United States Patent [19]

Lambert

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[54] **APPARATUS FOR PRODUCING WAFERS FROM WOOD**

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[73] Assignee: **Multiply Development Corporation, Ltd.**, Canada

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[21] Appl. No.: **443,500**

[52] **U.S. Cl.**..... **144/172;** 83/356.3; 144/162 R; 144/163; 144/176; 144/180; 144/242 R; 144/326 A; 214/301; 214/310

[51] **Int. Cl.**[2] **B27C 1/00;** B65B 69/00

[58] **Field of Search**..... 83/106, 356.3, 355; 144/242 R, 243, 242 L, 245 E, 162 R, 172, 163, 176, 180, 181, 323, 326 R, 326 A, 326 B, 326 C, 326 D; 214/310, 301

[56] **References Cited**

UNITED STATES PATENTS

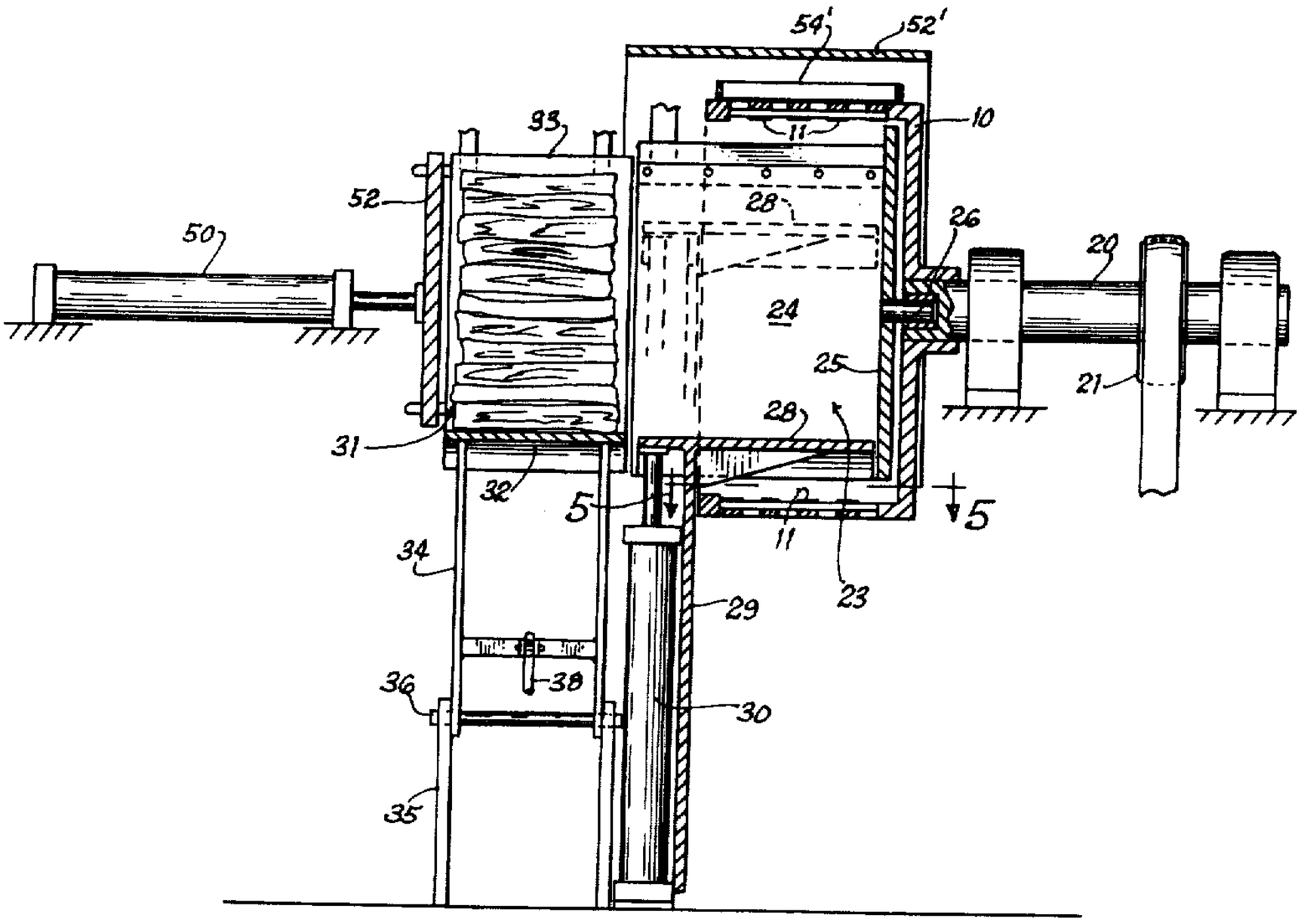
229,588	7/1880	Clark	144/172
1,480,051	1/1924	Dye	83/106
1,803,769	5/1931	Rohland	83/356.3
3,025,895	3/1962	Girad	144/172
3,297,068	1/1967	Bloomquist et al.	144/172 X
3,407,854	10/1968	Lindberg et al.	144/162 R

Primary Examiner—Harrison L. Hinson
Assistant Examiner—W. D. Bray
Attorney, Agent, or Firm—McDougall, Hersch & Scott

[57] **ABSTRACT**

An apparatus for producing uniform wafers from irregular pieces of wood is disclosed. The device utilizes a rotating drum having blades thereon for cutting thin crosscut wafers from wood supplied to a container within the drum. Various means are disclosed for continually loading the apparatus for high volume production. A set of fracture bars fixed outside the circumference of the drum restricts the length of the wafers.

18 Claims, 16 Drawing Figures



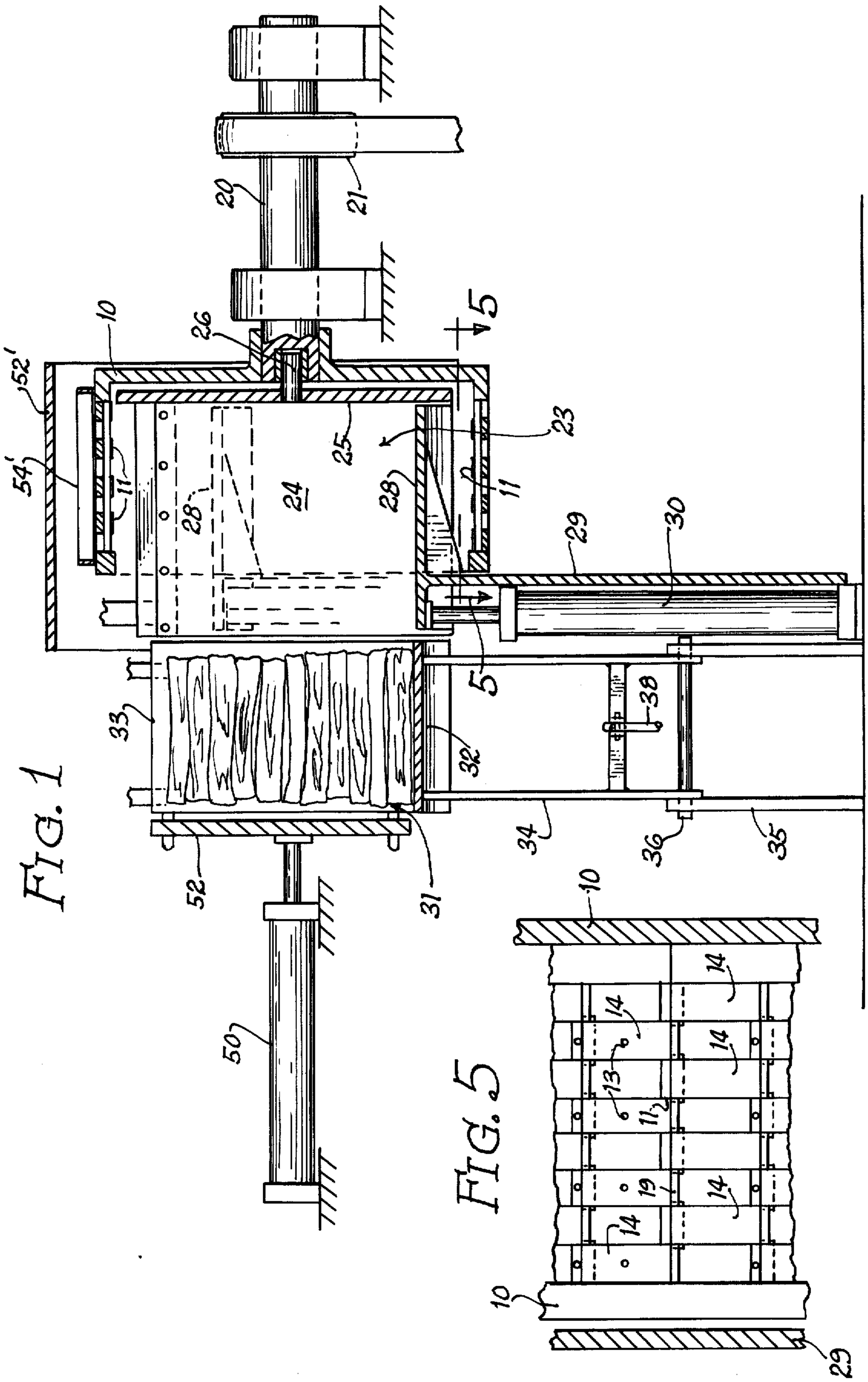

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FIG. 1

FIG. 5

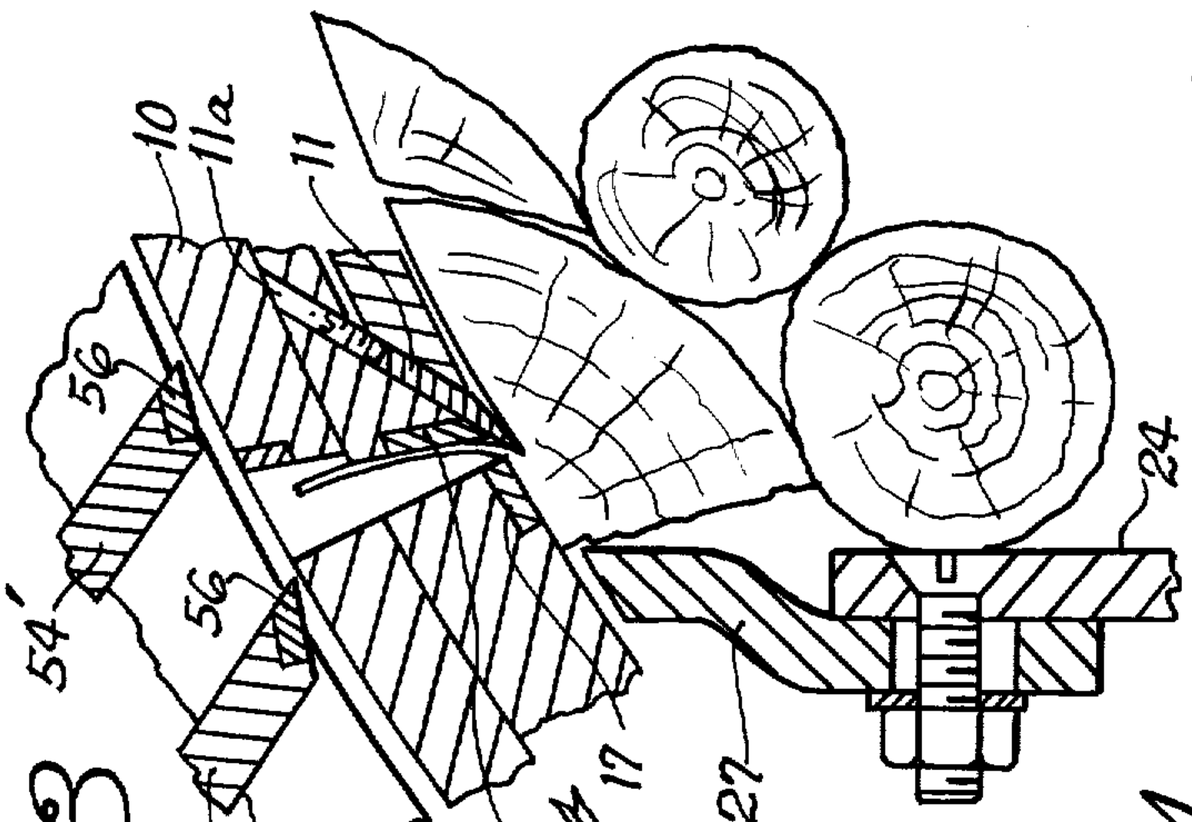


FIG. 3

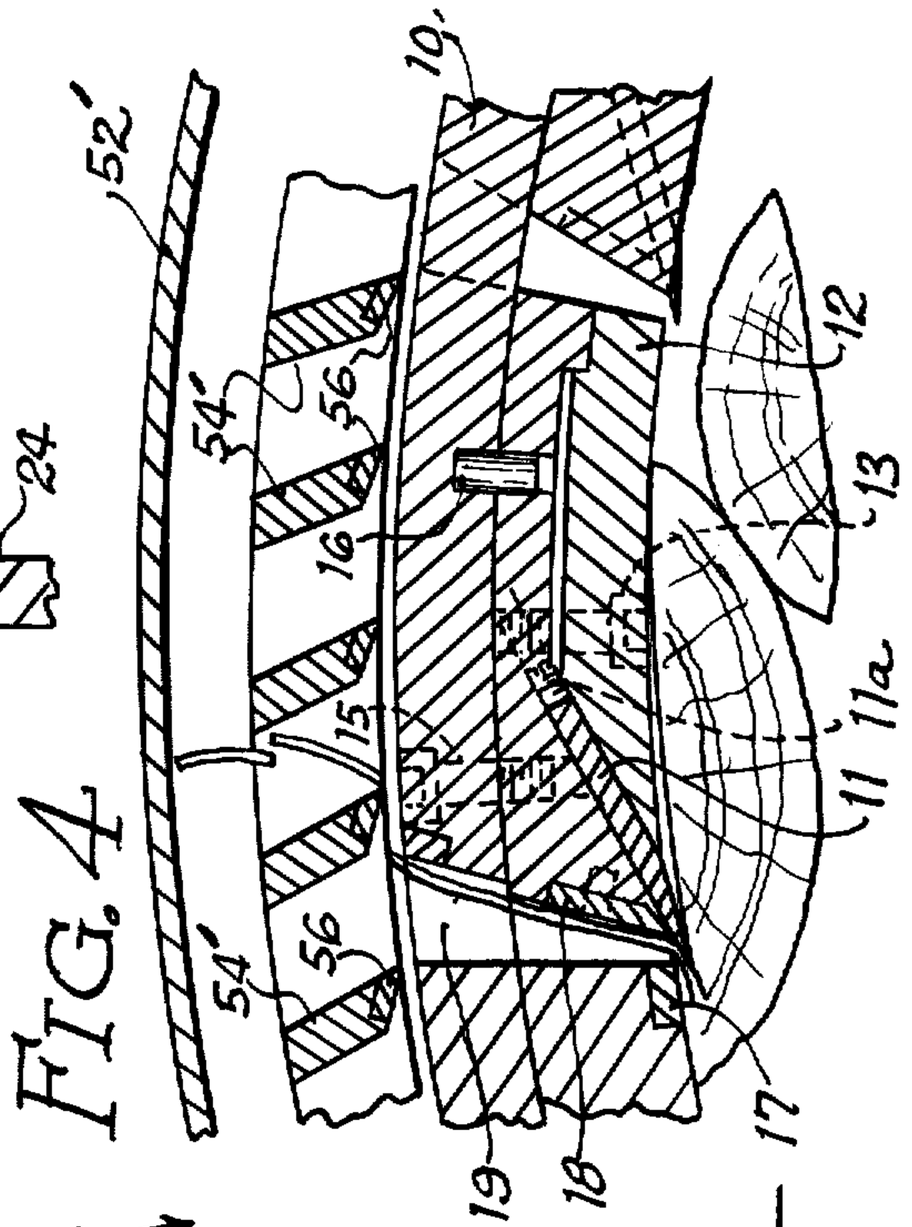


FIG. 4

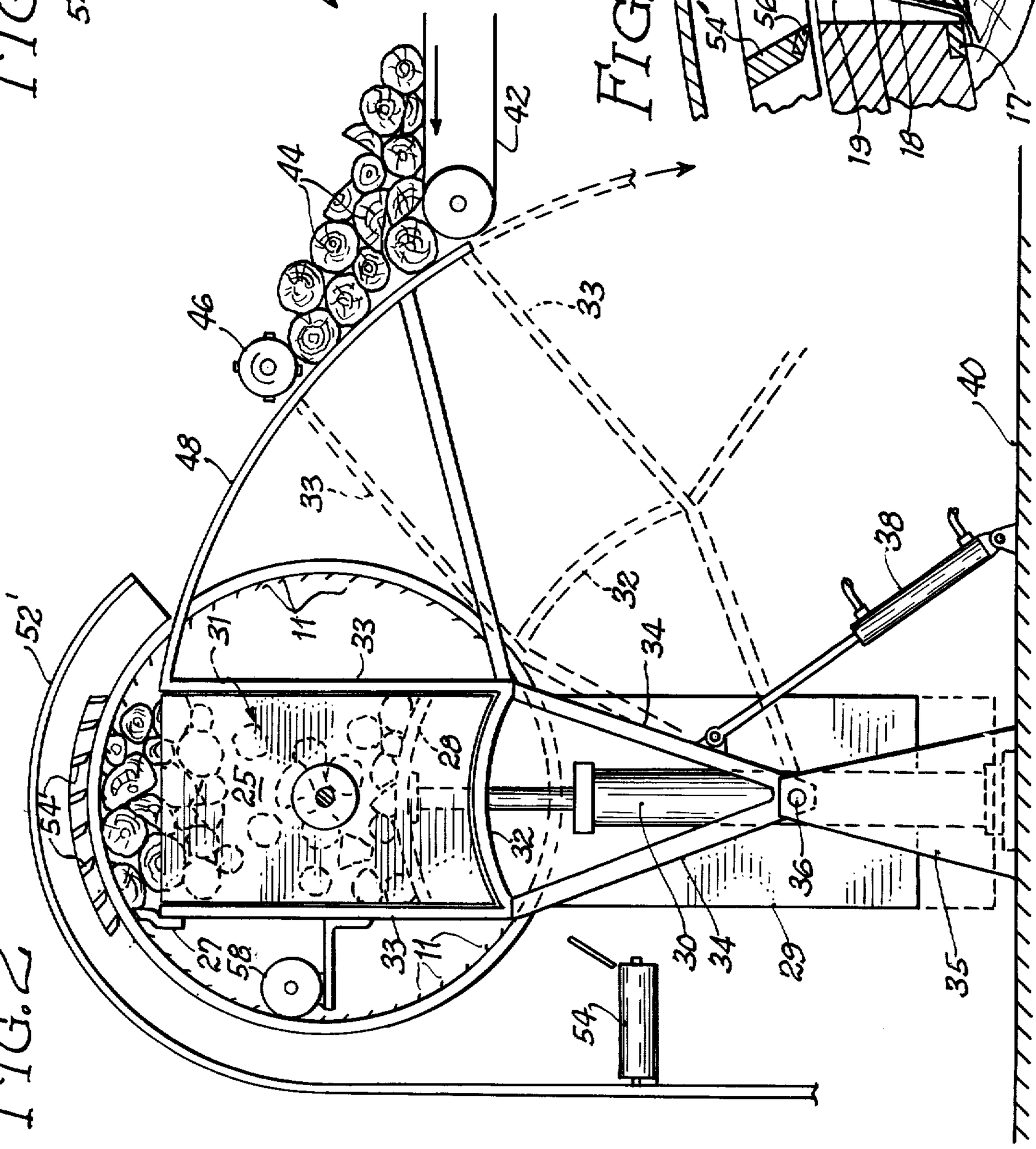


FIG. 2

FIG. 6a

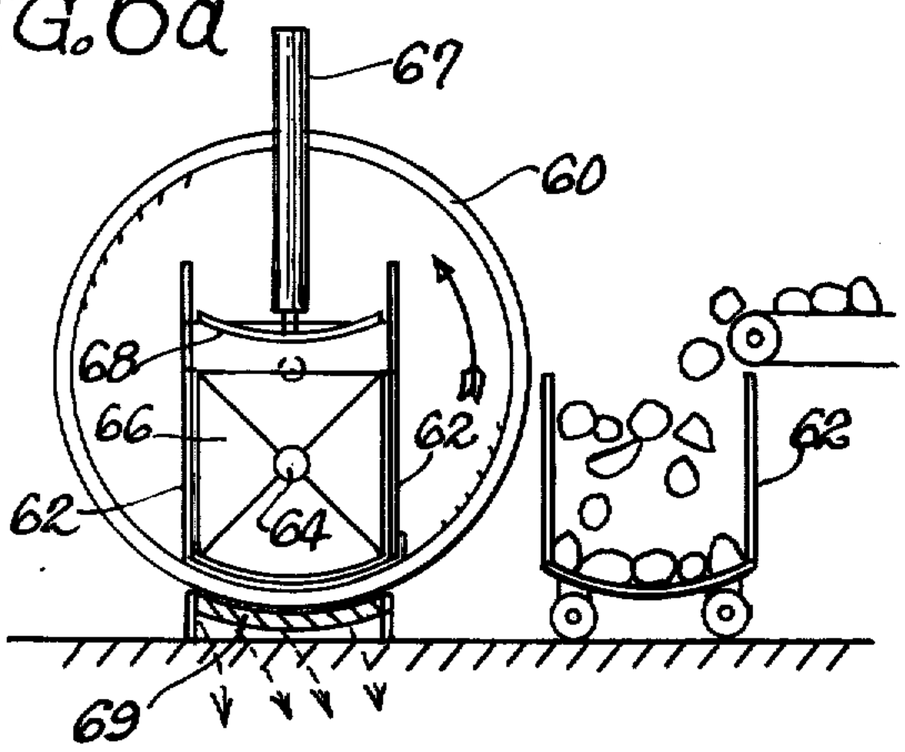


FIG. 6b

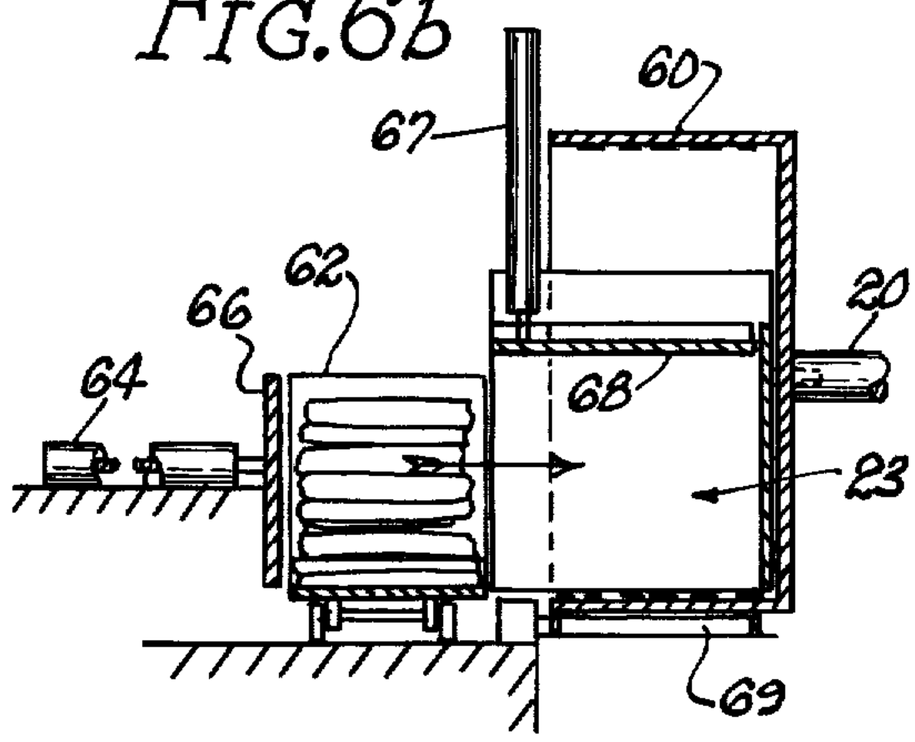


FIG. 7a

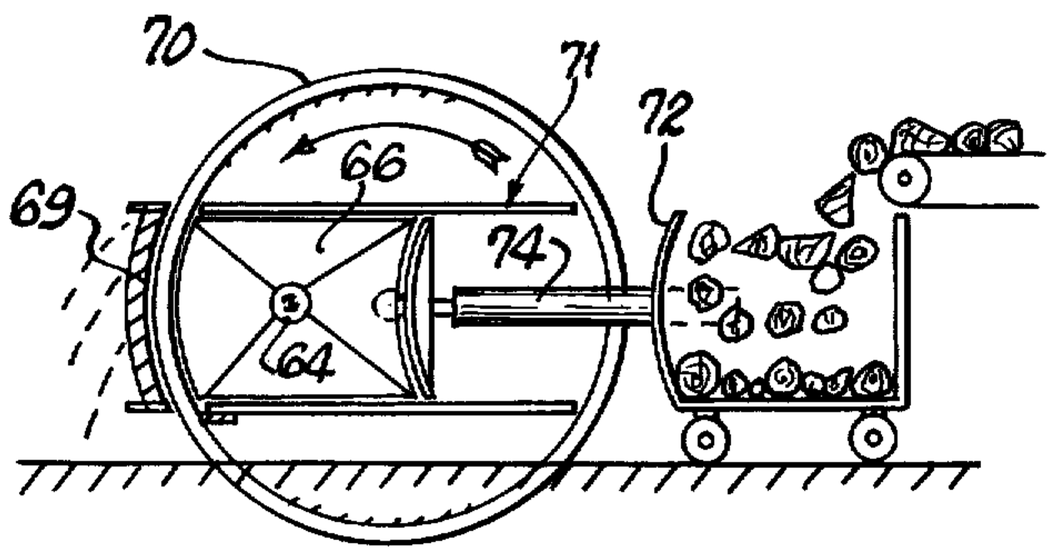


FIG. 7b

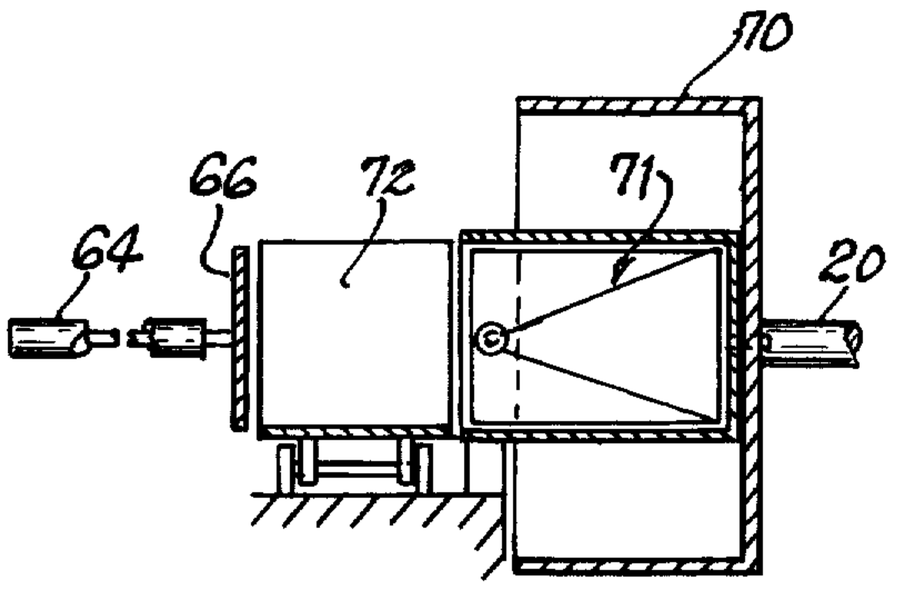


FIG. 8a

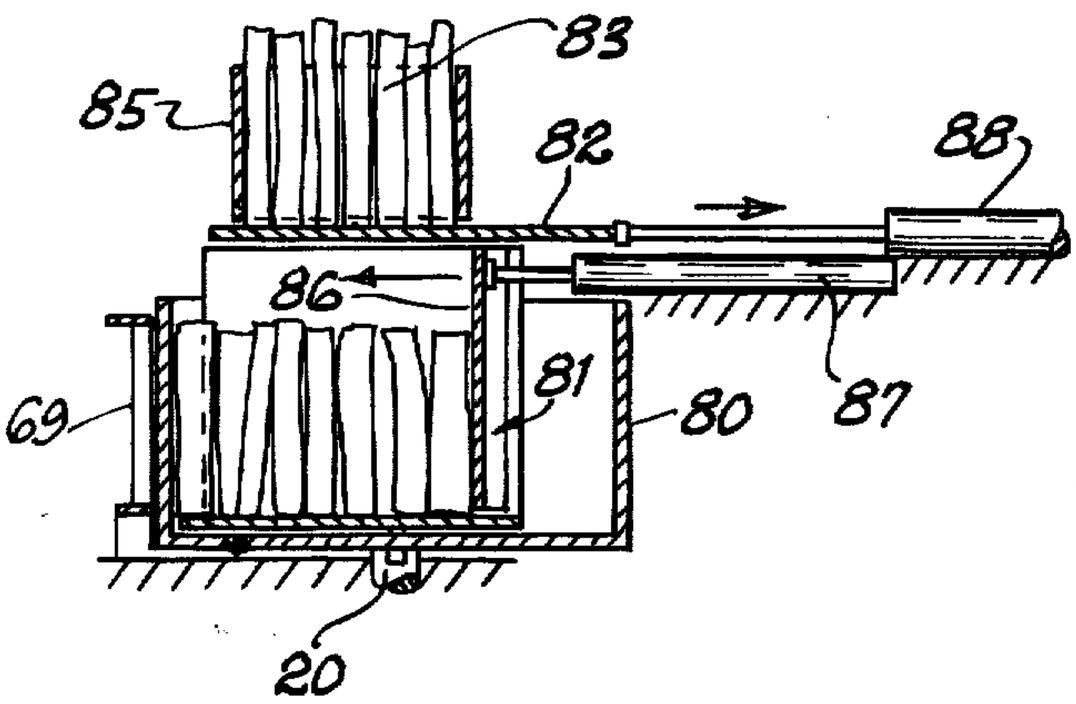


FIG. 8b

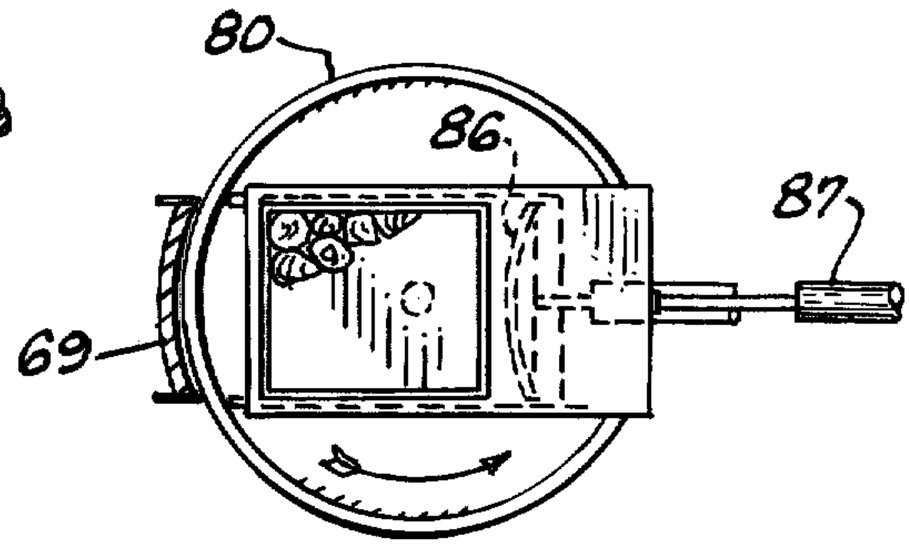


FIG. 9a

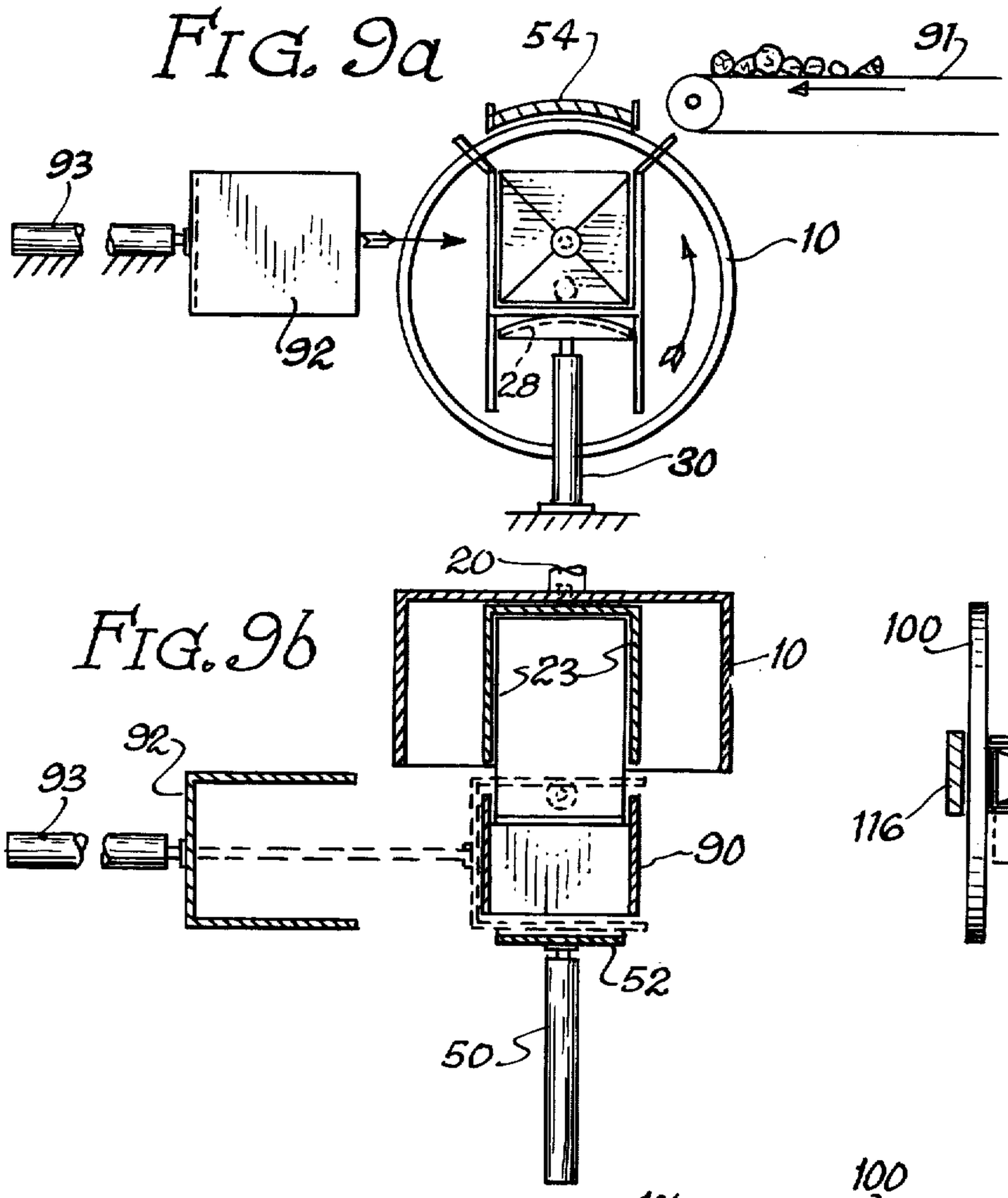


FIG. 9b

FIG. 10c

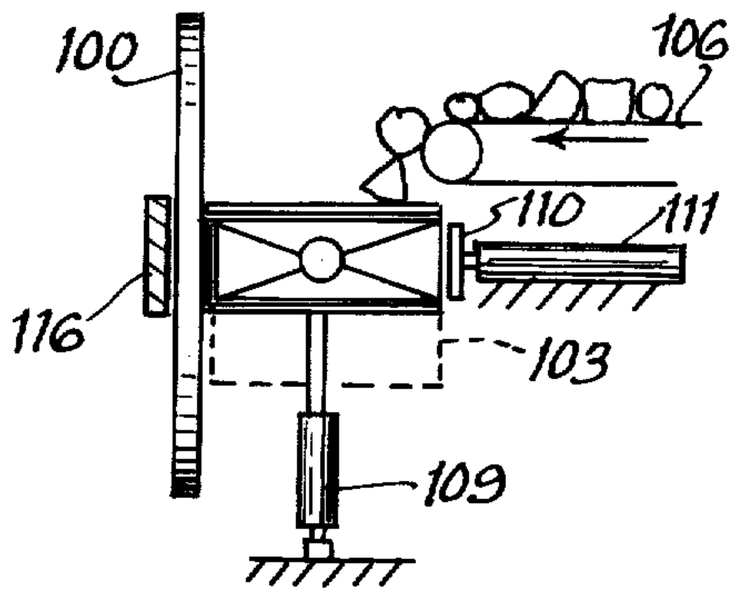


FIG. 10a

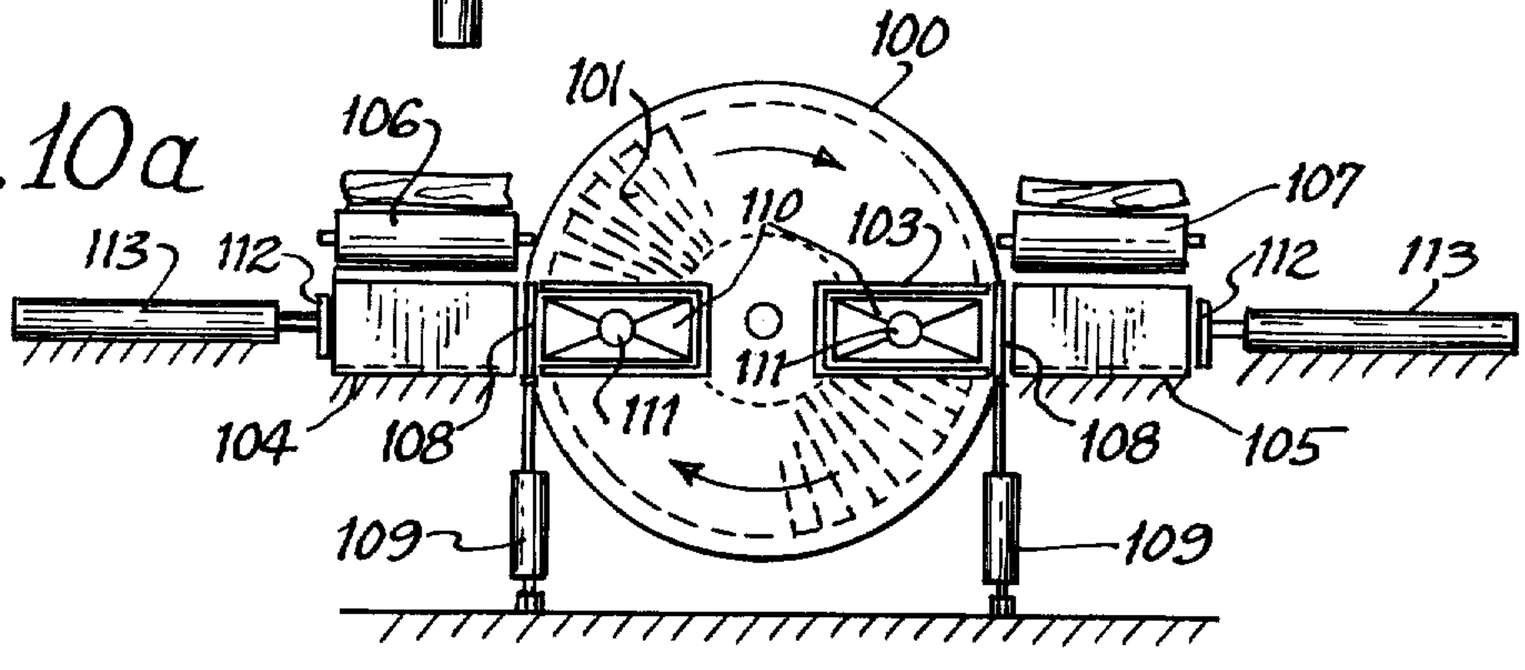
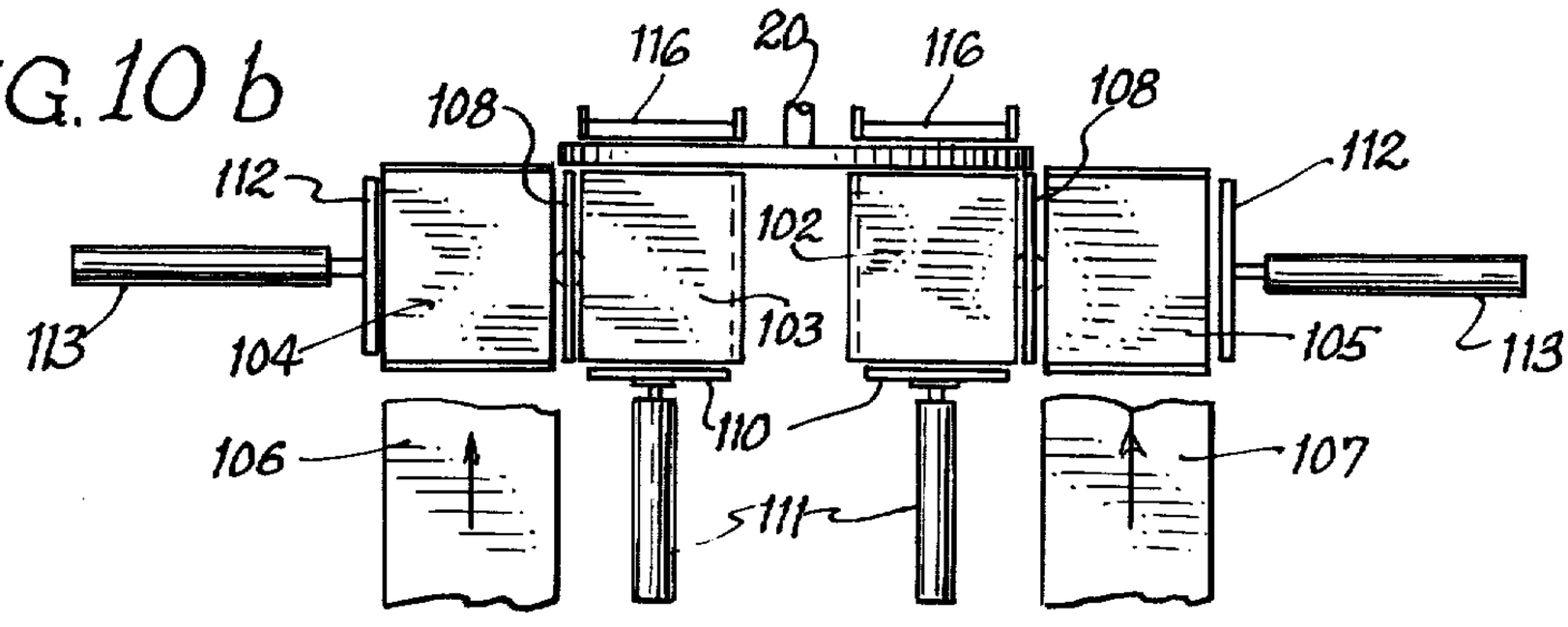


FIG. 10b



APPARATUS FOR PRODUCING WAFERS FROM WOOD

BACKGROUND OF THE INVENTION

This invention relates to the production, from irregular pieces of wood, of cross-cut elements or wafers of controlled width and thickness which have the grain of the wood substantially parallel to the grain of their faces. Such elements are particularly suitable for the manufacture of structural boards or for conversion to pulp.

There have been a number of different designs of waferizers or "flakers" as, for example: U.S. Pats. **2,776,686, -687, -688,** and **2,786,005.** Additionally, U.S. Pat. No. **3,155,130** to Logan et al. describes machines for the production of chips for cooking. However, as far as is known, the only machine in operation that will produce uniform wafers of controlled width and thickness from pieces of wood of irregular lengths and shapes is that described and illustrated on page **486** of "Wood Machine Processes" by Koch, Ronald Press **(1964).**

The machine described in Koch has been in operation for about twenty years. However, it has a limited capacity because it uses an intermittent feeding mechanism which limits the rate that wood pieces are fed to it. Another serious limiting factor is that its knives, being on the exterior of a cylindrical drum, require gullets which are large enough to receive the cut ribbons of wood and then discharge them by centrifugal action. If the knives and gullets are in line, they readily accept and discharge short and long coarse sticks from the remanents of each piece of wood being cut. However, because of the intermittent feeding, the sides of successive wood pieces are prevented from becoming objectionably slanted before cutting, which is a problem with machines having a continuous feed.

In a continuous feed machine slanting of the wood pieces will cause a jam or the wafers produced by the slanted pieces will have their grains at an objectionable angle to their plane faces. This drastically reduces the strength of the wafers and subsequent structures made therefrom. Further, it requires a substantial amount of extra force to cut them when the knife edges are disposed at an angle to the grain.

It will be apparent that the problem of keeping the wood pieces parallel to the edges of the cutting knives in a continuous wafer cutting machine becomes worse as the production rate of the machine rises, and especially so if other than straight wood pieces with a uniform cross section are used. Extreme non-uniformity of cross section is exemplified by slabs and edgings from a sawmill since they are usually cut from a tapered bole of a tree and in consequence are unsuitable for continuously fed waferizing machines. The remains of stumps or branches on such pieces further aggravates the problem. Further, small trees or branches, which are completely satisfactory for making into wafers, are frequently not straight.

OBJECTS OF THE INVENTION

It is accordingly an object of the present invention to provide improved means for continuously producing wood wafers in large quantities, said wafers having a preselected thickness, width and maximum length.

It is a further object to provide a device that ensures that the grain of the wafers remains substantially parallel to that in the pieces of wood being cut.

It is another object to provide an apparatus which is capable of producing wafers from pieces of wood of irregular cross section and length whether tapered or crooked.

It is another object to provide an apparatus which will permit the knives to be easily changed or sharpened when they become dull.

It is still a further object of the present invention to provide an apparatus which will enable the protrusion of the knives (which controls the thickness of the wafers) to be readily adjusted.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, embodiments of the invention are shown in the accompanying drawings, in which:

DESCRIPTIONS OF THE DRAWINGS

FIG. **1** is a sectional side view of the present invention according to a first embodiment;

FIG. **2** is a front view, portions of which are in section, of the apparatus of FIG. **1**;

FIG. **3** is a sectional view showing the cutting of a wafer from a piece of wood;

FIG. **4** is a sectional view illustrating the cutting of a wafer and its fragmentation into short lengths by the spaced bars;

FIG. **5** is a fragmentary view along the lines **5-5** of FIG. **1**;

FIG. **6-*a*** is a front view of an alternate embodiment of the invention;

FIG. **6-*b*** is a sectional side view of the embodiment of FIG. **6-*a*;**

FIG. **7-*a*** is a front view of a third embodiment of the invention;

FIG. **7-*b*** is a sectional side view of the embodiment of FIG. **7-*a*;**

FIG. **8-*a*** is an elevated sectional view of a fourth embodiment of the invention;

FIG. **8-*b*** is a plan view of the embodiment of FIG. **8-*a*;**

FIG. **9-*a*** is a front view of a fifth embodiment of the invention;

FIG. **9-*b*** is a plan view in section of the embodiment of FIG. **9-*a*;**

FIG. **10-*a*** is a sixth embodiment of the invention employing a rotating disc;

FIG. **10-*b*** is a plan view of the FIG. **10-*a*** embodiment;

FIG. **10-*c*** is a side elevation of the FIG. **10-*a*** embodiment.

DETAILED DESCRIPTION

Referring to FIGS. **1–4,** a large rotating drum **10** open at one end is shown. A plurality of knives **11** are clamped in position by a plate **12** and screw **13** (FIGS. **4** and **5**) in a knife bar **14.** Each knife bar extends across most of the inner width of the durm **10.** The knives in successive knife bars **14** are alternatively positioned, as shown in FIG. **5,** to cut wafers having a width equal to the edge of each knife, as described in U.S. Pat. No. **2,773,789** incorporated hereby. The individual knife bars are held in position on the inner periphery of drum **10** by screws **15** and dowels **16.** Wear of

the edges of the slot in front of the knife edges may be minimized by hard steel inserts **17** and wear of the block **14** under the knife edges by hard steel inserts **18.**

Preferably the slots in the periphery of the drum **10** do not extend the drum's full inner width but are interrupted by connecting bridge pieces **19** having a width less than that of a knife edge and situated across the slots in the drum in positions adjacent to the sides of a knife. The drum **10** preferably is made from a steel casting by which procedure the slots and bridge pieces are conveniently formed. The bridge pieces greatly improve the rigidity of the slotted drum.

As shown in FIG. **1**, the drum **10** is attached to a flange mounted on a shaft **20** carried in bearings and is rotated by a pulley **21** or driven by an electric motor (not shown).

Inside the drum **10** is a box **23** (FIG. **2**) whose sides are formed from cantilevered plates **24.** The box has a closed rear face **25** that is supported by a stub shaft **26** and self-aligning bearing in the center of shaft **20.**

Referring to FIG. **3**, along the top side of box **23** is an adjustable extension plate **27** set so as to prevent small sticks of wood from passing out between the sides **24** and the drum **10.**

As shown in FIGS. **1** and **2**, a vertically movable platform **28**, curved to conform to the upper circumference of drum **10**, is provided inside the drum. The platform **28** has a skirt **29** attached thereto and moves vertically in a guide channel preferably under control of a pneumatic cylinder and piston **30.** The platform **28** is arranged to extend into the box **23** and slidingly contact the side walls **24** and the back wall **25.** Thus the platform and box constitute means for feeding the wood upwardly to the blades on the inner periphery of the drum **10.**

Disposed alongside the open end of the drum **10** and aligned with the box **23** is a loading container **31** open at its front and back. The bottom **32** of the container is curved to match the movable platform **28** while the side walls **33** match the walls **24.** The container **31** is supported on a V-shaped frame member **34** which is pivotable about a base **35.** As indicated in FIG. **2**, the container can be rotated about the pivot pin **36** between an upright position shown in solid line and a tilted position indicated in dashed lines. The container is selectively moved between these positions by means such as cylinder and piston **38** attached to one side of the frame member **34** and to a support or floor **40.**

The container **31** is loaded with a supply of wood by tilting to the position indicated by the dashed lines. When the container is in position, such that its open top is at one end of a conveyor **42**, the conveyor is switched on. A wood supply **44** is carried on the conveyor and dumped into the container **31.** When the container is fully loaded it is returned to the vertical position. Any excess wood loaded into the container is held back by a slowly revolving roll **46** or alternately by a stationary bar. To facilitate loading there is an arcuate surface **48** attached to the container. This surface prevents excess wood from falling off the conveyor **42** between loading periods. Similarly, if desired, fixed walls (not shown) may be provided for the sides of the container when in the loading position.

Referring now to the platform **28** and the box **23**, the feeding means is controlled by strategically placed limit switches and electrically operated hydraulic valves. When the platform is in its lowest position as shown in FIG. **1**, a limit switch is closed if the container **31** is in the upright position. Closing of this switch activates cylinder and piston **50** to cause a plate **52** to push the wood from the container into the box **23** and onto the platform **28.** The plate **52** is then retracted.

After loading, cylinder and piston **30** continuously raise the platform to keep the wood in contact with the knives on the top inside periphery of the drum **10.** As the wood is pressed against the inside of the rotating drum the knives reduce it to wafers. As the wafers are cut they pass through narrow openings as shown in FIGS. **3** and **4** to the outer periphery of the drum. When an entire load of wood in the box has been waferized, a second limit switch is actuated causing the platform **28** and its cover skirt to be retracted to the lowest position for the purpose of receiving a further load of wood from the container **31** which has been reloaded during the waferizing operation.

After cutting, the wafers are directed by a hood **52'** surrounding a portion of the drum downwardly onto a conveyor **54** (FIG. **2**) for transporting to storage or a processing station.

As the wood is reduced to wafers, frequently there remain small sticks. Such sticks and other scraps are prevented from getting into the wafer path due to the narrowness of the slot openings in front of the staggered knives. Further, because of the intermittent arrangement of the slots, the sticks and scraps are reduced to lengths not much longer than the width of the wafers before they are capable of being discharged. This provides improved performance and is of particular importance to an operation that requires wafers free from sticks of wood.

It is undesirable to have the length of the wafers exceed about **2** inches, since the wafers from certain woods are inclined to curl up upon themselves making them more difficult to handle. Accordingly, as shown in FIGS. **2–4**, a series of spaced bars **54'** are fixed along and above the circumference of the drum **10.** Since the periphery of the drum is moving rapidly, desirably at a speed in the range of **3000** to **6000** feet per minute, any long ribbons of wood issuing from its periphery, as when cut from a wide piece of wood, will be fractured as shown in FIG. **4** by the leading edges of these bars into shorter lengths. The length of the ribbons after fracture is dependent on the spacing of the bars **54'** and the speed of the drum. Each of the bars is preferably tipped with a replaceable hard steel insert **56** to maintain a fairly shaft edge. If only small cross section wood is always utilized, the length-limiting bars **54'** are unnecessary.

When the knives **11** begin to get dull, they can be ground sharp again, by a stone or a grinding wheel **58** slidably mounted on a platform on the side of box **23** as shown in FIG. **2.** When the flat along the cutting edges of the knives becomes excessive as a result of this sharpening, they are all removed with the knife holding bars **14** and replaced with another set. The bars and dull knives in each bar are moved forward by releasing a screw **13** and reground so as to be sharp with the desired rake and to protrude to the required thickness of the wafers.

As an example only, for a drum **4** feet in diameter with **24** sets of staggered knives and which is driven at **450** r.p.m., the device will cut **0.42** inches of wood from the box **23** into wafers **0.035** inches thick in one revolution or **190** inches per minute. If a typical load

is 32 inches high, 32 inches deep, and the box 23 is 24 inches wide, it will take about 10 seconds to waferize a load during a reloading period of 20 seconds, thus reducing three loads of 12.5 cubic feet each per minute. This amounts to 17.5 cords of wood per hour or about 20 to 40 tons, depending on the density of the wood.

Referring to FIGS. 6-*a* and 6-*b* there is illustrated an alternate embodiment in which the wood pieces are waferized at the bottom of a drum 60. In this embodiment a container 62 mounted on a trolley or alternately, a plurality of containers 62 movable by means of a reciprocating chain drive and filled from either side of the drum are used to supply wood to the drum. As in the embodiment of FIGS. 1 through 5, when the container 62 is aligned with the box 23 disposed within the drum, a piston 64 pushes a plate 66 effective for pushing the wood from the container 62 into the box 23. After plate 66 retracts, a ceiling mounted pneumatic cylinder 67 is then utilized for pressing a platform 68 against the wood for producing wafers in the manner previously described. Fracture bars 69 are located along the outside periphery of the drum to limit the length of the wafers as previously described.

Referring to FIGS. 7-*a* and 7-*b*, an arrangement similar to FIG. 6 is shown; however, the waferizing is accomplished on a side of the rotating drum 70. The wood is loaded into the box 71 from a container 72 in the same manner described for FIG. 6 and a piston 74 forces the wood supply against the knife bearing periphery of the rotating drum.

Referring to FIGS. 8-*a* and 8-*b*, a further embodiment of the invention is illustrated. In this embodiment, a rotating drum 80 is mounted for rotation about a vertical axis. Wood is supplied to the box 81 through a top opening to the drum. The top is closed during waferizing by a retractable plate 82. Plate 82 supports pieces of wood 83 thereon prior to their being loaded into the box 81 for waferizing. When it is necessary to load the box, the plate 82 is retracted by cylinder 88 allowing the wood pieces 83 to drop vertically, end first, into the box 81. The plate 82 is then extended to the closed position covering the box. Wood is then loaded into the container 85 above the plate for subsequent loading into the box. As in the previous embodiments, a contoured platform 86 driven by a cylinder 87 pushes the new supply of wood against the rotating periphery of the drum for waferizing.

Referring to FIGS. 9-*a* and 9-*b*, a further arrangement of the invention is shown. This arrangement is similar to that shown in FIGS. 1 and 2. In this embodiment, however, the container 90 does not tilt but is fixed in a position aligned with adjacent box 23. The container is supplied with wood via an overhead conveyor 91 which dumps the wood into the container while the drum is waferizing a previous load. When the conveyor 91 is loading the container 90, a U-shaped member 92 is extended by means of cylinder 93 to cover the sides of the container to prevent wood from falling out. When wood is to be loaded from the container 90 to the box 23, the U-shaped plate 92 is retracted and the wood pieces are pushed onto the platform 28 by the pusher plate 52 as described in connection with FIG. 1. If desired, the U-shaped member 92 and cylinder 93 may be vertically mounted in order to save space.

Referring to FIGS. 10-*a*, 10-*b* and 10-*c*, a final illustrated embodiment according to the present invention is shown. In this embodiment, the drum 10 is replaced by a rotating disk 100 having radially arranged knives 101 on one face thereof similar to those provided on the drum 10. In this arrangement two boxes 102 and 103 are used in place of the box 23 for holding wood to be waferized. A pair of containers 104 and 105 located at one side of the boxes 102 and 103 are provided to accumulate wood from a pair of conveyors 106 and 107. A partition plate 108 is disposed between each pair of container and box and is extended or retracted by cylinder 109. A pusher plate 110 operated by a cylinder 111 pushes wood in the boxes 102 and 103 against the disk 100. When a supply of wood is to be loaded into the boxes 102 and 103, plates 108 and 110 are retracted. This permits transfer of wood from the containers 104 and 105 to the boxes 102 and 103 by means of pusher plates 112 operated by cylinders 113. After loading, the plate 108 is again raised after plate 112 is retracted. To begin waferizing plate 110 is extended to push the new wood supply against the knives mounted on the disk.

Located on the side of the disk opposite the knives 101 are spaced fracturing bars 116 for controlling the length of the wafers by fracturing those which are excessive in length.

While I have shown and described embodiments of this invention in some detail, it will be understood that the description and illustrations are offered merely by way of example, and that the invention is to be limited in scope only by the appended claims.

I claim:

1. An apparatus for cutting wafers from a wood supply comprising:

rotary means for cutting wafers from across the grain of said supply including a rotating drum open at one end and perforated with rows of slots substantially parallel to the grain of the wood; knives mounted on the inner periphery of said drum and projecting inwardly from the leading edges of said slots;

a platform radially movable within said drum receiving said wood supply; and

means for radially extending said platform toward the periphery of said rotating drum to bring the wood supply into contact therewith and for radially retracting said platform from the periphery of said drum to receive additional wood,

whereby said knives cut said wafers from said supply, said wafers passing through said slots to the outer periphery of said drum.

2. The apparatus of claim 1 further including means for supplying wood to said platform when said platform is retracted.

3. The apparatus of claim 1 further including means for collecting the wafers.

4. The apparatus according to claim 1 further including spaced bars positioned adjacent the outer periphery of said drum adapted to fracture wafers of excessive length issuing from said drum into shorter length wafers.

5. The apparatus according to claim 4 wherein the size of the fractured wafers is determined by the spacing of said bars and the velocity at which said drum rotates.

6. The apparatus according to claim 1 wherein said platform is arcuately contoured to the curvature of the drum.

7. The apparatus according to claim 1 wherein said means for extending and retracting said platform includes a piston and cylinder attached to said platform; and

relay means for controlling the operation of said piston and cylinder according to the location of the platform.

8. The apparatus according to claim 3 wherein the means for collecting the wafers includes a hood mounted about a portion of the outer periphery of said drum and a conveyor means positioned beneath said hood for conveying said wafers away from said apparatus.

9. The apparatus of claim 2 wherein said means for supplying includes:

at least one portable container adapted to be loaded at a location remote from said rotary means and then transported adjacent said rotary means;

means for transferring the wood to the platform when said container is adjacent said rotary means and said platform is retracted.

10. The apparatus according to claim 2 wherein said rotary means is a rotating drum mounted for rotation about a vertical axis and open at the top end thereof;

said means for supplying including a retractable plate disposed above said opening, said plate in its extended position supporting a supply of wood thereon; said plate retracting to permit said wood supply to drop into said open ended drum.

11. The apparatus according to claim 2 wherein said means for supplying wood includes:

a stationary container adjacent said rotary means adapted to receive wood from a conveyor;

a retractable U-shaped plate adapted to retain wood in said container during loading thereof; and

means for transferring the wood in said container onto said platform when said platform is retracted.

12. The apparatus of claim 1 wherein there are lateral connections between the bars formed by the slots in the periphery of said drum to stiffen the drum.

13. The machine of claim 1 wherein each of said knives has an edge as wide as that of the wafer to be produced and projects from said periphery by a distance substantially equal to the desired thickness of the wafer.

14. An apparatus for cutting wafers from wood comprising:

a. a movable platform for receiving a wood supply;

b. rotary means for cutting wafers from across the grain of said supply;

c. means for extending said platform toward said rotary means to bring the wood supply into contact therewith for cutting and for retracting said platform to receive additional wood;

d. means for supplying wood to said platform when said platform is retracted including a container adjacent said rotary means and movable between a tilted position and an upright position; means for filling said container with wood when in said tilted position; and means for transferring said wood when said container is in said upright position onto said platform when said platform is retracted.

15. An apparatus for cutting wafers from wood comprising:

a rotary disk for cutting wafers from across the grain of a wood supply;

at least one supply box positioned adjacent said disk;

at least one container receiving wood from a conveyor and disposed adjacent said box;

means for transferring wood from said container into said box; and

means for bringing the wood supply in the box into contact with said disk for waferizing.

16. The apparatus according to claim 15 further including spaced bars positioned adjacent the disk and adapted to fracture wafers of excessive length issuing from said disk into shorter length wafers.

17. An apparatus for cutting wafers from wood comprising:

a rotating drum open at one end for cutting wafers from across the grain of a wood supply;

a supply box positioned within said drum;

a container receiving wood from a conveyor; means for transferring wood from said container to said box when said box is empty;

means for bringing the wood in said box into contact with said drum for waferizing;

spaced bars positioned adjacent to the outer periphery of said drum adapted to fracture wafers of excessive length issuing from said drum into shorter length wafers;

a hood mounted about a portion of the outer periphery of said drum for collecting said wafers; and

a conveyor means positioned beneath said hood for conveying said wafers away from said apparatus.

18. In the production of wafers from the side of horizontally disposed pieces of wood, an apparatus comprising:

a drum open at one end rotating on a horizontal axis and having multiple slots with knife edges projecting inwardly therefrom adapted to cut and discharge said wafers;

a box for holding said wood pieces disposed inside said drum;

a movable platform forming the bottom of said box adapted to support wood thereon;

means for inserting a quota of wood pieces onto the platform substantially parallel to the axis of the cylinder when said platform is lowered;

means for raising said platform to press the sides of the wood pieces against said knives and for lowering the platform to receive a new supply of wood after completing waferization.

* * * * *