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(54) Titre : SYSTEME DE POSITIONNEMENT D'UNE PIECE A TRAVAILLER
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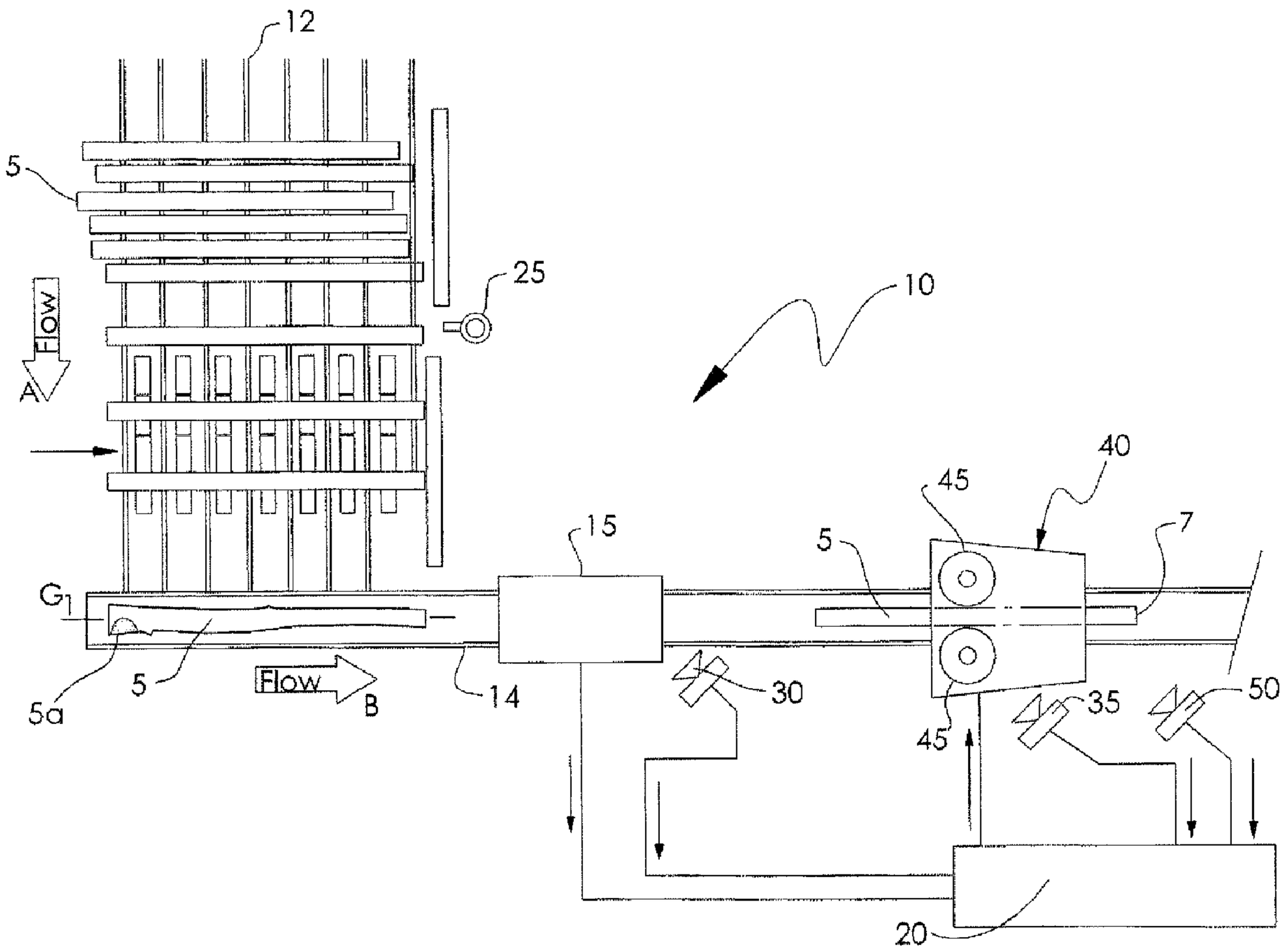

(57) Abrégé/Abstract:
A system for positioning a workpiece in an optimized position. In one embodiment a marking device places a mark on the workpiece prior to the workpiece passing through a scanner cooperating with an optimizer. The optimizer determines the optimized

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(57) Abrégé(suite)/Abstract(continued):
position of the workpiece. The orientation of the workpiece is identified by a first camera. The mark may be used as a point of reference such that the workpiece may be positioned in the optimized position by rotating the workpiece relative to the orientation of the mark. A turning mechanism rotates the workpiece to position it in the optimized position. A further camera identifies the orientation of the mark while the workpiece is being rotated. A processor compares in real time the orientation of the workpiece with the optimized position to determine if the workpiece is in the optimized position.

Abstract of the Disclosure

A system for positioning a workpiece in an optimized position. In one embodiment a marking device places a mark on the workpiece prior to the workpiece passing through a scanner cooperating with an optimizer. The optimizer determines the optimized position of the workpiece. The orientation of the workpiece is identified by a first camera. The mark may be used as a point of reference such that the workpiece may be positioned in the optimized position by rotating the workpiece relative to the orientation of the mark. A turning mechanism rotates the workpiece to position it in the optimized position. A further camera identifies the orientation of the mark while the workpiece is being rotated. A processor compares in real time the orientation of the workpiece with the optimized position to determine if the workpiece is in the optimized position.

SYSTEM FOR POSITIONING A WORKPIECE

Field of the Invention

This invention relates to the field of devices for positioning a workpiece in a sawmill, and more particularly, it relates to a system for positioning a workpiece into an optimized position to produce the highest value or yield of lumber.

Background of the Invention

Conventional log turners known as "flying log turners", typically comprise a pair of four to five foot long vertically oriented spiked rolls which are located on each side of a transporting conveyor. The log turner rotates a workpiece, such as a log, as the workpiece travels towards the infeed of a primary breakdown machine, such as canters, bandmills or circular Scragg saws. The spiked rolls of the log turner are movable laterally towards and away from the centreline of a workpiece, longitudinally along the length of the workpiece in an open-and-close operation, and vertically upwards and downwards to engage, manipulate, and rotate the workpiece. The pair of rolls moves in an open-and-close operation to control the location along the length of the log where the rolls contact and manipulate the log position. Each roll, or set of rolls also moves in the vertical direction.

Other conventional log turners known as knuckle turners provide a less accurate method of turning logs. If accurate turning feedback was achieved, this would be a more cost-effective method of turning the logs as compared to flying log turners.

As a workpiece travels along the conveyor en route to the primary breakdown machines, an optimizer, using data from a scanner, determines an optimized position of the workpiece such that the workpiece, when processed in accordance with the desired angular

rotation of the optimized position, may generate the highest value or yield of lumber. To position the workpiece in the optimized position, motion control data generated by the optimizer and associated programmable logic controller (PLC) initiates movement of the log turner to rotate the workpiece in order to attain the optimized position. In flying log turners lateral and longitudinal displacement of the spiked turning rolls brings the rolls into contact with the surface of the workpiece. The vertical displacement of each spiked roll allows the workpiece to be rotated about its longitudinal axis. The log turner rotates the workpiece until the optimized position is achieved.

During the turning process, surface irregularities such as protruding knots or indentations on the surface of the workpiece may affect proper contact of the spiked rolls with the workpiece, thereby inhibiting proper rotation of the workpiece to position it in the optimized position. This turning inaccuracy results in a significant reduction in lumber recovery. Furthermore, even if the optimized position is achieved, movement of the transport conveyor on which the workpiece travels may not maintain the workpiece in the optimized position. Precision in workpiece rotation and workpiece positioning is made even more difficult given the high speed at which the log turner performs its function. By providing a system to improve the accuracy of workpiece positioning, lumber volume and value will thereby increase.

The scanner/optimizer decides what angular orientation the log needs to be in to get the highest value breakdown solution from the log. Motion control data is sent from the Optimizer to the PLC control system allowing the rolls to contact the log, and by moving the rolls in opposite vertical directions; the log can be rotated to the desired angular position.

During the log turning process, approximately eight feet along the length of the log is in contact with the turning rolls. Because the outer surface of the log typically exhibits many geometric defects such as knots, cat-face, etc., smooth & consistent contact with the turning rolls is impeded. This in turn results in the target angular position of the log not being reached. For example, as the rolls pass over a knot that is sticking out, optimal contact with the log is sacrificed

and therefore the targeted position is not achieved. Depending on log geometry, log diameter and products being manufactured, this turning inaccuracy can have a significant impact on lumber recovery.

Summary of the Invention

It is an object of the present invention to provide a system of positioning a workpiece into an optimized position whereby rotational accuracy of a workpiece may be monitored, maintained, and/or corrected so that positional or rotational errors at primary breakdown may be avoided, thereby improving overall lumber recovery.

It is another object of the present invention to provide a marking device to place a mark on an end of the workpiece to assist the system in monitoring, maintaining, and/or correcting the position of the workpiece such that the optimized position may be achieved and maintained.

It is another object of the present invention to provide a means for identifying the orientation of the mark in real-time as the workpiece is transported through the turning mechanism such that any necessary corrective angular repositioning may be timely performed to ensure that the orientation of the mark prior to the workpiece leaving the turning mechanism coincides with the optimized position of the workpiece.

It is another object of the present invention to provide a evaluator to determine in real-time if there are any positional differences between the orientation of the mark and the optimized position while the workpiece is being rotated and transported towards the primary breakdown machine.

It is a further object of this invention to provide a mechanism for transmitting corrective positioning information to control the operation of the turning mechanism to adjust the position of the workpiece such that the optimized position may be achieved and maintained.

The present invention is a system for positioning a workpiece into an optimized position. The system includes a marking device adapted to place a mark on the workpiece prior to the workpiece passing through an optimizer. A first identifying means identifies the orientation of the mark as a point of reference such that the workpiece may be positioned into the workpiece's optimized position by rotating the workpiece relative to the orientation of the mark. A turning mechanism rotates the workpiece. A second identifying means identifies the orientation of the mark while the workpiece is being rotated. An optimizer or other processor receives information from the first identifying means and from the second identifying means to determine if the workpiece is in the optimized position. A PLC or other processor controls rotation of the workpiece such that the optimized position of the workpiece may be achieved.

The marking device may be a spray paint marking device for placing a spray paint line on an end of the workpiece. A first camera identifies the orientation of the mark. This may be prior to the workpiece exiting the optimizer. The optimizer determines the optimized position of the workpiece. A workpiece turning mechanism such as one including a pair of turning rolls, one turning roll on each side of a conveyor, rotates the workpiece to its optimized position. The turning rolls may be spiked to grasp the workpiece without slipping. The turning rolls may also displace horizontally to engage the workpiece. They may also rotate about a vertical axis to assist in transporting the workpiece along the conveyor. The pair of turning rolls displace vertically relative to one another, upwards and downwards, causing the workpiece to rotate where sandwiched between the rolls. A second camera may be positioned within the turning mechanism. A third camera may be positioned adjacent to the turning mechanism. The second and third cameras identify the orientation of the mark in real-time, continually or at predetermined time

intervals while the workpiece is being rotated. The real time orientation of the mark is transmitted to the processor which compares the real time orientation of the mark with the desired optimized position of the workpiece to determine if the workpiece is in the optimized position. To position or maintain the workpiece in the optimized position, the processor transmits information to the turning mechanism to control rotation of the workpiece such that the optimized position of the workpiece may be achieved and maintained.

Brief Description of the Drawings

Various other objects, features and attendant advantages of the present invention will become fully appreciated as the same becomes better understood when considered in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the several views, and wherein:

Figure 1 is a detailed plan view of the infeed, scanner/optimizer, conveyor and turning roll portions of the present invention;

Figure 1a is a schematic plan view of the present invention;

Figure 2 is a detailed side elevational view of the invention illustrated in Figure 1;

Figure 3 is an enlarged plan view of a portion of the turning roll mechanism;

Figure 4 is a sectional view taken on line 4-4 of Figure 3; and

Figure 5 is an enlarged view of a portion of Figure 3.

Detailed Description of Embodiments of the Invention

With reference to the Figures wherein similar characters of reference denote corresponding parts in each view, a system 10 according to the present invention includes a scanner/optimizer 15, a processor 20, a marking device 25, a first and a second mark orientation identifying means 30 and 35, and a turning mechanism 40.

As seen in Figures 1 and 1a, a plurality of logs, referred to herein alternatively as workpieces 5, located on an infeed 12 are transported by suitable means, such as a chainway or other conveyor, in downstream direction of flow A on a feedpath towards a conveyor 14. Marking device 25 mounted along infeed 12 makes or places a mark 28 on each workpiece 5. Alternatively, marking device 25 may be positionable along conveyor 14 so that marking device 25 places mark 28 on workpiece 5 prior to workpiece 5 passing through scanner/optimizer 15. In one embodiment, not intended to be limiting, marking device 25 is a spray paint marking device for placing a visually observable spray paint line on an end 7 of workpiece 5. Alternatively, marking device 25 may be a cutting means for making a superficial visual cut mark on end 7 of workpiece 5. It will be recognized that there are many different marks and marking devices within the scope of the present invention that may be used to provide a suitable mark on workpiece 5 as a reference point to provide information regarding the rotational position of workpiece 5. Further, as better described below, natural features or objects or irregular shapes occurring on or along the workpiece may serve as a mark for the purposes of tracking the rotational orientation of the workpiece.

Workpieces 5, which are marked on ends 7, are then transported on conveyor 14 in downstream direction B towards and through scanner/optimizer 15. Scanner/optimizer 15 detects, analyzes, and classifies the geometrical information and surface characteristics or features of each workpiece 5 and determines an optimized cutting solution to obtain optimal lumber production from each workpiece 5. Based on the optimized cutting solution, scanner/optimizer 15 calculates

an optimized position for each workpiece 5 such that workpiece 5 may be rotated into its position prior to processing in a downstream machine center such as a canter, gangsaw, etc. The optimizer may determine the optimized position of workpiece 5 simultaneously with first identifying means 30 identifying the orientation of mark 28 on end 7 of workpiece 5. In one embodiment, first identifying means 30 is a first vision camera such as a video camera mounted adjacent to and in proximity with scanner/optimizer 15 such that end 7 of workpiece 5 may be photographed or scanned prior to end 7 passing through scanner/optimizer 15. Data relating to the orientation of mark 28 identified by first identifying means 30 is then transmitted to processor 20. The optimized position calculated by scanner/optimizer 15 is also transmitted to processor 20. Typically, processor 20 is a computer or a PLC system capable of controlling turning mechanism 40 to rotate and position workpiece 5 into its optimized position. The orientation and position of mark 28 identified by first identifying means 30 serves as a reference point to assist processor 20 in controlling the rotation of turning mechanism 40 to position workpiece 5 in the optimized position, as described below.

As seen in Figures 3 to 5, turning mechanism 40 comprises a plurality of turning rolls 45 located on each side of conveyor 14. Turning rolls 45 are typically spiked to enable turning rolls 45 to engage the surface of workpiece 5 to rotate workpiece 5. As seen in Figure 3, only two pairs of turning rolls 45, one pair on each side of conveyor 14, are illustrated and is not intended to be limiting as two turning rolls 45, one on each side of conveyor 14, or four or more even numbered pairs of turning rolls 45 may be employed. Each pair of turning rolls 45 may simultaneously rotate about their vertical axis C and/or displace in direction D laterally of the direction of flow B, towards and away from the centreline of workpiece 5. Rotation of turning rolls 45 about vertical axis C assists with the transport of workpiece 5 along conveyor 14. Lateral displacement of turning rolls 45 in direction B allows turning rolls 45 to engage the surface of workpiece 5 of varying widths. To rotate workpiece 5, turning rolls 45 may also independently displace vertically upwards and downwards in direction E along their corresponding vertical axes C, to thereby rotate workpiece 22 in a clockwise or counter-clockwise direction about its

longitudinal axis G, as shown by arrow F. Turning rolls 45 are actuated by conventional actuator means such as hydraulic means while the rotational, lateral, and vertical movement of turning rolls 45 are controlled by processor 20. Processor 20 transmits information by conventional means to turning mechanism 40 to control actuation of rolls 45 so as to selectively rotate and position workpiece 5 into the optimized position.

Second identifying means 35 monitors the position of mark 28 as workpiece 5 is rotated by turning mechanism 40. Second identifying means 35 may include a second vision camera such as a video camera, wherein the second camera may be mounted within turning mechanism 40. In another embodiment, at least two second identifying means 35 are mounted within turning mechanism 40, as seen in Figure 3. A third identifying means 50, in a preferred embodiment including a third vision camera, is positioned along conveyor 14 where workpiece 5 exits turning mechanism 40. For simplicity, and not intending to be limiting, only a single second identifying means 35 and a single third identifying means 50 are illustrated in Figure 1a.

Second and third identifying means 35 and 50 identify the orientation of mark 28 continually or at predetermined length or time intervals, such as every 5 seconds, and transmits the orientation information for the mark such as mark 28 to processor 20. Processor 20 performs an evaluation in real time of any positional differences between the desired optimized position of workpiece 5 and the real time position of workpiece 5, as indicated by reference to the orientation of the mark such as mark 28. If the orientation of the mark indicates that workpiece 5 is not in the optimized position, processor 20 calculates the required angular rotation of workpiece 5 so as to position workpiece 5 into the optimized position and transmits such corrective information to turning mechanism 40. Any positional errors of workpiece 5 are thus corrected on a continual basis until workpiece 5 exits turning mechanism 40. If the orientation of mark 28 indicates workpiece 5 is in the optimized position, processor 20 and turning mechanism 40 cooperates to maintain workpiece 5 in the optimized position by making any necessary adjustments if workpiece 5 is displaced, for example, by the movement of conveyor 14.

Video images may be used to track the movement of the log or workpiece by identification of an object or other feature such as a patch of bark 5a in the image and tracking the relative movement of that object or feature or unique characteristic of the log, frame to frame. This may also be accomplished using mathematical techniques such as correlation or phase correlation, or object tracking techniques known in the art. To obtain a correct movement a range measurement must be added to determine if translation is occurring. This range measurement can also provide log diameter for side to side translation and geometric correction to the video image. If video information is taken in several locations the log can be tracked very accurately and the log can be rotated to the correct optimized location for log breakdown in the downstream machine center. The tools can also be adjusted to correct for translations that the log has made during rotation and transportation process before the machine center.

The same can be done using the three-dimensional shape of the log. The original log is scanned using a three-dimensional scanning system and that data correlated with the original three-dimensional shape data to determine rotation and location.

These are just examples and many methods may be used to measure the log rotation and provide feedback to allow for precise rotation and correct tool placement of the machine center.

The system would then, in real time, calculate and communicate corrective positioning information to the motion control system that is controlling the log turners, so any potential angular orientation error could be corrected on a continuous basis during the log turn process. If tracked further in the process, exact location of the log may be determined and the cutting tools adjusted accordingly.

In interpreting both this specification and the claims that follow, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms "comprises" and "comprising" should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced. The term "mark" is meant to include orientation marks added to a log, and to other inherent orientation objects and features including unique or non-symmetrical log shape which may be tracked to determine if a rotational orientation of a log has changed or if a preferred or optimized rotational orientation of a log has been obtained.

In this fashion, rotation position and location errors are reduced to thereby improve overall lumber value recovery. Placing a reference mark on the log prior to the turner rolls is described above. This may be in the form of a vertical line painted on the end of the log somewhere on the log infeed. A camera reads the orientation of the paint mark at frequent intervals during the turn process. The sub-system that looks at the vertical paint spray mark calculates an angular orientation and communicates this to the optimization system at predetermined intervals (every 6" to 12", for example along the log). The same error rotation correction could be accomplished using log image or shape recognition. Other methods would also work.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention. The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.

WHAT IS CLAIMED IS:

1. A system for rotationally positioning a log which is translating downstream along a feedpath, the system comprising:

a first identifying means along the feedpath, the first identifying means configured to detect a rotational orientation of the log about its longitudinal axis;

a turning mechanism downstream of the first identifying means along the feedpath, the turning mechanism configured to selectively rotate the log about its longitudinal axis while advancing the log along the feedpath;

a second identifying means downstream of the first identifying means, the second identifying means positioned to detect actual rotational positions of the log while the log is being rotated and advanced by said turning mechanism, wherein the second identifying means includes a first detector positioned proximal to the turning mechanism; and

a processor adapted to receive information from said first identifying means and said second identifying means and to compare the actual rotational positions to one or more desired rotational positions, said processor further adapted to control rotation of the log by said turning mechanism based at least on said actual rotational positions until the log exits the turning mechanism.

2. The system of claim 1 wherein the information from the first and second identifying means includes three-dimensional log shape data.

3. The system of claim 1 further comprising an optimizing scanner located upstream of the log turner, the optimizing scanner configured to calculate an optimized rotational position for the log.

4. The system of claim 1 wherein said first identifying means comprises an optimizing scanner configured to calculate an optimized rotational position for the log.

5. The system of claim 1 wherein said turning mechanism comprises at least two pairs of turning rolls, at least one pair of said pairs of turning rolls positioned on each side of a conveyor, said pairs of tuning rolls adapted to engage and rotate the log whereby contact of said pairs of turning rolls with uneven surfaces of the log is maintained despite abrupt surface irregularities disturbing contact of one turning roll of said pairs of turning rolls from the surface of the log.

6. The system of claim 1 wherein said first identifying means comprises a three-dimensional scanning system configured to detect the three-dimensional shape of the log.

7. The system of claim 6 wherein the second detector comprises a three-dimensional scanning system, and wherein the second detector is operable to scan the log until the log exits the log turner.

8. The system of claim 7 wherein the processor is adapted to correlate the three-dimensional shape data from the first identifying means with three-dimensional shape data from the second detector to determine the rotational orientation of the log.

9. The system of claim 1, the second identifying means further comprising a second detector positioned downstream of the first detector.

10. The system of claim 9 wherein said first and second detectors include cameras, and wherein said first and second detectors are in communication with said processor.

11. The system of claim 10 wherein the one or more desired rotational positions includes an optimized position, and wherein said first and second detectors identify the orientation of an inherent feature occurring along the log at predetermined intervals and transmit said identification to said processor for processing in real time.

12. The system of claim 11 wherein said processor compares in real time said orientation of said feature with the optimized position of the log to determine if the log requires further rotation prior to exiting said turning mechanism whereby the log is maintained in the optimized position.

13. The system of claim 12 wherein said processor transmits information to said turning mechanism to control rotation of said workpiece such that the optimized position of the log is achieved and maintained.

14. The system of claim 1 wherein the processor is further adapted to calculate a rotational correction based at least on the information received from said first and second identifying means.

15. The system of claim 9 wherein said information includes video images of a feature of the log.

16. The system of claim 9 wherein said information includes video images of an object on the log.

17. The system of claim 7 wherein said information includes a three-dimensional shape of the log.

18. The system of claim 10 wherein said processor includes means for correlating at least one feature of the log in said information from said first and second identifying means so as to track rotational orientation of the log about its longitudinal axis.

19. The system of claim 10 wherein said processor includes means for tracking at least one object on the log in said information from said first and second identifying means so as to track rotational orientation of the log about its longitudinal axis.

20. The system of claim 1 wherein said first identifying means comprises a first three-dimensional scanner, and wherein said second identifying means comprises a second three-dimensional scanner, and wherein said processor includes means for tracking changes in rotational orientation of the log about its longitudinal axis by correlating three-dimensional shape data from the first three-dimensional scanner with three-dimensional shape data from the second three-dimensional scanner.

21. A method for rotationally positioning a log into an optimal rotational orientation comprising the steps of:

translating the log downstream along a feedpath;

detecting, by a first identifying means located along the feedpath, a rotational orientation of the log about its longitudinal axis;

selectively rotating the log in a turning mechanism about the longitudinal axis of the log while advancing the log downstream, wherein said turning mechanism is provided downstream of said first identifying means along the feedpath;

detecting actual rotational positions of the log by a second identifying means downstream of the first identifying means while the log is being rotated and advanced along the feedpath by said turning mechanism, wherein the second identifying means includes a first detector proximal to the turning mechanism;

determining, based at least on data from the first identifying means and the second identifying means, whether the log is in an optimized rotational position by transmitting data from the first identifying means and the second identifying means to a processor adapted to receive said data, and processing of said data in said processor to determine deviations of said actual rotational positions of the log from one or more desired rotational positions; and

controlling rotation of the log in said turning mechanism by said processor, based at least on said actual rotational positions, until the log exits the log turner.

22. The method of claim 21, wherein the one or more desired rotational positions includes an optimized rotational position, the method further comprising providing an optimizing scanner upstream of said turning mechanism along the feedpath, the optimizing scanner configured to calculate the optimized rotational position.

23. The method of claim 21 wherein said data includes three-dimensional log shape data.

24. The method of claim 23 wherein said first identifying means comprises a first three-dimensional scanning system.

25. The method of claim 24 wherein said first detector comprises a second three-dimensional scanning system.

26. The method of claim 24 wherein said first identifying means further includes an optimizing scanner configured to calculate the optimized rotational position.

27. The method of claim 21, the second identifying means further comprising a second detector downstream of the first detector, the first and second detectors operable to detect the rotational position of the log until the log exits said turning mechanism.

28. The method of claim 27 wherein said first and second detectors detect said actual rotational positions at predetermined intervals and transmit the data to said processor for processing in real time.

29. The method of claim 21, further comprising comparing by said processor, in real time, at least one or more of the actual rotational positions and an optimized rotational position to determine whether the log is in the optimized position.

30. The method of claim 29 further comprising calculating by the processor, based at least on said comparing, a rotational correction to adjust the rotation of the log by the log turning mechanism to achieve or maintain the optimized position of the log.

31. The method of claim 25 wherein processing said data includes correlating the three-dimensional shape data from the first identifying means with the three-dimensional shape data from the second identifying means.

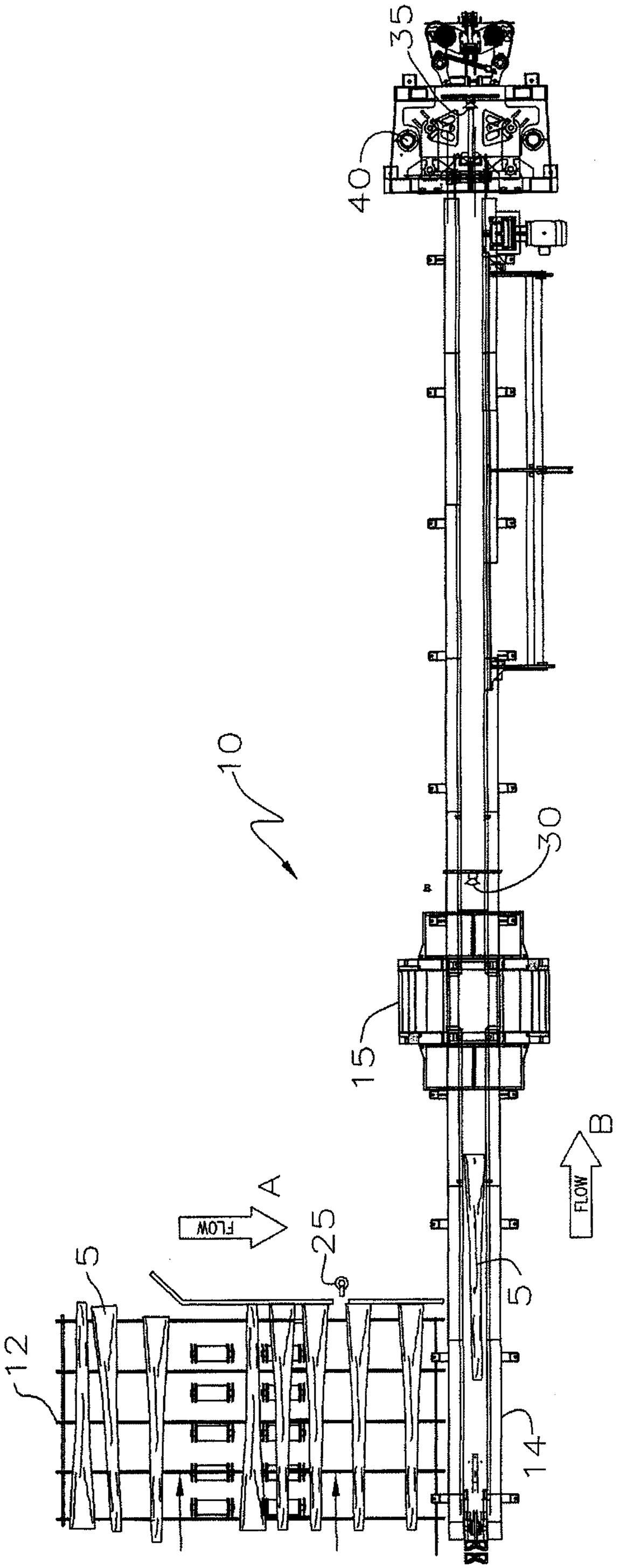


Fig 1

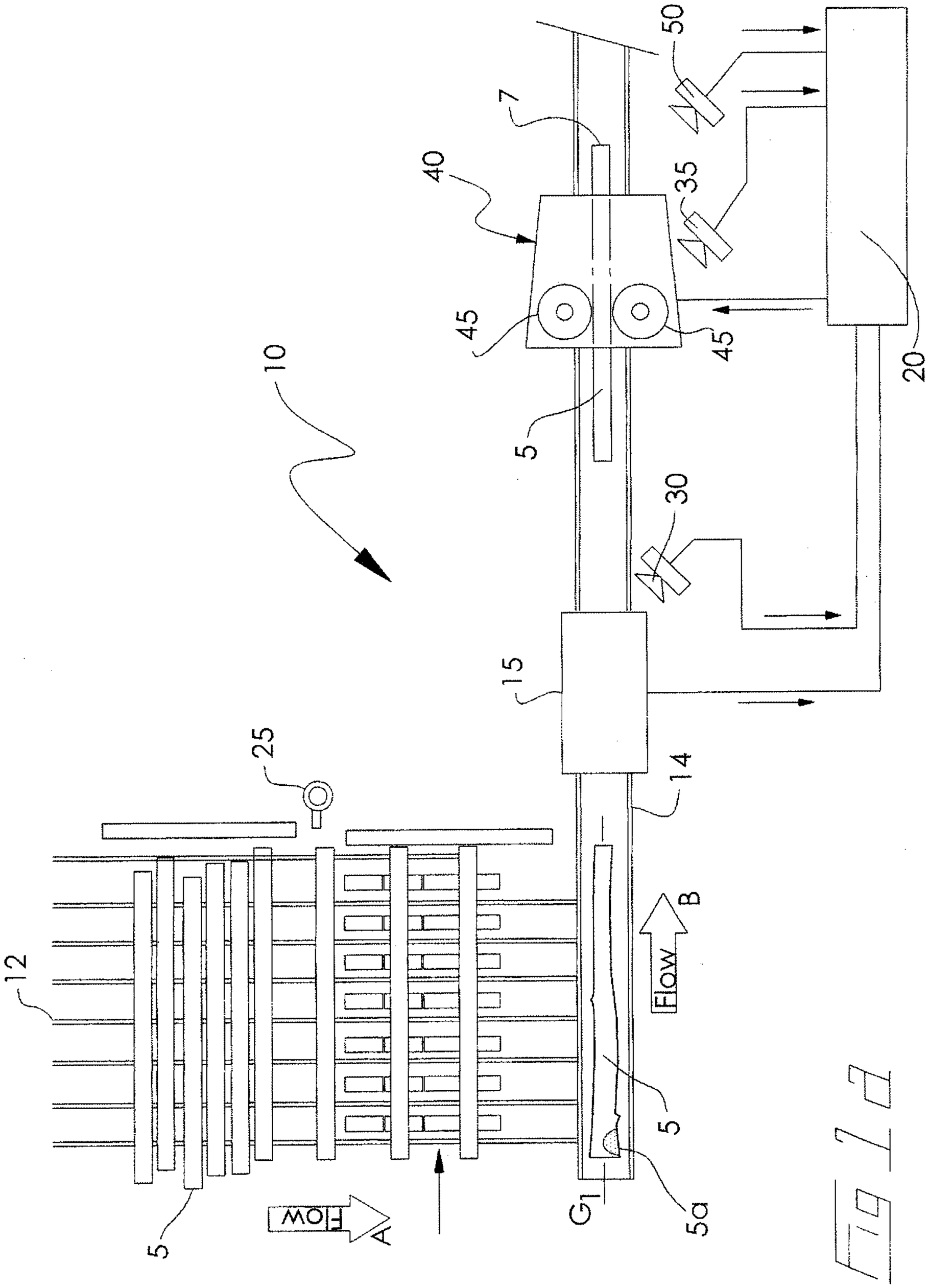


FIG 1a

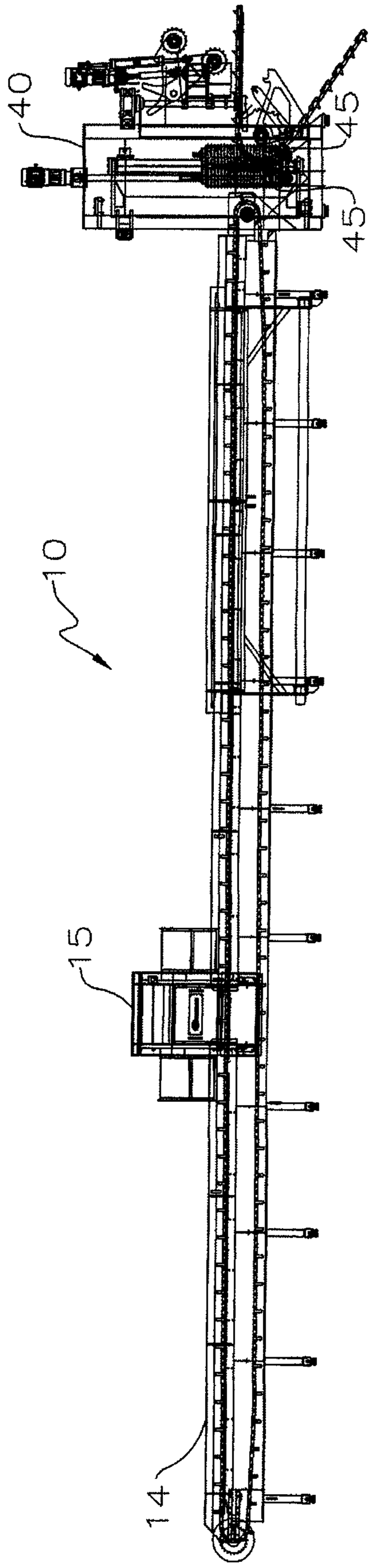


Fig 2

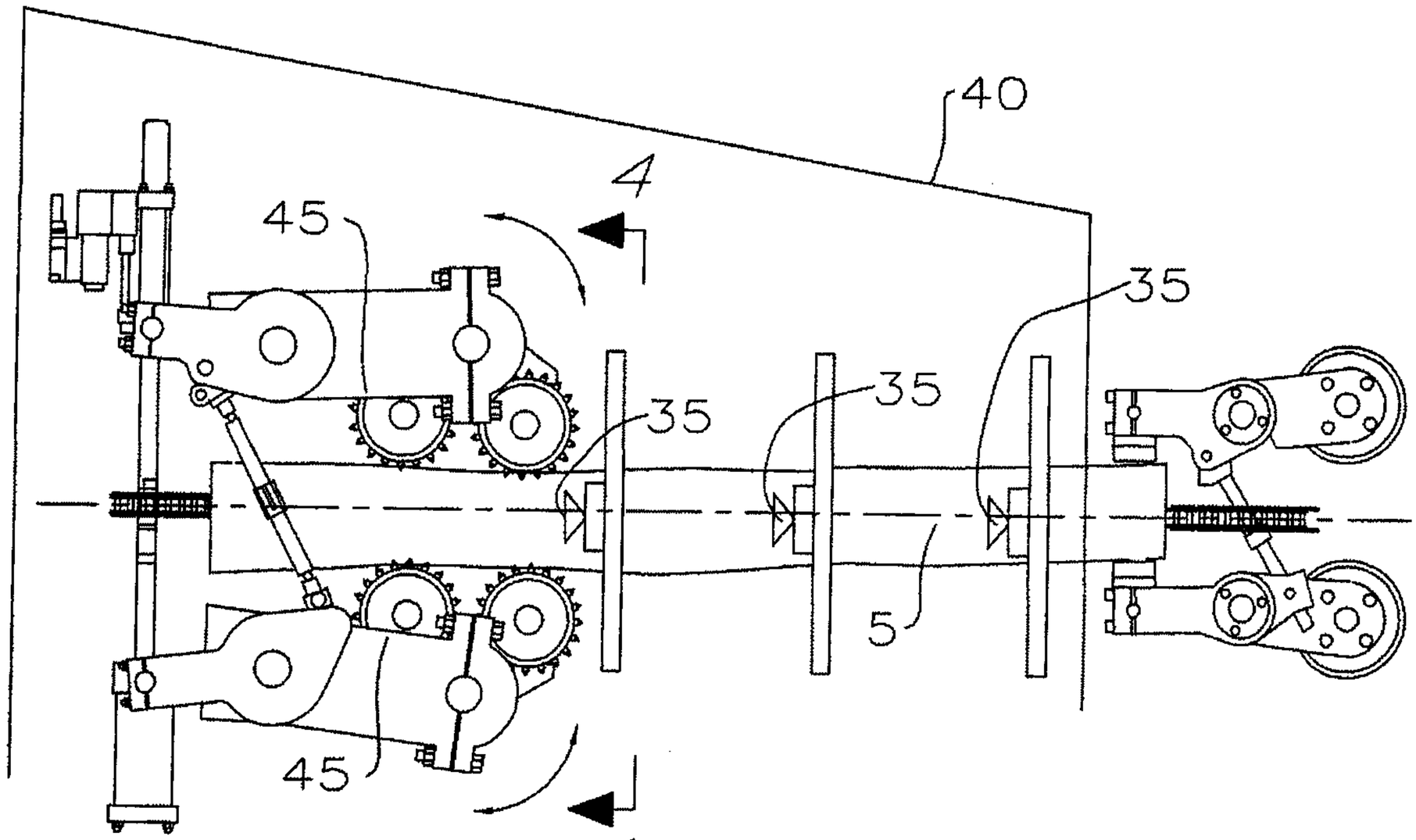


Fig 3

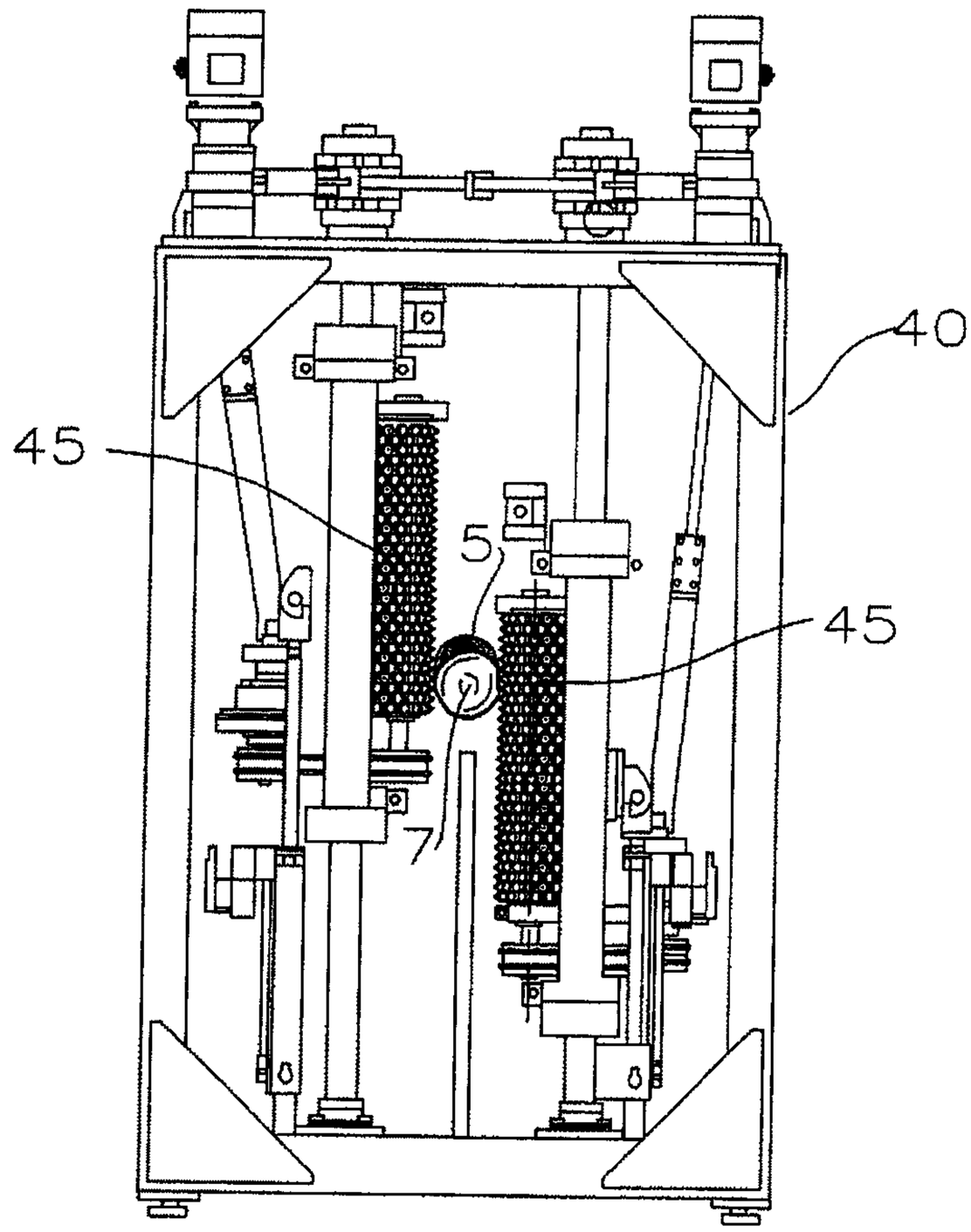


Fig 4

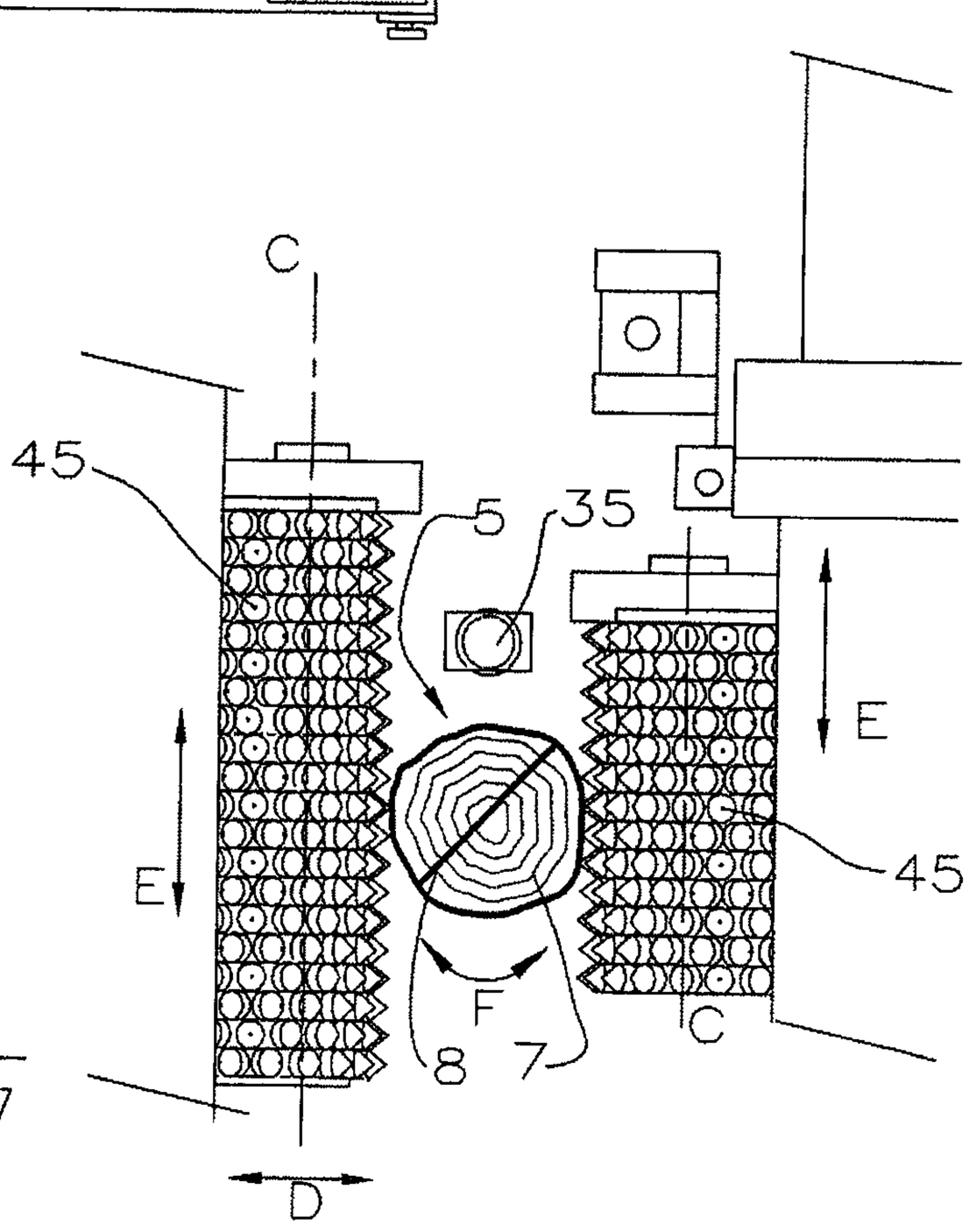
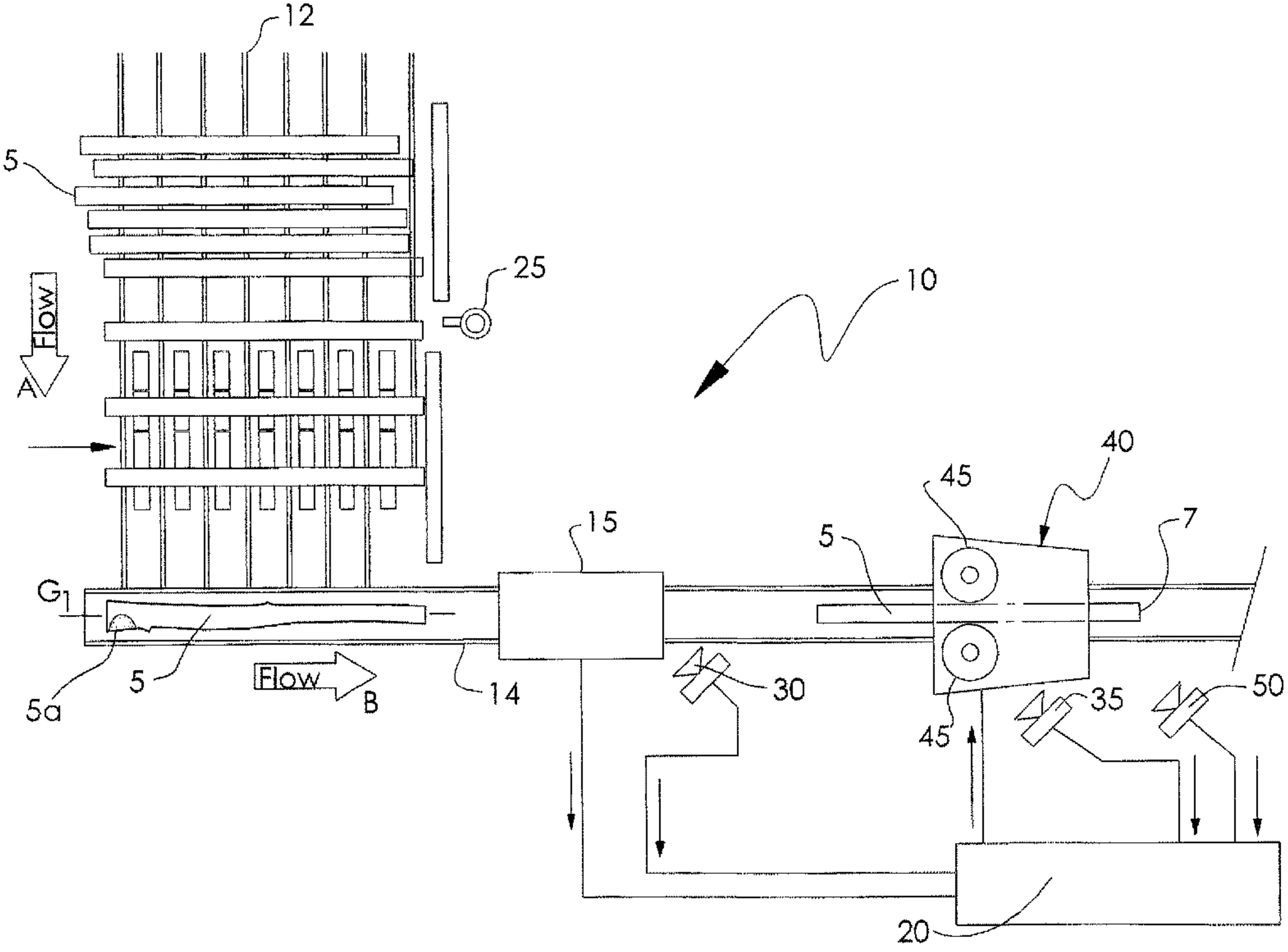


Fig 5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