United States Patent [19]
Mason

[11] **3,736,968**
[45] **June 5, 1973**

[54] METHOD AND APPARATUS FOR PROCESSING LOGS

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[22] Filed: **Nov. 25, 1970**
[21] Appl. No.: **92,581**

[52] **U.S. Cl.** .... **144/312,** 144/3 R
[51] **Int. Cl.** **B27b 1/00**
[58] **Field of Search** .... 144/312, 209, 326, 144/3 R; 143/22

[56] **References Cited**

UNITED STATES PATENTS

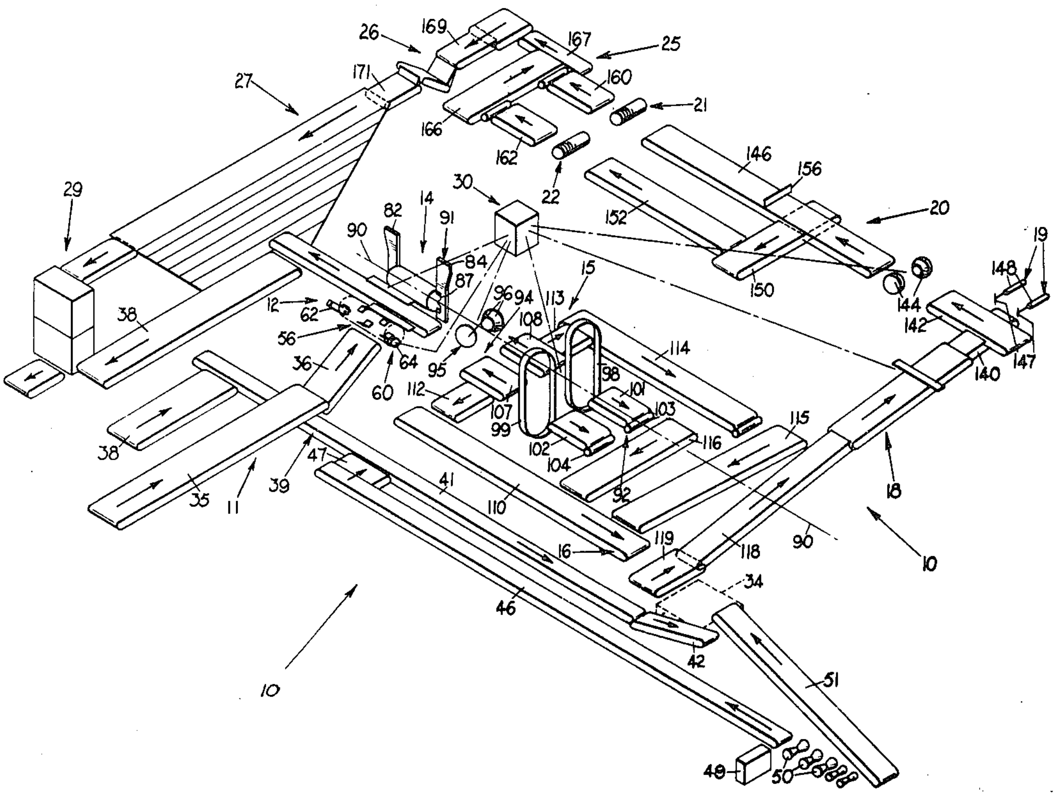
3,459,246	8/1969	Ottosson	144/312 R
3,037,538	6/1962	Graham	144/209 A

Primary Examiner—Donald R. Schran
Attorney—Daniel P. Chernoff and Jacob E. Vilhauer, Jr.

[57] **ABSTRACT**

A method and apparatus for processing logs to obtain an optimum amount of wood products of predetermined quality from each log. The method includes the steps of positioning each log along a reference axis, electronically scanning the log to determine certain of its dimensions with respect to the reference axis, computing the center axis of the largest surface of a preselected shape that can be superimposed within the measured dimensions, and repositioning the log with the center axis parallel to an index line such as the cutting line of a predetermined processing equipment. Scanning arrangements and processing apparatus are disclosed for practicing the steps of the method in the processing of logs of different diameters.

5 Claims, 7 Drawing Figures



Patented June 5, 1973 **3,736,968**

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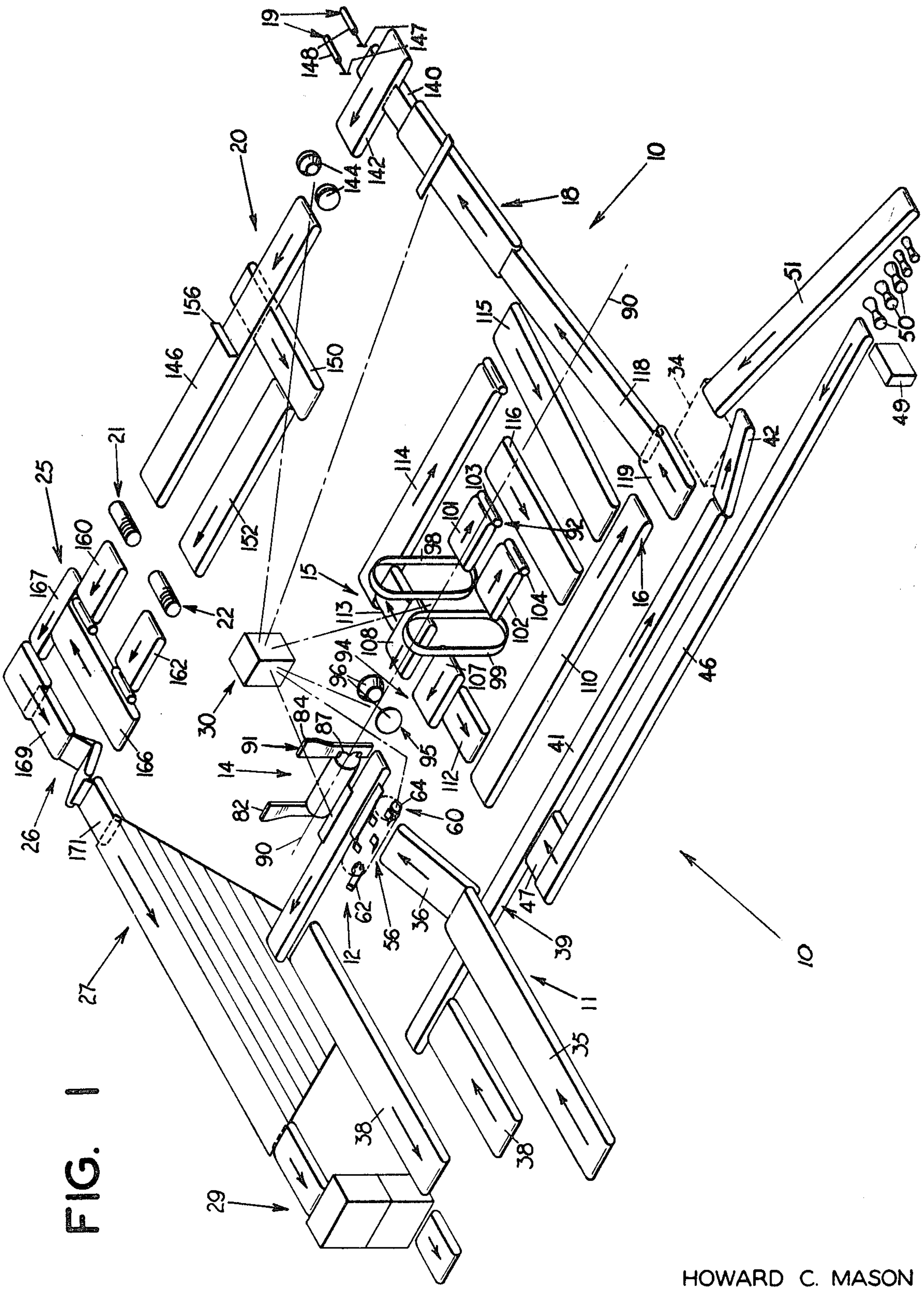

FIG. 1

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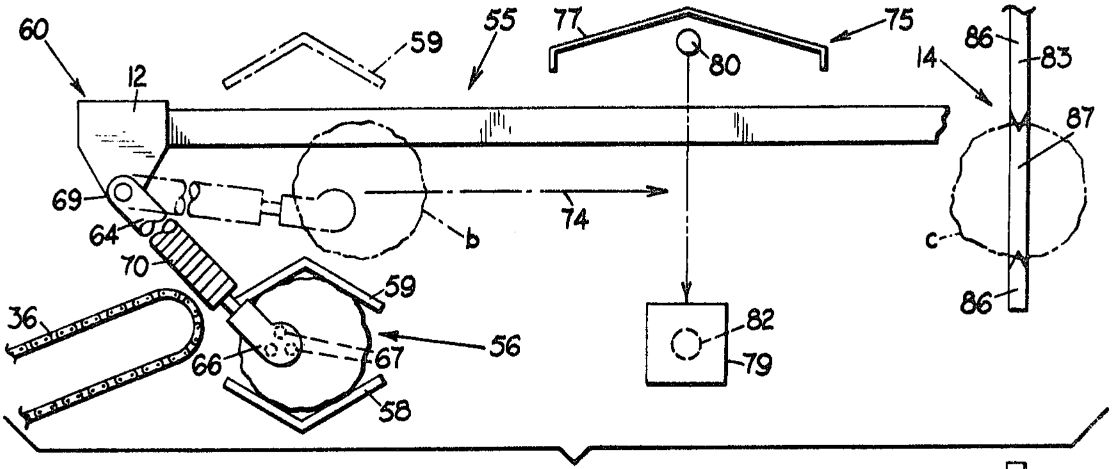

FIG. 2

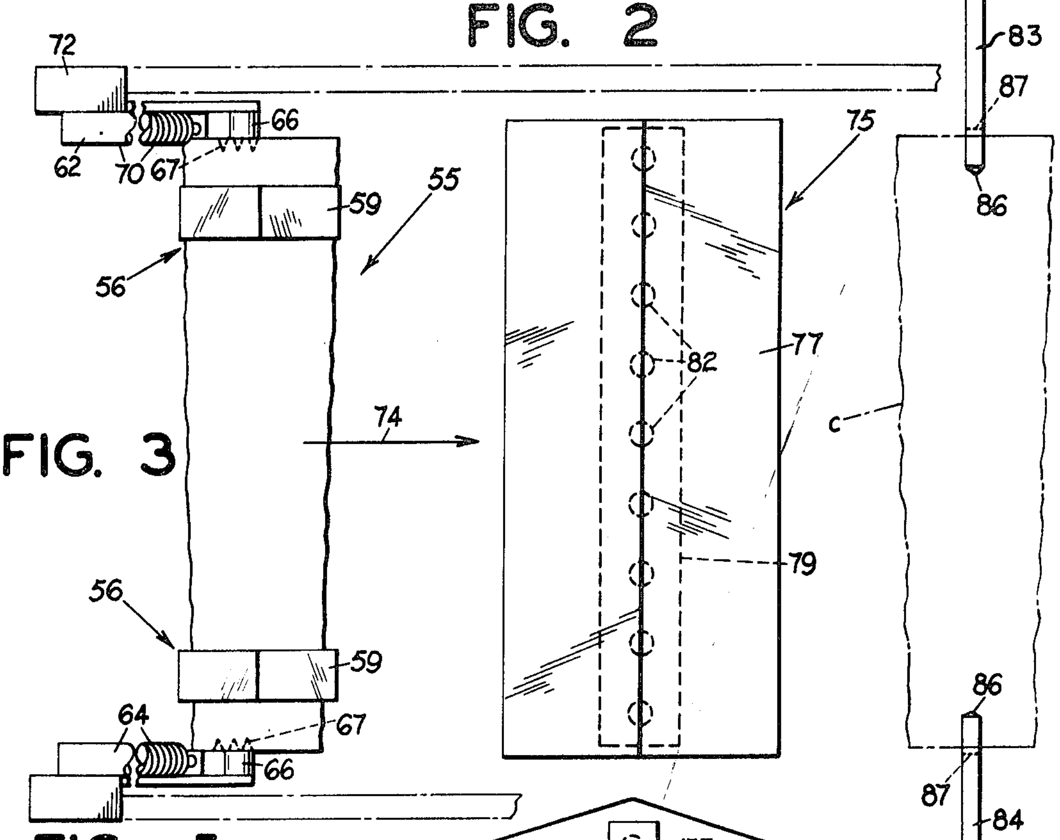

FIG. 3

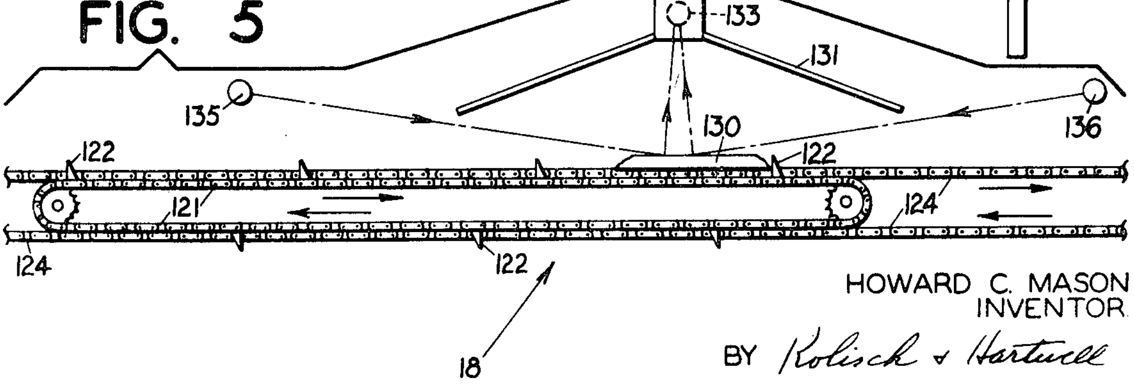

FIG. 5

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FIG. 6

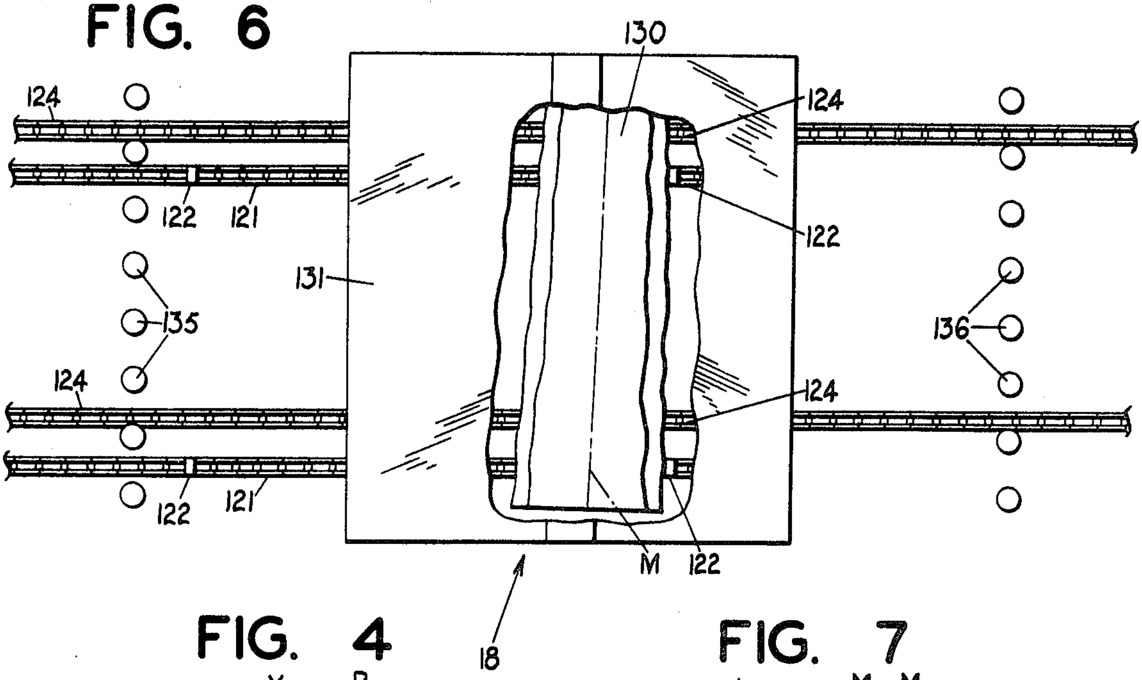


FIG. 4

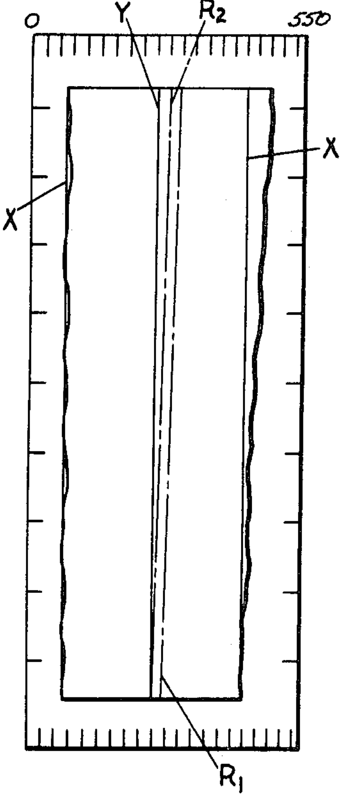
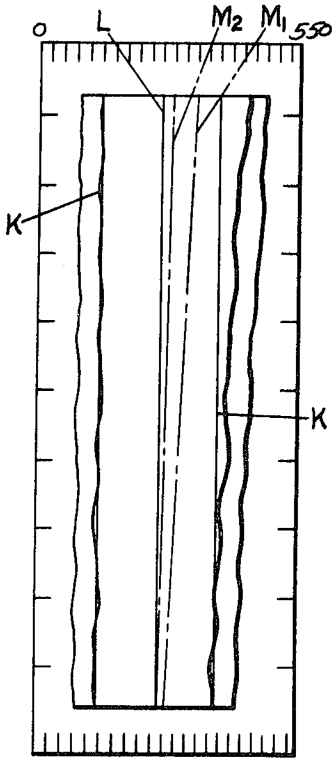


FIG. 7



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METHOD AND APPARATUS FOR PROCESSING LOGS

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for the processing of logs to produce optimum results. More particularly, the invention is related to a method and apparatus for the processing of logs of different diameters to obtain the maximum amount of salable wood products of a predetermined quality from each log.

In processing logs, such as in peeling veneer or sawing logs into cut lumber, it is desirable to obtain the maximum amount of salable wood products of high quality from each log. New saws and saw arrays, as well as improved methods of treating and softening logs, are continuously being developed to permit the processing of logs with a minimum of wood wastage. However, a major problem still exists in the wood industry in determining how a given log should be divided in an optimum fashion, and then in automatically controlling a predetermined processing equipment to divide the log in the selected fashion.

It is conventional in the lumber industry to reduce logs to cut lumber by means of a saw array, and a saw carriage that is movable with respect to the saw array under the control of an operator. Prior to gripping of a given log in the saw carriage, the log is positioned with its best side up, as determined from a visual inspection by the operator. With the log aligned with its best side up, (i.e., usually the side most free from crooks), the log is gripped in the saw carriage and moved through the saw array repeatedly, with cants or flitches of various widths being removed from the log on each pass as determined arbitrarily by the operator in accordance with certain rules of thumb.

In such practice, many factors are not considered that should enter into a determination of the optimum manner of dividing or breaking down a given log. For example, all logs are tapered from one end to the other. Consequently, some wastage always occurs in producing lumber of regular or rectangular dimensions therefrom. Furthermore, logs are commonly of very irregular and/or elliptical diameter, and include crooks along their length, as well as depressions or extensions in their outer surfaces. For obvious reasons, each of these factors has a significant effect upon the way the log should be divided to achieve optimum results. Accordingly, it would be desirable to eliminate operator judgment from the determination of how to divide each given log, in favor of a system which would precisely and automatically evaluate all the above factors in arriving at an optimum solution.

U.S. Pat. No. 3,459,246 to Ottosson represents an advance in the art in this regard in that it describes an apparatus for sawing logs that includes an automatically controlled saw array. The Ottosson system further includes means for examining an incoming log with a photocell array to determine the smallest diameter of the log, and uses this information to automatically set the saw array for dividing the log. In other words, in the Ottosson system, each log is sawed in accordance with a programmed cutting schedule determined by the measured minimum diameter of the log. This tends to reduce the wastage that occurs as a result of log taper, and can partially compensate for irregularities in the logs surface that result in a noticeable reduction in the log diameter.

However, the Ottosson system does not include means for repositioning a log after scanning. Consequently, a crooked log of a given diameter is processed in the same fashion as a straight log of the same diameter, with significant wastage resulting. Furthermore, unnecessary wastage results due to the other factors such as elliptical diameter and irregular surface depressions and extensions. Therefore, the Ottosson system does not produce optimum results in the division of logs into cut lumber.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide a method and apparatus for processing logs that overcomes the disadvantages of conventional methods.

It is another object of the invention to provide a method for processing logs to obtain the maximum amount of wood products of a predetermined quality from a given log.

It is a further object of the invention to provide a method for processing logs wherein certain dimensions of each log are accurately measured and the largest surface of a preselected shape that can be superimposed within the measured dimensions is determined.

It is yet a further object of the invention to provide apparatus for repositioning the log with respect to a predetermined processing equipment for maximum utilization of the wood encompassed by such surface.

It is yet a further object of the invention to provide novel apparatus for practicing the method described herein.

The inventor of the method and apparatus described herein has determined that there is an arithmetical best solution for the division of each circular area of a different diameter, such as a log cross section, into rectangular components of a given size or set of sizes, such as the cross sections of pieces of cut lumber. The inventor also has found that to obtain the maximum amount of salable wood products from a given log, it is desirable to measure accurately certain of the dimensions of the log and to determine the largest surface of preselected shape that can be superimposed within the measured dimensions of the log.

If the log is to be reduced to cut lumber or veneer the preselected surface should have parallel sides. Therefore, if the log is measured in two dimensions so that a planar profile of the log can be plotted, a planar surface such as a rectangle or parallelogram is selected. However, if the log is measured in three dimensions so that a volumetric representation of the log can be plotted, a volumetric surface such as a cylinder is selected. In either case, the largest surface of the preselected form that can be superimposed within the measured dimensions of the log encompasses the maximum amount of lumber within the log that can be reduced to cut lumber of the desired rectangular dimensions or reduced to veneer. In the event the log is to be divided into irregular components, an appropriate surface of irregular form could be selected, although this is not a usual requirement of log processing systems.

Accordingly, the above objects of the invention are attained by a method which includes the steps of positioning a log along a reference axis, scanning the log to determine certain of its dimensions, computing the center axis of the largest surface of preselected form (such as a rectangle or a cylinder) that can be superimposed within the measured dimensions of the log, and repositioning the log with the center axis parallel to an index line such as the cutting line of a predetermined processing equipment, allowing maximum use of the wood encompassed within such surface. The method can be utilized in producing cut lumber from logs, or it can be utilized in other log processing operations such as peeling veneer.

Scanning arrangements and an automatically controlled sawmill are described for processing logs of different diameters.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will become apparent from the following detailed description of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a schematic diagram of a sawmill adapted to process lumber in accordance with the invention;

FIG. 2 is a diagrammatic side elevation view of a scanner and block charger for positioning logs, of the type used in the apparatus illustrated in FIG. 1;

FIG. 3 is a partial top elevation view of the scanner and block charger shown in FIG. 2, illustrating the outline of a log as initially positioned in the charger;

FIG. 4 is a diagrammatic view of a scan grid illustrating the axial alignment of a log before scanning and the axial alignment of the same log as repositioned in the charger of FIG. 2 just prior to engagement in the saw carriage;

FIG. 5 is a diagrammatic side elevation view of a cant scanner and charger assembly of the type used for positioning cants in the sawmill disclosed in FIG. 1;

FIG. 6 is a top elevation view of the cant scanner assembly illustrated in FIG. 5 with a cant positioned for scanning therein; and

FIG. 7 is a diagrammatic view of a scan grid illustrating the axial alignment of a cant before scanning and the axial alignment of the same cant as repositioned for further processing upon leaving the cant scanner illustrated in the FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

According to the invention, logs of different diameter are automatically processed to obtain an optimum amount of salable wood products of a predetermined quality from each log. Each log is supplied to a processing apparatus and aligned in a charger along a reference axis. The log is then examined, such as by a photoelectric scanning device, to accurately determine certain of the dimensions of the log.

The scanning can be carried out in numerous ways. One convenient way of scanning the log is to utilize a single array of photoelectric scanning devices generally positioned along the length of the log and oriented to scan the log along one side for measuring the length of the log and the diameter of the log at spaced intervals along the length thereof. This permits the "plotting" of a two-dimensional representation or planar profile of the log. The term "plotting" is used to mean the orientation of data representations within data processing equipment and not physical plotting, although the latter is possible. After the first scanning operation, the log is repositioned in the log processing apparatus and divided into subcomponents such as cants or flitches. The cants or flitches are then rescanned along a flat side prior to being processed into cut lumber.

Alternatively, a single set of scanning devices can be used, and the log can be periodically rotated beneath the scanning devices, to derive a series of readings that measure the spaced diameters of the log at the different angular positions. This permits the "plotting" of a three dimensional representation of the log.

In yet another scanning method, two arrays of scanning devices are positioned along the length of the log, oriented in different planes (for example, at right angles to each other) to simultaneously measure the spaced diameters of two different sides of the log. This method of scanning also permits the "plotting" of a three dimensional representation of the log.

The dimensional data derived from the scanning devices is supplied to an electronic data processing unit for evaluation or "plotting." From the dimensional data, the electronic data processing unit produces an output that represents the coordinates of the largest surface of preselected form that can be superimposed within the measured dimensions of the log taking into account certain arbitrary factors that relate to the predetermined acceptable quality of the wood products to be derived from the log. As previously explained, if the scanning device used in one from which a planar profile of the log can be "plotted" a planar surface with parallel sides, such as a rectangle or parallelogram, is selected. However, if a scanning device is used which produces data from which a volumetric profile of the log can be "plotted," a volumetric surface with parallel sides, such as a cylinder, is selected. In addition, the output of the data processing unit includes information representing the coordinates of the center axis of the selected surface. The output signals of the data processing unit are used to control the repositioning of the log in a carriage with the calculated center axis parallel to an index line such as the cutting line of a saw array.

Upon evaluation of the dimensional information the data processing unit also selects, from a number of possible sawing or processing patterns that were previously designed by empirical methods and stored in the processing unit memory, a processing pattern which is the optimum pattern for the largest surface. Such an optimum pattern is the pattern that will yield the maximum amount of wood products of a desired quality from the given log. For example, if it is desired to divide a log into 2 inch × 4 inch studs, the optimum pattern would produce the greatest possible number of studs of acceptable quality from the given log. After selection, the processing program for the selected pattern is automatically carried out by the processing apparatus under the control of the data processing unit.

The method described herein can be used with saw arrays for producing cut lumber from logs, or can be used with other processing apparatus such as that used for peeling veneer.

One preferred apparatus for practicing the method of the invention is illustrated in the drawings in the form of a sawmill especially adapted for sawing logs into cut lumber such as 2 inch × 4 inch studs. The sawmill is designed for processing, continuously, logs of predetermined lengths ranging from 84 to 104 inches and having different diameters, for example ranging from 5 to 50 inches.

In accordance with the method of the invention, each of the logs, referred to hereinafter as blocks, is scanned along one side whereby a planar profile of the dimensions of the log can be "plotted," and is regarded as including a volume of usable wood encompassed within the largest parallelogram that can be superimposed within the measured dimensions. The center axis of the optimum surface or parallelogram for a given block is also determined from data obtained during photoelectric scanning of one side of the log. The best or optimum solution for dividing each block is the solution that provides the greatest number of cants of 2 inch or 4 inch width and is determined after making allowance for such lumber grading factors such as acceptable sawing variations, shrinkage, surfacing, saw kerf, and for allowable wane consistent with acceptable grade standards. After a block is divided into cants, the cants are scanned along a flat side whereby a planar profile of each cant is "plotted." An optimum solution is then determined for dividing each cant into the maximum number of studs of 2 inch × 4 cross section.

Referring now to FIG. 1, a sawmill 10 is generally illustrated including a block infeed network 11, a charger and scanner array 12, a saw carriage 14, and a twin band mill 15. The sawmill further includes an intermediate transfer conveyer arrangement 16 interconnecting the band mill with a cant scanner generally indicated at 18. A cant guide 19 is arranged between scanner 18 and a cant processing station 20 that includes a 4 inch gang edger 21 and a 2 inch gang edger 22. A conveyor system generally indicated at 25 receives cut lumber from the edgers and precedes an unscrambler 26 and a sorter 27 that ultimately supply sorted lumber to a stacker 29. A data processing unit generally indicated at 30 is provided for automatically controlling all the components of the sawmill in a manner explained hereinafter. It should be understood that the conveyors and chains shown in the drawings are of conventional design and are schematically illustrated to permit simplication of the drawings. Suitable power means, not shown, are associated with each of the conveyors and chains to drive them at the desired speeds in the directions indicated by the arrows.

Referring more particularly to the components mentioned above, block infeed network 11 includes a horizontal block infeed chain 35, and an inclined block infeed chain 36 arranged at the rear of chain 35. Infeed chain 35 is adapted to receive blocks deposited thereon, for example by means of a lift truck, and both chains are adapted for transferring blocks therealong. The block infeed network also includes a horizontal reject chain 38 and a conveyor 39 including end-to-end chains 41, 42 that communicate between reject chain 38 and a conventional Nicholsen chipper 34. Chains 41, 42 are adapted to receive reject blocks from chain 38 and to transport such blocks to chipper 34. The chipper is adapted to reduce the reject blocks into commercially usable chips as a byproduct of the sawmill. Chains 41, 42 are positioned, as schematically indicated, at a lower level than block infeed chain 35. Therefore, operator controlled ejection means, not shown, can be used for transferring reject blocks from the infeed chain to chain 41 for transport to the chipper.

A conveyor 46 and a transfer chain 47 are arranged to communicate between chain 41 and a cutoff saw 49, having an infeed roller set 50 associated therewith. The cutoff saw is a conventional unit adapted for reducing logs to a suitable block size for processing in the chipper. The sawmill also includes an inclined conveyor chain 51 adapted to communicate directly with chipper 34.

Referring now to FIGS. 1–3, the block charger and scanner array 12 are particularly illustrated as comprising a block alignment yoke 55 including two sets of vertically opposed V-members or V's 56. Each set of V's includes a fixed lower V 58 and an upper V 59 adapted for power movement between a closed or clamped position shown in solid outline in FIG. 2 and an open or retracted position shown in dotted outline in FIG. 2.

The lower V's are positioned beneath the upper end of chain 36 and are suitably constructed to receive and support blocks as they leave the end of chain 36. The upper V's occupy a noninterfering position when retracted and are adapted for gripping and firmly clamping blocks against the lower V's when closed. The block is centered in the V's and retained in a fixed position along a lengthwise axis that is arbitrarily used as a reference axis during the scanning operation described hereinafter. It should be apparent that the reference axis is not coincident with the center axis of the log, but the reference axis will always pass through the ends of the log.

The positioning of the upper V's is automatically controlled by processing unit 30. However, a manually controlled override switch and a block rotating mechanism, not shown, are provided by which the V's can be opened and the block rotated for realignment. This enables each block to be clamped in the block alignment yoke with its best side up as determined by an operator.

A block charger 60 is provided in conjunction with the alignment yoke, having arms 62, 64 positioned outwardly on either side of the V-members to selectively engage the ends of a block clamped within yoke 55. For this purpose, each charger arm includes an enlarged outer portion 66 having spikes 67 fastened thereto. Each charger arm otherwise includes a multiposition stacked hydraulic cylinder set works 70 adapted for extending the length of the arm, independently, in increments, such as 1/10th inch increments. The upper end 69 of each charger arm is secured to a power assembly 72 controlled by processing unit 30. The power assembly is adapted for moving the arms, selectively, into and out of contact with the ends of a block in yoke 55. In addition, the power assembly is designed to pivot the charger arms upwardly, to the position *b* shown in dotted outline in FIG. 2, wherein a block carried thereby is generally positioned along a scanning path indicated at 74. The power assembly is further adapted for driving the charger arms and block as a unit whereby the block traverses path 74 through a block scanner 75 and ultimately is rested in a region adjacent saw carriage 14 in position *c* shown in dotted outline in FIG. 2. During this entire phase of the operation the block is positioned along the reference axis, running longitudinally of the block, as determined by the original positioning of the block in the alignment yoke 55.

Referring to FIGS. 1–3, the block scanner 75 is particularly illustrated as comprising an upper hood 77 and a lower hood 79 spaced therefrom. The upper hood is positioned above scan line 74 and serves as a housing and reflector for a line source of light 80, such as a neon tube, supported therefrom and extending parallel to the length of a block oriented in the charger arms. Source 80 produces light of appropriate intensity and direction to illuminate the upper half of each block as it traverses the scanner. Lower housing **79** supports a plurality of light responsive elements **82**, such as photocells and electrical circuitry associated therewith. The photocells are arranged in a line directly beneath light source **80** for exposure thereby, being interspersed at predetermined intervals along the length of lower hood **79.** The photocells are adapted to produce an electrical output in the presence of light and to produce no output in the absence of light. Accordingly, the presence of any portion of a block between light source **80** and each individual photocell can be detected.

In the preferred embodiment illustrated 55 photocells are utilized being spaced at 2 inch intervals over a 110 inch span along the length of the scanner. The output of each photocell is connected to a conventional electronic unit, not shown, for amplifying the output of the photocell and supplying the amplified output to processing unit **30.** In the embodiment illustrated, the photocell array is actuated, by means not shown, upon the approach of the charger arms and 550 readings are obtained from each photocell during the traverse of a given block, each reading being taken at a 1/10th inch interval of horizontal travel of the block through the scanner. The data procured from such a scanning sequence is supplied to processing unit **30** and utilized in the calculation and "plotting" of the block dimensions. From such data processing unit **30** calculates the center axis of the largest parallelogram that can be superimposed within the measured and "plotted" dimensions of the block and independently controls the operation of the hydraulic set works **70** of each charger arm **62, 64** to realign the block with the center axis parallel to an index line, such as a saw line, prior to engagement in the saw carriage, in a manner explained in more detail hereinafter.

Saw carriage **14** is of conventional design, including spaced-apart carriage arms **83, 84** adapted to engage the ends of a block. Conventional means, not shown, are provided for moving the carriage arms into engagement with a block and for releasing the arms at the end of the sawing program. The carriage arms are formed with knife edges **86** designed to slice into the ends of the block for firm engagement. The knife edges have recesses **87** formed therein, located so as to be centered over ends **66** of the charger arms when a block is engaged by carriage arms **83, 84.** This permits gripping of the block in the saw carriage along the calculated center axis prior to release of the block by the charger arms.

Conventional means, not shown, are provided for driving the carriage arms, with a block gripped therein, along an index line such as a carriage center line or saw line **90** between a start position **91** indicated in FIG. **1** and a stop position **92.** Intermediate stops at a backstand position **94** are also possible. A conventional slab chipper **95** is provided having heads **96** arranged on either side of the carriage center line between the start and backstand positions for removal of chips from the outer periphery of the blocks. The spacing of the slab chipper heads is automatically controlled by unit **30.**

Twin band mill **15** is arranged along center line **90** for removing slabs from either side of a block traversing the center line. The band mill is of conventional design, comprising a pair of band saws **98, 99.** Each band saw includes front and rear cutting edges and is adapted for selective lateral movement toward or away from center line **90** in response to signals from processing unit **30.**

Conveyors **101, 102** and rollers **103, 104** are adapted to receive cants removed from the blocks on forward passes; and conveyors **107, 108** are arranged to receive cants removed from the blocks on rearward passes.

A main outfeed conveyor **110** is provided for receiving cants from the band mill. The main conveyor communicates with conveyor **107** by means of a conveyor **112,** and with conveyor **108** by means of a series of conveyors **113, 114, 115.** A conveyor **116** is adapted to receive cants from conveyors **101, 102** and deliver them to the main outfeed conveyor. Intermediate transfer conveyor **118** is adapted to receive cants from outfeed conveyor **110** via chain **119** and to deliver such cants to cant scanner **18.**

Referring now to FIGS. **5** and **6,** the cant scanner is particularly illustrated as including a pair of parallel scan chains **121** each having a plurality of lugs **122** secured thereto in opposed pairs or sets, and a pair of crowder chains **124** arranged parallel with and overlying the scan chains. Cants are received on the scan chains from transfer conveyor **118** and are conveyed thereby through the cant scanner. The cants, such as cant **130,** are arranged on the scan chains with their length transverse to the direction of movement of the chain. The cants are also positioned by conventional means with their worst side up, (i.e., the side having the narrowest strip of smooth surface) as illustrated in FIGS. **5** and **6.**

Lugs **122** on the scan chains extend above the level of the crowder chains and the crowder chains are operated at a higher speed than the scan chains. Therefore, each cant is maintained in contact with a set of lugs on the cant chain during transfer through the cant scanner. The difference in speeds between the crowder chain and the cant chain is adjusted to a suitable value to maintain the cants in firm contact with the lugs.

The cant scanner comprises a hood **131** supported above the cant chains that serves as a reflector element and as a support for a plurality of detectors such as photocells **133.** A pair of light sources such as lamps **135, 136** are supported on either side of the hood arranged to direct light upon the upper surface of each cant as it is guided beneath the hood. The light from these lamps is reflected by the smooth surfaces of the cant upwardly to the photocells. However, any light striking the rough or wane surfaces of the cant is absorbed or diffused whereby the photocells do not receive it. Accordingly, the photocells accurately detect the dimensions of the flat surface on the upper side of the cant. In the preferred embodiment **55** photocells are utilized, arranged in line along a 110 inch axis passing through the center of the scanner hood. As with the block scanner, a scan grid 55 inches wide is utilized, with measurements of the cant being taken every one-tenth inch of its transverse of the scan grid. Therefore, the output data from the photocell array can be supplied to unit **30** where it is processed for calculation of an optimum parallelogram of wood of uniform thickness in the cant, as well as the center axis thereof.

A conveyor **140** is provided for receiving cants from the crowder chain, after scanning, and delivering such cants to a conveyor **142** having a set of cant guides **19** associated therewith. Each cant guide includes a stop **147** that is independently positioned by a hydraulic ram **148** at a desired lateral distance from the edge of conveyor **142.** The stops of both cant guides are adjusted, under the control of processing unit **30,** to contact the leading edge of the cant and to establish a desired alignment for each cant as it is projected onto conveyor **142.** Thus, the cants are realigned or repositioned with the center axis of the optimum parallelogram parallel to the cutting line of the edger saws.

A cant chipper **144** is arranged downstream of conveyor **142** for removing any excess portions of the cants prior to sawing, and a conveyor **146** is adapted to receive cants leaving the cant chipper. Four inch gang edger **21** is arranged downstream of conveyor **146.** A transfer conveyor **150** and an edger infeed conveyor **152** are arranged upstream of 2 inch gang edger **22.** A selector fence **156** of conventional design is associated with conveyor **146.** The fence permits passage of 2 inch cants and controls the transfer of 4 inch cants to the transfer chain for delivery to the 2 inch gang edger. Consequently, in the embodiment illustrated, all the cut lumber is reduced to 2 inch × 4 inch studs. It should be apparent, however, that other sawing arrangements are possible without departing from the invention.

An outfeed conveyor **160** receives cut lumber from gang edger **21** and a corresponding outfeed conveyor **162** receives cut lumber from gang edger **22.** The cut lumber is delivered to an unscrambler **26** via a transfer conveyor **166,** a conveyor **167,** and a cross conveyor **169.** The unscrambler is of conventional design and provides aligned cut lumber to a sorter **27** via a transfer conveyor **171.**

A conventional stacking unit **29** is located downstream of the sorter. The stacking unit serves to automatically stack the cut lumber or studs in predetermined lots for delivery from the sawmill.

The operation of the sawmill described hereinbefore is automatically controlled by means of data processing unit **30,** with the exception of certain operator responsive override controls, such as the block rotating control previously mentioned. Blocks are transmitted into the mill for processing via the block infeed conveyors and reach the alignment yoke. When a block drops into the lower V's of the yoke, the V's automatically close and clamp the block in a position along a reference axis such as that illustrated in FIG. **3.**

Ordinarily, it is preferred that the block be positioned with the best side up. Therefore, after the clamping action, if the operator observes that the block is not so positioned, he can reopen the V's, rotate the block on the lower V's until its principal curvature or any excessive surface irregularity is arranged in a vertical plane. The V's are then permitted to reclamp the block in that position and the block charger arms automatically grip the block at each end, in response to processing unit control signals. The V's then retract allowing the charger arms to pivot the block upwardly and move it horizontally along the scan path.

As the block approaches the scan zone, the photocell array is actuated and scanning begins at a point corresponding to the zero line of the block scan grid schematically represented in FIG. **4.** During the passage of the block through the scan zone, a signal is generated from each photocell for each one-tenth inch of block travel through the 55 inch scan zone. As light is occluded by portions of the block, the recorded signal from each of the blocked photocells changes whereby the profile of the leading edge of the block is detected. When the trailing edge of the block passes by a particular photocell, the signal from that photocell again changes whereby the profile of the trailing edge of the block is detected.

When the last point on the trailing side of the block has passed the photocell array, the data supplied to the processing unit is used in the computation of the maximum parallelogram which can be superimposed within the profile dimensions of the block. The center axis of the maximum parallelogram is also calculated and an electrical signal representing that center axis is transmitted to the charger arm set works. As the charger arms approach a position adjacent the saw carriage, the electrical signal from the processing unit controls the movement of the calibrated stacked hydraulic cylinders comprising the set works. The hydraulic cylinders are extended, individually, until the center axis of the optimum parallelogram is parallel with the sawing line of the saw carriage. The center axis can coincide with the sawing line or it can be offset therefrom by a small distance as is required by the particular cutting program selected.

With the block properly repositioned, the saw carriage arms close on each end of the block and the charger arms are released from the block. The charger arms are then withdrawn to their original location for handling the next block fed into the sawmill.

Referring now to FIG. **4,** a planar profile of a typical block is shown in solid outline superimposed upon a grid that schematically represents the block scan grid. The parallelogram having the greatest width that can be superimposed within the block profile is represented by parallelogram X and the center axis of parallelogram X is represented by line Y. Line R_1 represents the position of the reference axis of the block during scanning and line R_2 represents the position of the reference axis after the block is repositioned in the saw carriage arms. It should be apparent that the block is repositioned after scanning so that center axis Y of parallelogram X is parallel to the base of the scan grid which is, in turn, parallel to the saw line. As shown, such repositioning results in the movement of both ends of the block which causes both angular and lateral adjustment of the reference axis.

Before sawing, the processing unit **30** positions the slab chipper heads to convert a calculated amount of slab from each side of the block into chips, in accordance with the appropriate preselected cutting pattern. As previously mentioned, the sawing pattern for each particular block is automatically selected by the processing unit from one of a number of empirically determined cutting patterns that are retained in the processing unit, a different pattern being provided for each 1/10th inch difference in width of the maximum parallelogram.

As the block is passing through the slab chipper, the two band saws of the twin band mill are moved into position for the first cuts, also under the control of the processing unit. When the band saws are positioned, the saw carriage completes its first pass through the band mill with the first pair of cants being removed, one from each side of the block, and delivered through the conveyor network previously described toward the cant scanner. The band saws are then repositioned for the second cuts and the saw carriage and block are passed back through the band mill with the second set of cants being removed and dropped, one on each side of the block. This process is repeated until the selected cutting program for the block has been completed.

Upon completion, the saw carriage stops in the backstand position between the band mill and the slab chipper and releases the remaining section of the block. The saw carriage then returns to the start position to receive the next block to be processed.

It should be noted that it is possible for the processing to include several passes of the block through the slab chipper in order to remove excess wood such as would occur with a flared block. This serves to prevent damage to the chipper in the event it is necessary to remove more wood than the chipper is capable of on the first pass.

The cants are transferred sequentially from the outfeed conveyor and indexed onto the lugged scan chains. The cants are positioned on the intermediate transfer conveyor with their narrow side up as illustrated in FIG. **6** and are maintained in this relative position during the remaining sawing operations. Each cant is carried onto the scan chains and maintained in contact with a set of lugs by the crowder chain. The position of the cant in contact with the lugs establishes a reference position for the cant during processing which is the equivalent of gripping the cant along a reference axis M as shown in FIG. **6.** Each set of lugs retains its cant aligned along the reference axis M during transfer through the cant scanner. Therefore, each individual cant can be identified by its relative position during and after scanning. This facilitates the "housekeeping" task of the processing unit since a significant interval occurs between the scanning of a particular cant and the processing of that cant by the cant chipper and edger saw arrangement.

The cant scanning operation is similar to the block scanning operation previously described in that a 55 inch by 110 inch scan grid is utilized. In the embodiment described, 55 photocells are utilized, although a different number could be used if desired. The photocell array is actuated as each set of lugs approaches the zero line of the scan grid and as the cant traverses the scan line an output signal is derived from each photocell during each one-tenth inch of cant movement across the scan grid. As previously described, when light is reflected from the smooth upper surface of the cant the photocell produces a positive output. However, when light strikes the wane portions of the cant or is diffused by a front or trailing edge of the cant, the photocell produces no output. Accordingly, an accurate profile of the upper surface of the cant can be detected and measured.

As with the block scanner, data from each cant is processed in unit **30** and the widest parallelogram of wood of uniform thickness encompassed within the profile of the cant is determined. Data representing the center axis of the parallelogram is also calculated and supplied to the cant guides. In response to this data, the two adjustable set stops at the edge of the cant guide conveyor are set to predetermined positions. Accordingly, as the leading edge of the cant moves onto the conveyor into contact with these set stops, the cant is automatically positioned with the center axis of the optimum parallelogram of wood aligned parallel to the center line of the cant chipper and the edger saws. The cant is maintained in this alignment during subsequent sawing.

Referring now to FIG. **7,** the profile of a typical cant is shown in solid outline superimposed upon a grid that schematically represents the cant scan grid. The widest parallelogram that can be superimposed within the cant profile is represented by parallelogram K and the center axis of parallelogram K is represented by line L. Line M_1 represents the position of the reference axis of the cant during scanning and line M_2 represents the position of the reference axis after the block is retained on conveyor **142.** It should be apparent that the cant is repositioned after scanning so that the center axis L of parallelogram K is parallel to the base of the scan line and parallel to the edger saws. As shown, such repositioning results in the movement of both ends of the cant, causing both angular and lateral adjustment of the reference axis.

The processing unit also controls the movement of one or both heads of the cant chipper to locations which will convert to chips all except the wood within the widest parallelogram as the cant is driven through the chipper. As the edged cants leave the chipper they are carried by conveyor **146** into contact with fence **156.** Two inch cants pass the fence member and are ultimately processed through a 4 inch gang edger. The 4 inch cants, however, are transferred by means of transfer conveyor **150** and conveyor **152** for processing through the 2 inch gang edger.

From these saws, the resulting cut lumber is passed onto the conveyor systems previously described and on through an unscrambler into the sorter. Studs from the sorter are usually made up into 7 foot kiln packages in a stacker at the end of the sorter, at which point they can be rolled out for transport to other areas, such as the drying kilns.

It should be apparent that in the sawmill described, the processing units and conveying systems are arranged for convenient handling of cut lumber. However, other arrangements are possible without departing from the scope of the invention.

Likewise, the block scanner is particularly designed for conveniently and accurately handling blocks of 8 foot lengths. However, other scanning systems and scanning grids could be utilized so long as the blocks are repositioned along an optimum cutting axis. As previously mentioned, it is possible to simultaneously scan the block along two planes to derive a three-dimensional profile of the block. With such scanning, it is possible to calculate in a single step the maximum cylindrical surface that can be superimposed within the dimensions of a block. The block can then be repositioned with the center axis of the cylinder parallel to an index line for processing the block into cut lumber or into veneer.

In addition, with a single scanning array, a block could be repeatedly passed through the scanner, being rotated a predetermined amount such as 30°, between each pass. This would produce data from the scanner output which could also be utilized to derive a three dimensional profile of the block. The center axis of the largest cylindrical surface that could be superimposed within the block could be identified and the block could then be repositioned for processing as previously described. The disadvantage of such scanning is the additional time required. In addition, such scanning requires more intricate "housekeeping" operations in the processing unit. Therefore, such scanning is not preferred for the processing of cut lumber.

However, it should be apparent that any of the types of scanning described herein can be used to obtain more wood products from a given log than was heretofore possible. In addition, the invention described results in the automatic processing of blocks at a higher rate than was previously possible with a reduction in personnel.

It is claimed and desired to secure by Letters Patent:

1. A method of processing a log to obtain the optimum amount of wood products of a selected grade therefrom, comprising the steps of

positioning the log with respect to a reference location,

scanning the log to determine certain of its dimensions with respect to the reference location,

plotting in a data processing equipment at least one planar profile of the dimensions of the log, said profile being taken in a plane passing through the ends of the log,

computing in a data processing equipment at least the center axis of the widest parallelogram that can be superimposed within the plotted profile of the log, and

repositioning the log with the center axis parallel to an index line of a log processing equipment.

2. Log processing equipment comprising

a saw array aligned with an index line,

aligning means for receiving and holding a log at a reference location,

photoelectric scanning means spaced from said reference location for producing an output signal representative of the dimensions of a log passed by said scanning means,

data processing means connected to said scanning means for evaluating said output signal and producing a data output signal in response thereto,

charger means for releasably gripping said log at said reference location and transporting the log past said scanning means, said charger means including means responsive to said data output signal for angularly repositioning said log with respect to said index line,

a saw carriage, aligned with said index line and movable with respect to said saw array, for receiving from said charger means said log when repositioned, and

control means associated with said saw carriage for selectively moving said carriage with respect to said saw array, said control means being responsive to said data output signal whereby said log carried by said saw carriage is divided into cants by the saw array in accordance with a preselected cutting pattern stored in said data processing means.

3. Log processing equipment as described in claim **2** further including

a movable cant chain having means thereon for receiving and holding cants each at a reference position,

transfer conveyor means for receiving cants produced by said saw array and conveying said cants onto said cant chain,

cant scanning means for producing a cant output signal representative of the profile dimensions of a cant passed by said scanning means while being carried on said cant chain, said profile being taken along a flat side of said cant,

said data processing means being connected to said cant scanning means for evaluating said cant output signal and producing a cant data output signal in response thereto,

a cant sawing station spaced from said cant scanning means, including a sawing conveyor and a saw array aligned along a second index line with respect to said sawing conveyor, and

second transfer conveyor means for receiving cants from said cant chain and conveying said cants onto said sawing conveyor, said second transfer conveyor means including adjustable cant guide means responsive to said cant data output signal from said data processing means for repositioning each cant with respect to said second index line before sawing thereof by said saw array.

4. The method of claim **1** further including the steps of

dividing the log into cants,

positioning each cant with respect to a cant reference position,

scanning each cant to measure certain of its dimensions with respect to the reference position,

plotting in said data processing equipment a planar profile of the measured dimensions of the cant, said profile being taken along a flat side of said cant,

computing in said data processing equipment the center axis of the widest parallelogram that can be superimposed within the plotted profile of the cant, and

repositioning the cant with the center axis parallel to an index line of a cant sawing array.

5. A method of processing a log including the steps of

placing the log in a reference position,

scanning the log to measure the diameter of the log at numerous locations spaced along the length of the log,

plotting in a data processing equipment a profile of the measured diameters of the log,

computing in said data processing equipment the coordinates with respect to said reference position of the cylindrical surface having the largest diameter defined within said plotted profile, and

repositioning said log with the sides of said cylindrical surface parallel to an index line of a log processing apparatus.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,736,968 Dated JUNE 5, 1973

Inventor(s) Howard C. Mason and Fred Sohn

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

The invention is a joint invention of Howard C. Mason and Fred Sohn, rather than a sole invention of Howard C. Mason alone.

Column 4, line 26, change "in" to --is--.

Signed and sealed this 21st day of May 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents