **48** and thence to a threeway directional valve **49.** The valve **49** directs the acceptable chips into conduits leading to one of three destinations as selected by a human operator. For acceptable chips that are relatively free from foreign material, a first mode is provided wherein chips are directed into a first conduit or blow pipe **50** and are received in a storage area (not shown), and a second mode is also provided wherein chips directed into a second blowpipe **51** are received at a loading area (not shown) for immediate shipment. For chips that have excessive foreign material intermixed therewith or are excessively dry, or need further treatments for quality improvement, a third mode is provided wherein acceptable chips are directed into a

third blow pipe **52** and are received by a cyclone feeder **53** which accumulates the chips and discharges them at a uniform rate into chip compactor **54.** The chip compactor **54** compacts the acceptable chips, preferably by utilizing a revolving screw feeder (not shown) wherein the screw feeder and its housing decrease in diameter from the inlet end to the outlet end of the compactor **54.** The compaction of the chips in the screw feeder reduces the volume of the chips and consequently reduces the amount of entrapped air in the chips. The compressed chips are discharged from the compactor **54** into a chip conditioner **55** and pass through a spray section **55***a* wherein the chips are immediately subjected to a water or water-chemical spray such as a borax solution. The borax solution spray action not only introduces the desired percentage of moisture into the chips, but also chemically treats the chips in terms of preservation of the chips during storage and improvement of the chips for further chemical treatment during the process of converting such chips into end products. The chips released from the compactor **54** expand in the spray and absorb a desired amount of water or water-chemical solution depending on the required moisture content of the end product. The amount of moisture absorbed is controlled by controlling the spray and the feed rate of the chip compactor **54.**

After the spray, the chips are discharged into a water bath section **55***b* of the conditioner where the chips are subjected to a bath. A screw feeder (not shown) turns within the bath to further agitate the chips and move them along the length of the chip conditioner. The agitating and washing action within the bath section provides a means for cleansing foreign matter and other small debris from the chips. In addition, the combined effect of the chip compactor **54** and chip conditioner **55** enables the pH of the chips to be controlled within limits.

In the case where two separators are to be used instead of a triple deck separator the first separator would have a double deck screen with a top screen of 1 ½ to 2 inch mesh which sorts out the oversize chips for regrinding. The lower deck screen would be a ⅛ inch mesh which separates the sawdust from the chips to be transferred to the second separator. The second separator has a single deck screen with a ¾ to 1 inch mesh. Chips sorted out by this single deck screen are fed into a pin chipper which reduces the chips length to between ½ to ¾ inch. Chips discharged from the pin chipper are then mixed with the chips which pass through the single deck screen. These accepted chips thereafter go through the previously described sequence of the compactor and chip conditioner.

The chip conditioner **55** discharges the cleaned and conditioned chips into a blower **56** which blows the chips into a blow pipe **57.** A two-way directional valve **58** allows the operator to select a first mode wherein the chips are directed through a first blow pipe **59** to a storage area (not shown) or a second mode wherein the chips are directed through a second blow pipe **60** to a loading area (not shown) for immediate shipment.

It is understood that my invention is not confined to the particular construction and arrangement of the parts herein illustrated and described, but embraces all such modified forms thereof as come within the scope of the following claims.

I claim:

**1.** A process for treating waste wood to produce usable wood chips, comprising the steps of;

a. grinding said waste wood to produce wood chips:
b. magnetically separating said wood chips from magnetic material intermixed therewith;
c. separating said wood chips by selectable sizes into oversize chips, acceptable chips and fines;
d. compacting said acceptable chips;
e. releasing said compacted acceptable chips in a water spray during expansion of said chips to thereby facilitate absorption of moisture into said chips; and
f. washing said acceptable chips in a water bath.

**2.** The process specified in claim **1** including before grinding the step of introducing said waste wood to a water float tank wherein said waste wood is substantially separated from debris intermixed therewith which is denser than or suspendable in water.

**3.** The process specified in claim **1** including before grinding the step of breaking up waste wood into smaller pieces that can be more easily ground into wood chips.

**4.** The process specified in claim **1** including after compacting the step of releasing said compacted acceptable chips in a borax solution spray during expansion of said chips to thereby facilitate absorption of borax solution into said chips.

**5.** A waste wood treating apparatus for producing usable wood material from waste wood, comprising:

a. a receptacle for said waste wood;
b. grinding means for grinding waste wood into wood chips;
c. waste wood conveyor means for conveying waste wood from said receptacle to said grinding means;
d. a chip separator for separating wood chips by selectable sizes into oversize chips, acceptable chips, and fines;
e. a magnetic separator for magnetically separating wood chips from magnetic material intermixed therewith and delivering the magnetically separated wood chips to said chip separator;
f. a wood chips conveyor for conveying wood chips from said grinding means to said magnetic separator;
g. an oversize chips conveyor for conveying oversize chips from said chip separator to said grinding means for further grinding thereof;
h. a chip compactor for compacting acceptable chips and then releasing the compacted acceptable chips;
i. acceptable chips conveyor means for conveying acceptable chips from said chip separator to said chip compactor;
j. chip moisturizing means for receiving compacted acceptable chips released from said chip compactor and subjecting them to a water spray during expansion of the acceptable chips to thereby facilitate absorption of moisture into the chips; and
k. chip cleansing means for receiving moisturized acceptable chips from said chip moisturizing means and washing them in a water bath.

**6.** The waste wood treating apparatus as specified in claim **5** having a gantry crane extending over the length of said waste wood receptacle and movable across the width thereof, and drop weight means suspended from and movable over the length of said gantry crane for breaking up waste wood in said receptacle.

7. The waste wood treating apparatus as specified in claim 6 wherein said waste wood conveyor means comprises:

a. a plurality of serially positioned endless belt conveyors extending from said waste wood receptacle to said grinding means, each of said conveyors traveling at a higher speed than the conveyor sequentially preceding it; and

b. grapple means suspended from and movable over the length of said gantry crane for transferring broken up waste wood from said receptacle to said plurality of conveyors.

8. The waste wood treating apparatus as specified in claim 5 including a sink-float apparatus comprising:

a. a tank for holding water and receiving waste wood, said tank having at least one side which slants downwardly and inwardly toward an opposite side;

b. conveyor means extending along said slanted side for conveying sunken debris out of said tank;

c. valve means for periodically releasing water and suspended debris from said tank;

d. control valve means for introducing water into said tank to maintain the water level in said tank; and

e. said sink-float apparatus being located in said waste wood receptacle in position to receive waste wood deposited in said receptacle, and to have waste wood that is separated from heavier intermixed material removed from said sink-float apparatus by said waste wood conveyor means.

9. The waste wood treating apparatus as specified in claim 5 wherein said chip moisturizing means subjects the acceptable chips to a borax solution spray during expansion of the acceptable chips to thereby facilitate absorption of borax solution into the chips.

10. The waste wood treating apparatus as specified in claim 5 wherein said chip separator comprises a triple deck chip separator for separating wood chips by selectable sizes into over-size chips, large chips, acceptable chips, and fines.

11. The waste wood treating apparatus specified in claim 10 including a pin chipper which receives large chips from said triple deck chip separator, reduces the large chips to substantially uniform length acceptable chips, and deposits the acceptable chips on said acceptable chips conveyor means.

12. The waste wood treating apparatus as specified in claim 5 including:

a. a fines separator for separating fines by size into a plurality of grades; and

b. fines conveyor means for conveying fines from said chip separator to said fines separator.

13. That waste wood treating apparatus as specified in claim 5 wherein said acceptable chips conveyor means has directional valve means for selectively directing said acceptable chips to one of a plurality of conduits including a conduit portion of said acceptable chips conveyor means leading to said chip compactor.

14. The waste wood treating apparatus as specified in claim 13 including selectable conveyor means for conveying acceptable chips received from said chip cleansing means, said selectable conveyor means having directional valve means for selectively directing said acceptable chips to one of a plurality of conduits.

* * * * *

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3878994 Dated April 22, 1975

Inventor(s) Liong-Hian Tee

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 63 -- "comparator" should be compactor.

Column 2, line 20 -- after "Depending" the word "on" should be inserted.

Column 3, line 14 -- after "two-way" the word "valve" should be inserted.

Signed and Sealed this

*fourth* Day of *November 1975*

[SEAL]

*Attest:*

**RUTH C. MASON**
*Attesting Officer*

**C. MARSHALL DANN**
*Commissioner of Patents and Trademarks*