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(54) **An apparatus for cutting and splitting of tree trunk such as log**

(57) The invention relates to an apparatus (1) for cutting and splitting a tree trunk (P1) such as a log, said apparatus comprising a cutting saw provided with a frame (30) performing a reciprocating motion relative to the tree trunk (P), a stationary splitting blade (5), as well as a conveyor (7) for bringing the tree trunk in a lengthwise direction to a position below the cutting saw, and a pusher (72b) functionally linked with the conveyor (7) for carrying cut blocks of tree trunk (P1) onwards to the splitting blade (5), such that each cut block of tree trunk (P1) is pushed by means of the pusher (72b) towards the splitting blade (5) for splitting the blocks of wood in a lengthwise direction. The cutting saw is a bandsaw (3), which is surrounded by an enclosure (2) and which bandsaw has its frame (30) mounted in a vertically movable manner above the conveyor (7), such that the bandsaw has at least a cutting part (35a) of its blade (35) pointing in a direction transverse relative to a conveying direction of the tree trunk (P) traveling on the conveyor. When the frame of the bandsaw (3) is on its way from its top position (C) towards its bottom position (D), the conveyor (7) or a section of the conveyor presently below the bandsaw (3) is concurrently set in a standstill condition for cutting the tree trunk (P) with the blade (35) of the bandsaw (3) in a direction transverse relative to its conveying direction.

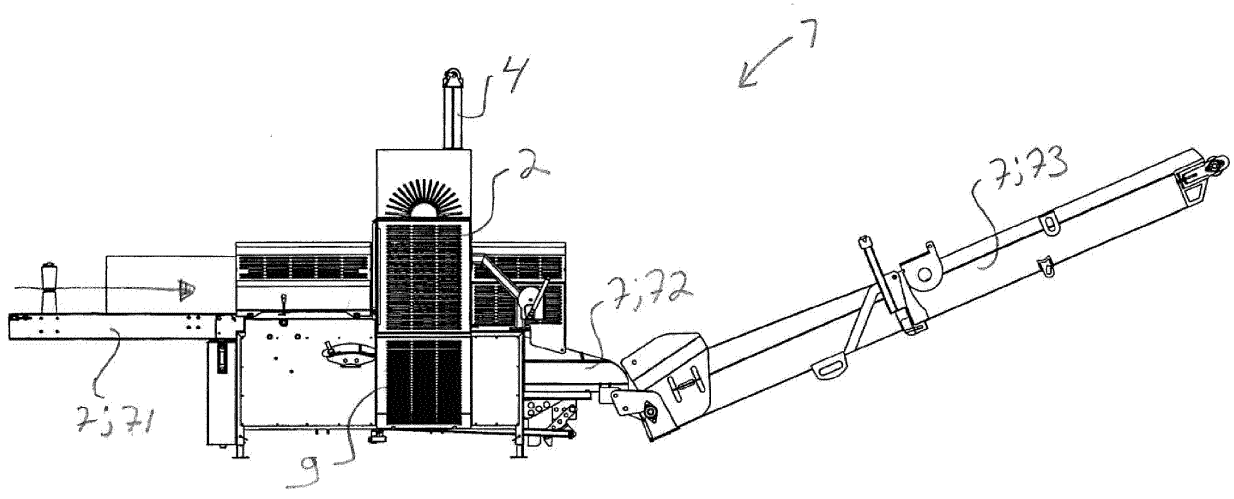

Fig. 1A

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Description

[0001] The invention relates to an apparatus as set forth in the preamble of claim 1 for cutting and splitting a tree trunk such as a log.

[0002] In so-called firewood processors, intended for making firewood, the tree trunk is cut with a vertically moving circular blade, after which the cut blocks of wood are conveyed and pushed against an appropriate splitting blade for making cut and split pieces of wood useful as firewood.

[0003] Using the above prior art as a starting point, the inventors set their sights on providing a quick action apparatus for cutting and splitting tree trunks, while at the same time managing to reduce the amount of sawdust produced during the sawing operation.

[0004] The foregoing objectives of the invention were achieved with an apparatus characterized by what is presented in claim 1.

[0005] More specifically, the invention relates to an apparatus for cutting and splitting a tree trunk such as a log, said apparatus comprising a cutting saw, having its frame adapted to perform a reciprocating motion relative to the tree trunk, a stationary splitting blade, as well as a conveyor for bringing the tree trunk in a lengthwise direction to a position below the cutting saw, and a pusher functionally linked with the conveyor for transporting cut blocks of tree trunk onwards to the splitting blade, such that each cut block of tree trunk is pushed by means of the pusher towards the splitting blade for splitting the blocks of wood in a lengthwise direction. The cutting saw is a bandsaw, which is surrounded by an enclosure and which bandsaw has its frame mounted for a vertical reciprocating motion above the conveyor in such a way that at least a cutting section of the bandsaw blade points in a direction which is transverse relative to the conveying direction of a tree trunk traveling on the conveyor. While the bandsaw is on its way from its top position towards its bottom position, the conveyor or a section of the conveyor presently below the bandsaw is concurrently set in a standstill condition for cutting the tree trunk with the bandsaw blade transversely relative to its conveying direction.

[0006] On the other hand, the invention relates also to a method which comprises at least the following steps of:

- transporting a tree trunk on a conveyor or on a section of the conveyor to a position below a bandsaw, wherein at least a cutting section of the blade points in a direction which is transverse relative to the tree trunk conveying direction,

- stopping the tree trunk movement by stopping the conveyor or a section of the conveyor present below the bandsaw, after which

- the bandsaw frame presently in a top position is lowered or swiveled in a vertical direction around its pivot point for bringing the cutting section of its blade into contact with a tree trunk for cutting the tree trunk and for producing a block/blocks of wood,

- the cut block of wood is pressed with a pusher linked with the conveyor operation against a splitting blade/splitting blades for splitting the cut block of wood in its lengthwise direction for at least two cut and split pieces of wood, and

- the bandsaw frame is lifted or swiveled in a vertical direction around its pivot point for returning the bandsaw frame to its top position.

[0007] Since the cutting saw employed in an apparatus of the invention comprises a bandsaw with an endless narrow blade, the cutting of a tree trunk produces considerably less waste (sawdust) than for example the use of a circular saw blade as the cutting blade.

[0008] In addition, the Inventors have unexpectedly discovered that, when the employed cutting saw is a bandsaw instead of a conventional circular saw, the bandsaw blade is afforded a longer effective use even in a rather worn condition, thus increasing longevity and reducing operating costs of the apparatus.

[0009] In a preferred embodiment of the invention, the bandsaw frame is mounted on tracks in a way that the bandsaw has its drive and guide wheels inclined at a specific angle relative to vertical direction, preferably at an angle of 5-30 degrees relative to vertical direction.

[0010] In another preferred embodiment of the invention, the bandsaw frame is movably mounted on vertical tracks above the conveyor so as to enable its frame, and at the same time the frame-mounted drive and guide wheels of the bandsaw, to be operated in an up-down direction (vertical direction), while the frame's longitudinal axis remains roughly in the same direction (horizontal direction) during the movement.

[0011] In yet another preferred embodiment of the invention, the conveyor comprises two co-directional horizontal conveyors, the first conveyor of which, the one arriving at a bandsaw, has its bottom surface at a level higher than that of the second section, the one departing from the bandsaw, and between the first and second conveyor sections is a flap which can be pivoted in a vertical direction for bringing it first to level with the belt conveyor as a block of wood is being separated from a tree trunk by sawing, as well as thereafter pivoted downward for passing (dropping) the cut block of wood from the first conveyor onto the second conveyor present at a lower level. Such a flap between the conveyor sections expedites and streamlines the passing of a cut block of wood from the conveyor section arriving at a bandsaw onto the conveyor section departing from the bandsaw. Preferably, the first conveyor is a belt conveyor and the second one is a tray conveyor, the latter comprising an elongated tray and a pusher movable above the tray.

[0012] In the method according to a preferred embod-

iment of the invention, the bandsaw frame is movably mounted on a pair of vertical tracks above the conveyor's rear section or the rear conveyor, such that said bandsaw frame can be operated in an up-down direction or vertical direction along the tracks while the bandsaw frame's longitudinal axis remains in a roughly horizontal position. Hence,

- the tree trunk is transported on the conveyor or on a section of the conveyor to a position below the bandsaw, whereby the blade has its cutting section pointing in a direction which is transverse relative to the tree trunk conveying direction,

- the tree trunk movement is stopped by stopping the conveyor or a section of the conveyor present below the bandsaw as soon as a leading end of the tree trunk (P) is at a desired distance from a lower blade of the bandsaw and is supported on a surface of the flap present as an extension of the rear conveyor,

- the bandsaw, along with its frame, is lowered from its top position downward while the saw blade is operated with a drive wheel for bringing the blade's cutting section into contact with a tree trunk for cutting the tree trunk and for producing a block of wood/blocks of wood,

- the bandsaw, along with its frame, is raised back towards its top position and simultaneously the cut block of wood is pressed with a pusher linked with the conveyor operation against a splitting blade/splitting blades for splitting the cut block of wood in a lengthwise direction for at least two cut and split pieces of wood.

[0013] Next, the invention will still be described in more detail with reference to the accompanying figures.

[0014] Figs. 1A-1D show an apparatus of the invention with a protective enclosure from various perspectives.

[0015] Figs. 2A-2C show an apparatus of the invention without a protective enclosure from various perspectives.

[0016] Figs. 3A and 3B, on the other hand, show details of a bandsaw used as a cutting saw of the apparatus, as seen from various perspectives. In fig. 3A the bandsaw is viewed from the front right with regard to the conveying direction of tree trunks, and in fig. 3B from a direction IIIB in fig. 3A.

[0017] Figs. 4A and 4B illustrate a bandsaw mounted on tracks in its top position and in its bottom position. In fig. 4A the bandsaw is shown in a view directly from the front as seen in the conveying direction, and in fig. 4B directly from the side, i.e. in a view from a direction IVB in fig. 4A.

[0018] Next discussed will be the main features depicted in figs. 1-3 for an apparatus of the invention, as well as which details of the invention are to be demonstrated by each figure.

[0019] Figs. 1A-1D illustrate an apparatus 1 of the invention as a whole and equipped with an enclosure assembly protecting the bandsaw. Fig. 1A shows the apparatus in a view directly from the side, fig. 1B shows the apparatus directly from a tree trunk conveying direction (the conveying direction is indicated with a solid arrow in fig. 1A), i.e. in a direct front view as seen from a direction IB in fig. 1A. Fig. 1C shows the apparatus obliquely from behind and fig. 1D in a view directly from above. The apparatus 1 depicted in figs. 1A-1D comprises a duplex conveyor 7 on the one hand for bringing tree trunks P to a position below a cutting saw and on the other hand for transporting cut blocks of wood away from said cutting saw. The conveyor 7 is supported on an apparatus frame 9. The employed cutting saw is a bandsaw 3, whose construction and operation are more clearly illustrated in figs. 2, 3 and 4. The bandsaw 3 is surrounded by a protective enclosure 2.

[0020] Figs. 2A and 2B illustrate an apparatus of the invention without the protective enclosure 2 of the bandsaw 3 from perspectives respectively the same as those in figs. 1A and 1B. Fig. 2c shows the apparatus without a protective enclosure in the same perspective as shown in fig. 1D.

[0021] Figs. 3A and 3B illustrate the bandsaw 3 operated as a cutting saw. The bandsaw 3 comprises a frame 30 as well as an endless blade 35, the latter extending along the peripheries of a drive wheel 31 and a guide wheel 32 from the drive wheel 31 to the guide wheel 32 and back to the drive wheel 31. The drive and guide wheels 31, 32 are equal in size, i.e. have the same diameters and hubs 31a, 32 thereof roughly at the same vertical height and at a specific horizontal distance T from each other. The bandsaw 3 has its drive wheel 31 and guide wheel 32 supported on the bandsaw frame 30, which on the other hand is movably mounted on vertical tracks 4 coupled with the apparatus frame 9. The bandsaw 3 is adapted to saw the tree trunk P by means of a cutting part 35a of the blade 35. In this case, the cutting part 35a of a bandsaw is that section of the bandsaw blade 35 which is used for sawing a tree trunk and which is confined between bandsaw blade guides 34; 34a' and 34; 34". The bandsaw blade guides 34; 34a' and 34; 34" are fitted on either side of a tree trunk P1 supported on a belt 71a of a belt conveyor 71 arriving at the bandsaw, such that the bandsaw blade 35 has its cutting part 35a, which proceeds thereby, turning downward for a transverse, preferably perpendicular position relative to the lengthwise direction of the tree trunk P and the belt conveyor 71.

[0022] Figs. 4A and 4B illustrate how the bandsaw 3 is operated along vertical tracks 4; 4', 4". When the bandsaw, along with its frame, is in its top position C, the endless blade 35, which is extending by way of the drive and guide wheels 31, 32 coupled with the frame 30 of the bandsaw 3, has its cutting part 35a at such a height that it does not touch the tree trunk P presently below the cutting part 35a regardless of the tree trunk diameter.

When the bandsaw, along with its frame 30, is in its bottom position D, the blade 35 has its cutting part 35a respectively in a position close to the bottom of a belt conveyor transporting a tree trunk to the bandsaw, i.e. close to an endless belt 71a.

[0023] Hereinafter, the invention will be described in even more detail with reference to figs. 1-4 and to the foregoing cursory explanation thereof.

[0024] The invention relates to an apparatus 1 for cutting and splitting a log. The apparatus 1 comprises a cutting saw, which includes a cutting saw blade 35 performing a reciprocating motion relative to a tree trunk P, a stationary splitting blade 5, as well as a conveyor 7 and a pusher 72b functionally linked with the conveyor for bringing the tree trunk P to a position below the cutting saw, such that its lengthwise direction lies transversely relative to the direction of the cutting saw, and for transporting cut blocks P1 of tree trunk onwards to the splitting blade 5, such that each cut block P1 of tree trunk is pushed by means of the conveyor and the pusher towards the splitting blade. The cutting saw is a bandsaw 3, which is surrounded by an enclosure 2 and which bandsaw 3 has its frame 30 mounted for a vertically reciprocating motion above the conveyor 7, such that the bandsaw 3 has a cutting section 35a of its blade 35 extending transversely relative to the conveying direction of the tree trunk P traveling on the conveyor 7. When the bandsaw 3, along with its frame, is shifted from its top position C towards its bottom position D, the conveyor 7 or a section of the conveyor presently below the bandsaw 3 is set in a standstill condition for cutting a tree trunk transversely relative to its conveying direction with the blade 35a of the bandsaw 3.

[0025] The apparatus 1 has its actual conveyor 7 consisting of two sections, comprising a rear conveyor 71 transporting a tree trunk into a zone below the bandsaw 3, and a front conveyor 72 transporting cut blocks of wood P1 away from the bandsaw and including a pusher 72b for pushing the blocks of wood against a splitting blade/blades. In addition, the conveyor includes a per se conventional discharge conveyor 73 for carrying the cut and split pieces of wood away from the apparatus 1.

[0026] The rear conveyor 71, which is the downstream one in the wood conveying direction, consists of a belt conveyor including an elongate rear conveyor frame 71c, on top of which revolves an endless belt 71a which functions at the same time as a bottom of the belt conveyor. In addition, the rear conveyor includes guide rollers 71b, which are present alongside the conveyor, close to the apparatus frame 9 and which, in this case, provide a pair of vertical rollers capable of guiding the tree trunk 7 traveling on the rear conveyor belt 71a to a desired location on a section of the belt conveyor 71 directly below the bandsaw 3. The rear conveyor 71 has its rearmost section unsupported, while its furthest upstream end in the wood conveying direction is supported on the apparatus frame 9. The front conveyor has its belt 71a extending, in the tree trunk transporting direction, slightly beyond the location of the bandsaw 3, thus taking part in supporting a tree trunk from below during the sawing operation.

[0027] Slightly before a front end of the belt 71a of the rear conveyor 71 in the conveying direction is located the bandsaw 3. The bandsaw 3 has at least the cutting part 35a of its blade 35 fitted transversely, preferably at a 90 degree angle, relative to the conveying direction of a tree trunk P, thus enabling the tree trunk P to be cut in a transverse direction. The bandsaw 3 has its frame 30 mounted on either side of the rear conveyor 71 on vertical tracks 34. The vertical tracks are made up of a pair of vertical tracks 4, 4' and 4; 4", the internal surface of which has a groove for a vertical member of the frame. Each vertical track 4; 4' and 4; 4" is located on different sides of the rear conveyor as seen from a longitudinal centerline of the rear conveyor. Preferably, the vertical tracks 4; 4' and 4; 4"are located in such a way that the connecting virtual line therebetween is roughly transverse with respect to the conveying direction.

[0028] The vertical tracks 4 are supported on a foundation at bottom ends thereof and connected to each other at top ends thereof by a horizontal member disposed crosswise relative to the conveying direction for a more stable assembly. The bandsaw 3 has its frame 30 comprising two triangle frames 30; 30' and 30; 30", on which the drive wheel 31 and the guide wheel 32 are in turn supported. The triangle frames 30' and 30" have top ends thereof interconnected by a horizontal bracing member 30a. Each triangle frame 30' or 30" comprises an upright member 30b, by which the triangle frame connects movably to the vertical track 4' or 4". To a top end of the upright member 30b is connected a horizontal member 30c, which extends in the conveying direction and to which is in turn connected a bracing member 30d at an angle inclined relative to the vertical direction. The bracing member 30d has its unengaged bottom end inclined in the direction towards the upright member 30b or the tracks 4, and has its front surface fitted with the guide wheel 32 or the drive wheel 31 by its hub. Since the bracing member 30d extends in an inclined direction relative to the vertical direction, the guide wheel 32 and the drive wheel 31 connected thereto also extend in a direction inclined relative to the vertical direction, such that the top parts thereof are further away from the tracks than the bottom parts thereof.

[0029] Along the periphery of and between the guide wheel 32 and the drive wheel 31 revolves the endless thin saw blade 35. The height of a lower blade and an upper blade included in the endless saw blade 35 is determined by the highest and lowest point on the periphery of the guide wheel 32 and the drive wheel 31, because the endless blade 35 has its lower blade proceeding directly from the periphery of the drive wheel 31 to the periphery of the guide wheel 32 and its upper blade directly from the periphery of the guide wheel 32 to the periphery of the drive wheel 31. Accordingly, the saw blade 35 has the height of its lower and upper blades

determined on the basis of the guide wheel and drive wheel diameters. A maximum length for the cutting lower blade of the bandsaw 3 is determined by a distance T between the midpoints of the hubs 32a, 31a of the drive wheel 31 and the guide wheel 32, as well as by diameter sizes of the drive wheel 31 and the guide wheel 32. The cutting lower blade can be adjusted for its length and tautness by changing the distance T between the guide wheel and the drive wheel.

[0030] By means of the blade guides 34; 34' and 34; 34", by way of which the lower blade passes and which are located close to the drive wheel 32 and the guide wheel 31, respectively, a section of the lower bandsaw blade left therebetween is turned to its cutting position, i.e. perpendicularly downward. Between the blade guides 34' and 34" is thereby left the downturned cutting part 35a of the lower blade. The bandsaw can have its saw blade speed 5 adjusted with a suitable motor. As for the apparatus depicted in the figures, the blade speed is adjusted by a hydraulic motor 55 regulating the rotating speed of the drive wheel 31, but the saw blade speed of a bandsaw, i.e. the rotating speed of the drive wheel 31, can be equally well adjusted by an electric motor and a frequency converter linked therewith.

[0031] The bandsaw 3, along with its lower blade, is adapted to be movable in an up-down direction (vertical direction) by mounting the upright members 30b; 30b' and 30b of the frame's 30 triangle frames 30; 30' and 30, 30" movably on the respective vertical tracks 4; 4' and 4; 4". The upright members 30b can be actuated along the vertical tracks 4 by an appropriate power means and a lever system coupled therewith. As for the apparatus depicted in the figures, the power means is a hydraulic cylinder 6, which is in connection with the frame element 30; 30" associated with the guide wheel 32 and which is operated by a hydraulic pump (not shown in the figures). The hydraulic cylinder 6 operates the upright members 30b; 30b' and 30b; 30b" in vertical direction along the respective tracks 4; 4' and 4; 4".

[0032] The front conveyor 72 consists of a tray 72a, which commences immediately downstream of the rear conveyor's 71 belt, yet lies at a lower level than the rear conveyor 71 and is supported on the conveyor frame 9, and of a pusher 72b fitted above the tray to be movable co-directionally with the tray, whereby the tray 72a and the pusher 72b make up jointly a tray conveyor 72a, 72b. Between the tray conveyor 72a, 72b and the belt conveyor 72c is a splitting blade 5 concentrically with a longitudinal axis of the tray conveyor 72a, 72b. The tray 72a of the tray conveyor 72a, 72b and the belt conveyor 72c are co-directional with each other. The rear conveyor 72 and the front conveyor 71 are located on the same line, in other words are concentric in terms of the lengthwise centerlines thereof.

[0033] The front conveyor 72 has its tray conveyor 72a, 72b provided with the tray 72a and the pusher 72b, which travels above the tray co-directionally with the tray, and which can be implemented for example with a power means, such as a pressure cylinder or the like, performing a reciprocating horizontal motion. The illustrated pusher 72b is a hydraulic cylinder. At what is a distal end of the tray conveyor 72a, 72b when viewed from the bandsaw, there is a stationary splitting blade 5, against which the cut blocks of wood are urged for splitting the same in a lengthwise direction thereof. The belt conveyor 71, i.e. the rear conveyor, is followed by a downward pivotable flap 8 which can be set up as an extension of the belt conveyor's leading section roughly at the same level with the belt conveyor's belt 71a once a block of wood P1 has been cut off a tree trunk. The flap 8 is located immediately downstream of the front conveyor in the conveying direction of the blocks of wood P1 and is situated above the tray of the tray conveyor 72a, 72b in an upturned condition. The flap 8 has its length in the tree trunk conveying direction adapted to more or less match the length of a block of wood P1 to be cut.

[0034] Since the front conveyor's belt 71a terminates immediately downstream of the bandsaw 3, a downward pivoting of the flap 8 linked to the conveyor frame 9 enables a cut block of wood P1 resting thereon to fall onto the tray conveyor's tray 72a present therebelow.

[0035] Downstream of the tray conveyor 72a, 72b in the conveying direction of blocks of wood P1 is still a belt conveyor 73 for carrying the cut and split pieces of wood to storage or a service destination.

[0036] The apparatus operates as follows:

In a method for cutting and splitting a tree trunk P, such as a log, the apparatus of claim 1 involves at least the following operations:

The tree trunk P is transported on the conveyor's 7 rear conveyor 71 to a position below a lower blade of the bandsaw 3, wherein the lower blade has its cutting part 35a pointing in a direction transverse to the tree trunk conveying direction. Once a leading end of the tree trunk P has arrived below the lower blade of the bandsaw 3 and progressed in the tree conveying direction a specific distance beyond the cutting part 35a of the bandsaw blade 35, such that its leading end is in juxtaposition with the flap 8, which makes up an extension of the rear conveyor 71 and which at this point is still in a downturned position, the rear conveyor 71 is stopped and so is the tree trunk P supported on its belt 71a. This is followed by lowering the frame 30 of the bandsaw 3 from its top position C along tracks for bringing the cutting part 35a of its blade 35 into contact with the tree trunk P. The flap 8 has its operation linked with a movement of the bandsaw frame along the tracks in such a way that, when the bandsaw frame 30 is lowered down, the flap 8 rises up. The top position for the bandsaw frame 30, and thereby for the bandsaw itself, is visible in figs. 4A and 4B. In its top position

C, the bandsaw frame 30 is located on tracks 4 of such a height that the lower bandsaw blade does not come into contact with a tree trunk. If desired, a top position of the bandsaw frame 30 can be changed in terms of its height on the basis of a tree trunk size, but generally the bandsaw frame is driven to a constant height along the tracks 4 irrespective of the diameter of tree trunks.

[0037] More specifically, the bandsaw frame 30 is lowered in such a way that the upright members 30b of frame parts 30" and 30' (triangle frames 30" and 30'), which members are coupled with the guide wheel 32 and the drive wheel 31 and mounted to be movable along the tracks 4; 4" and 4; 4', are shifted by means of a lever system associated with the parts 30" and 30' of the frame 30, such as by means of the hydraulic cylinder 6 operated by way of a hydraulic pump (not shown in the figures).

[0038] The bandsaw frame 30 is lowered further by means of the hydraulic cylinder 6 by using at the same time the drive wheel 31 for revolving the endless saw blade 35 and achieving a sawing action until the bandsaw blade 35 has traversed across the tree trunk in a crosswise direction thereof and the bandsaw frame has reached its bottom position D. When the bandsaw frame 30 has reached its bottom position D, the flap propping the tree trunk from below has at the same time reached its top position, being in a more or less horizontal condition. At this point, the tree trunk P has been cut and from it has been separated a block of wood P1 resting mainly on top of the flap 8.

[0039] After this, the bandsaw frame 30 is lifted upward along tracks 34 back to its top position C and the cut block of wood P1 is dropped onto the tray conveyor's tray 72a by pivoting the flap 8 downward. The block of wood P1 is pressed by the pusher 72b along the tray 72a towards the splitting blade 5. Pressing of the block of wood P1 with the pusher 72b against the splitting blade 5 is continued until the cut block of wood P1 has become split in its lengthwise direction for at least two cut and split pieces of wood. Since the tray conveyor 72a, 72b does not have its tray 72a provided with its own drive, the split block of wood P1 is removed from the splitting blade 5 by pressing it with a subsequent block of wood which is forced by the pusher 72b through the splitting blade 5. This is followed by carrying the split block of wood P1 on a conveyor 73 away from the apparatus 1.

[0040] The apparatus according to the invention lends itself to adjustments of at least the following aspects: operations of the bandsaw 3 and the conveyor 7 with an effect on the sawing speed either manually or by way of an appropriate control logic. The bandsaw speed can be changed by adjusting the drive wheel speed. The drive of a rear conveyor 71 can be adjusted in such a way that a tree trunk P present on the rear conveyor 71 can be transported to a sawing location below a lower blade of the bandsaw and stopped at an appropriate position relative to the lower blade. If necessary, the rear conveyor speed can also be changed. The vertical (up-down directed) motion speed of the bandsaw can also be adjusted for a direct effect on the sawing speed.

[0041] The foregoing description only deals with a few embodiments of the invention and it is obvious for a skilled artisan that the invention lends itself to also other implementations within the inventive scope as defined in the claims.

[0042] Accordingly, the stationary splitting blade 5 may comprise one or a plurality of blades for splitting a block of wood. In case the number of blades is two or more, the blades can be in a co-directional with each other or transverse relative to each other, such as in a criss-cross pattern.

[0043] The bandsaw 3 can also have a lower part of its frame mounted in a swiveling manner or pivoted to the conveyor 7 or to the apparatus frame 9. In this case, the tree trunk 9 is brought to a position alongside the bandsaw blade, such that its leading end is supported on a top surface of the flap 8 making up an extension of the rear conveyor 71. The rear conveyor 71, along with the tree trunk resting on its belt 71a, is stopped and the frame of the bandsaw 3 is swiveled around its pivot point with the result that frame's top edge and at the same time also the lower bandsaw blade perform a motion directed from top to bottom with the pivot point between the bandsaw frame and the conveyor or the conveyor frame constituting a fulcrum.

Claims

1. An apparatus (1) for cutting and splitting a tree trunk (P1) such as a log, said apparatus comprising a cutting saw provided with a cutting saw blade performing a reciprocating motion relative to the tree trunk (P), a stationary splitting blade (5), as well as a conveyor (7) for bringing the tree trunk in a lengthwise direction to a position below the cutting saw, and a pusher (72b) functionally linked with the conveyor (7) for carrying cut blocks of tree trunk (P1) onwards to the splitting blade (5), such that each cut block of tree trunk (P1) is pushed by means of the pusher (72b) towards the splitting blade (5) for splitting the blocks of wood in a lengthwise direction, **characterized in that**

- the cutting saw is a bandsaw (3), which is surrounded by an enclosure (2) and which bandsaw has its frame (30) mounted in a vertically movable manner above the conveyor (7), such that the bandsaw has at least a cutting part (35a) of its blade (35) pointing in a direction transverse relative to a conveying direction of the tree trunk (P) traveling on the conveyor,
- when the frame of the bandsaw (3) is on its way from its top position (C) towards its bottom

position (D), the conveyor (7) or a section of the conveyor presently below the bandsaw (3) is concurrently set in a standstill condition for cutting the tree trunk (P) with the blade (35) of the bandsaw (3) in a direction transverse relative to its conveying direction.

2. An apparatus (1) as set forth in claim 1, **characterized in that** the bandsaw frame (30) is mounted on tracks (4) in such a way that a drive wheel (31) and a guide wheel (32) for the bandsaw blade are at upper parts thereof in a deflected condition at a specific angle relative to vertical direction, preferably at an angle of 5-30 degrees relative to vertical direction.

3. An apparatus (1) as set forth in claim 1 or 2, **characterized in that** the bandsaw frame (30) is pivoted at one of its bottom corners to an apparatus frame (9) or to the conveyor (7), such that the bandsaw frame can be swiveled in a vertical direction, whereby its top end performs an up-down directed motion along a circular arc with its midpoint located at the said pivot point.

4. An apparatus (1) as set forth in claim 1 or 2, **characterized in that** the bandsaw frame (30) is mounted in a movable manner on the vertical tracks (4) above the conveyor (7) for enabling its frame (30) to be shifted in an up-down direction (vertically back and forth) while the frame (30) remains more or less horizontal regarding its longitudinal axis.

5. An apparatus (1) as set forth in claim 4, **characterized in that** the bandsaw frame (30) is adapted to perform a vertical reciprocating motion effected by a power means such as a hydraulic cylinder (6), whereby the bandsaw frame (30) is supported in a movable manner on vertical tracks located on various sides of the conveyor as seen from the conveyor's longitudinal axis, such that, in a top position (C) of the bandsaw frame (30), the tree trunk (P1) can be transported on the conveyor (71) below the bandsaw without a lower blade of the bandsaw (3) coming into contact with the discussed tree trunk (P1).

6. An apparatus (1) as set forth in any of the preceding claims, **characterized in that** the conveyor (7) comprises two approximately concentric horizontal conveyors, the first conveyor (71) of which, the one arriving at the bandsaw, has its bottom surface at a level higher than that of the second conveyor (72), the one departing from the bandsaw, and, in addition, between the first conveyor (71) and the second conveyor (72) is a flap (8), which can be brought to approximately the same level as the bottom surface of the conveyor (71) arriving at the bandsaw and which flap (8) can be pivoted in a vertical direction for passing a sawn block of wood (P1) from the first conveyor (71) onto the second conveyor (72) present at a lower level.

7. An apparatus (1) as set forth in claim 6, **characterized in that** the first conveyor (71), the rear one located in the conveying direction upstream of the bandsaw, is a belt conveyor, and the second conveyor (72), the front one located downstream of the bandsaw, is a tray conveyor (72a, 72b) which comprises an elongated tray (72a) and a pusher (72b) movable above the tray.

8. A method for cutting and splitting a tree trunk (P) such as a log with an apparatus (1) as set forth in claim 1, **characterized in that** the method comprises at least the following steps of:

- transporting the tree trunk (P) on a conveyor (7) or on a section of the conveyor to a position below a bandsaw (3), wherein at least a cutting section (35a) of a blade (35) points in a direction which is transverse relative to a conveying direction of the tree trunk (P),
- stopping a movement of the tree trunk (P) by stopping the conveyor (7) or a section of the conveyor present below the bandsaw, after which
- a bandsaw frame (30) presently in its top position (C) is lowered or swiveled in a vertical direction around its pivot point for bringing the cutting section (35a) of its blade (35) into contact with the tree trunk (P) for cutting the tree trunk and for producing a block/blocks of wood (P1),
- the cut block of wood (P1) is pressed with a pusher (72b) linked with the conveyor operation against a splitting blade/splitting blades (5) for splitting the cut block of wood (P1) in its lengthwise direction for at least two cut and split pieces of wood, and
- the bandsaw frame (30) is lifted or swiveled in a vertical direction around its pivot point for raising the bandsaw frame (30) back to its top position (C).

9. A method as set forth in claim 8, **characterized in that** the block of wood (P) is delivered from a conveyor section (7; 71), arriving at the bandsaw, onto a tray conveyor (7; 72), present at a lower level and departing from the bandsaw, by pivoting in a vertical direction a flap (8) present between the conveyors (71, 72).

10. A method as set forth in claim 8 or 9, **characterized in that** the conveyor (72) carrying blocks of wood away from the bandsaw (3) is a tray conveyor (72a, 72b), which is made up of an elongated tray (72a) as well as a pusher (72b), the latter being functionally linked with the tray and used for pushing the block of wood (P1) resting on a bottom of the tray (72a) at

least partially across the blades of the splitting blade (5).

11. A method as set forth in any of claims 8-10, **characterized in that** the bandsaw (3) has its frame (30) movably mounted on a pair of vertical tracks (4) above the conveyor's rear section or the rear conveyor (71), such that said bandsaw frame (30) can be operated in an up-down direction or vertical direction along the tracks (4) while the bandsaw frame's longitudinal axis remains in a roughly horizontal position, whereby

- the tree trunk (P) is transported on the conveyor (7) or on a section of the conveyor to a position below the bandsaw (3), whereby the blade (35) has its cutting section (35a) pointing in a direction which is transverse relative to the tree trunk conveying direction,
- movement of the tree trunk (P) is stopped by stopping the conveyor (7) or a section of the conveyor present below the bandsaw as soon as a leading end of the tree trunk (P) is at a desired distance from a lower blade of the bandsaw (3) and coincides with or is supported on a surface of the flap (8) present as an extension of the rear conveyor,
- the bandsaw frame (30) is lowered from its top position (C) down towards its bottom position (D) while the saw blade (35) is operated with a drive wheel (31) for bringing the cutting section (35a) of said blade (35) into contact with the tree trunk (P) for cutting the tree trunk and for producing a block of wood/blocks of wood (P1),
- the cut block of wood (P1) is pressed with a pusher (72b) linked with operation of the conveyor (7) against a splitting blade/splitting blades (5) for splitting the cut block of wood (P1) in a lengthwise direction for at least two cut and split pieces of wood,
- the bandsaw frame (30) is raised to its top position (C).

12. A method as set forth in claim 11, **characterized in that** the block of wood (P) is delivered from a conveyor section (71), arriving at the bandsaw (3), onto a conveyor (72), departing from the bandsaw, by pivoting in a vertical direction a flap (8) present between the conveyors (71, 72).

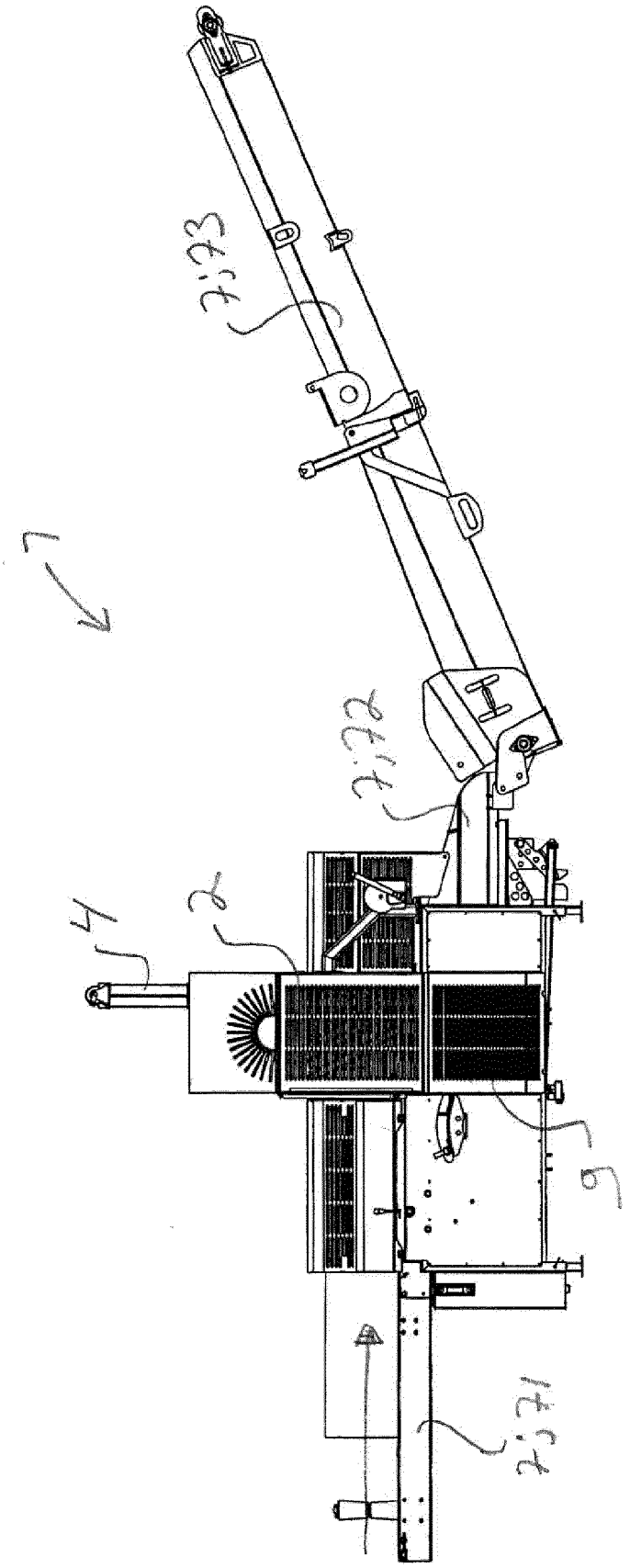
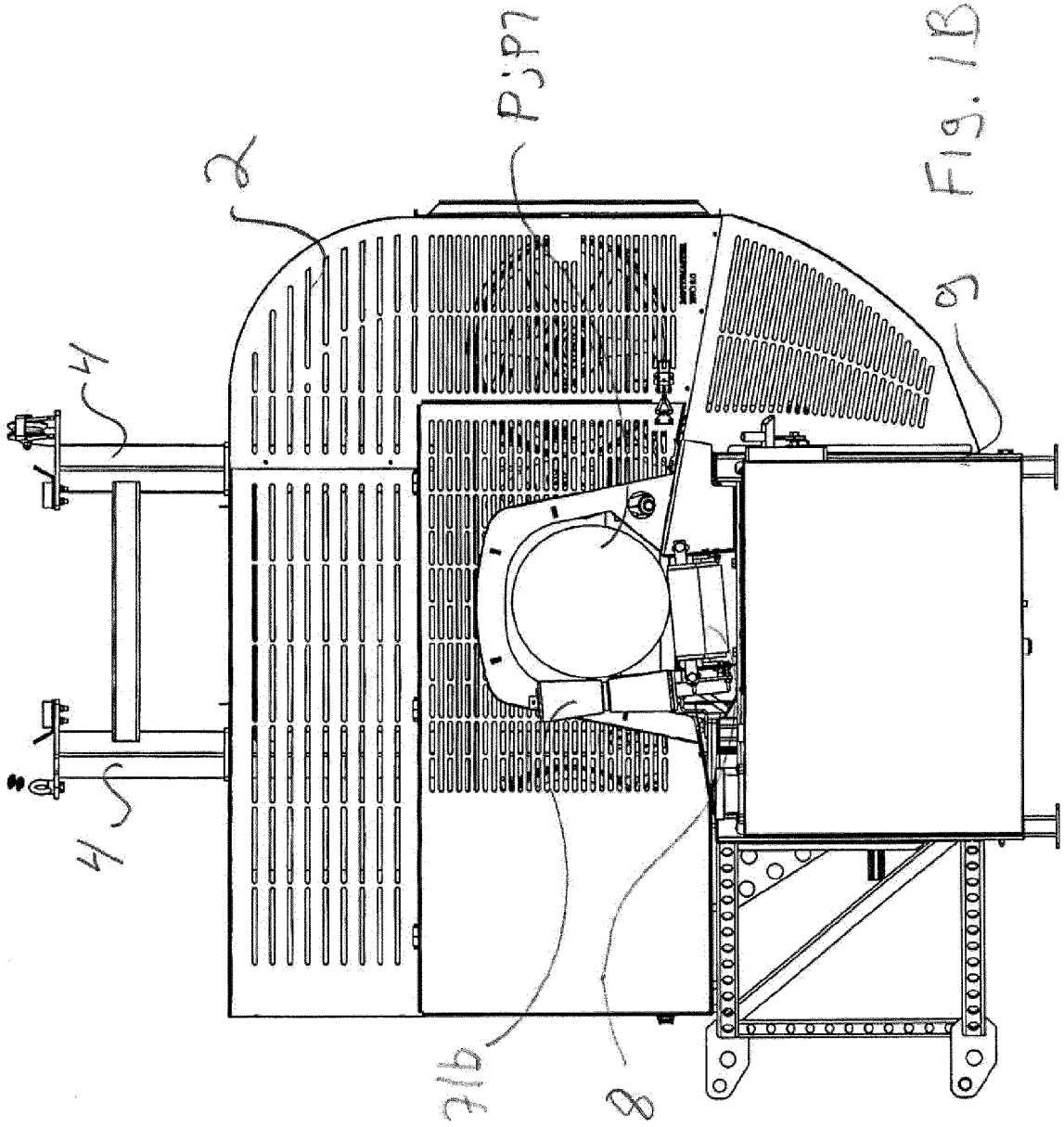


FIG. 1A


2
P;P7
Fig. 1B
9
4
4
7b
8

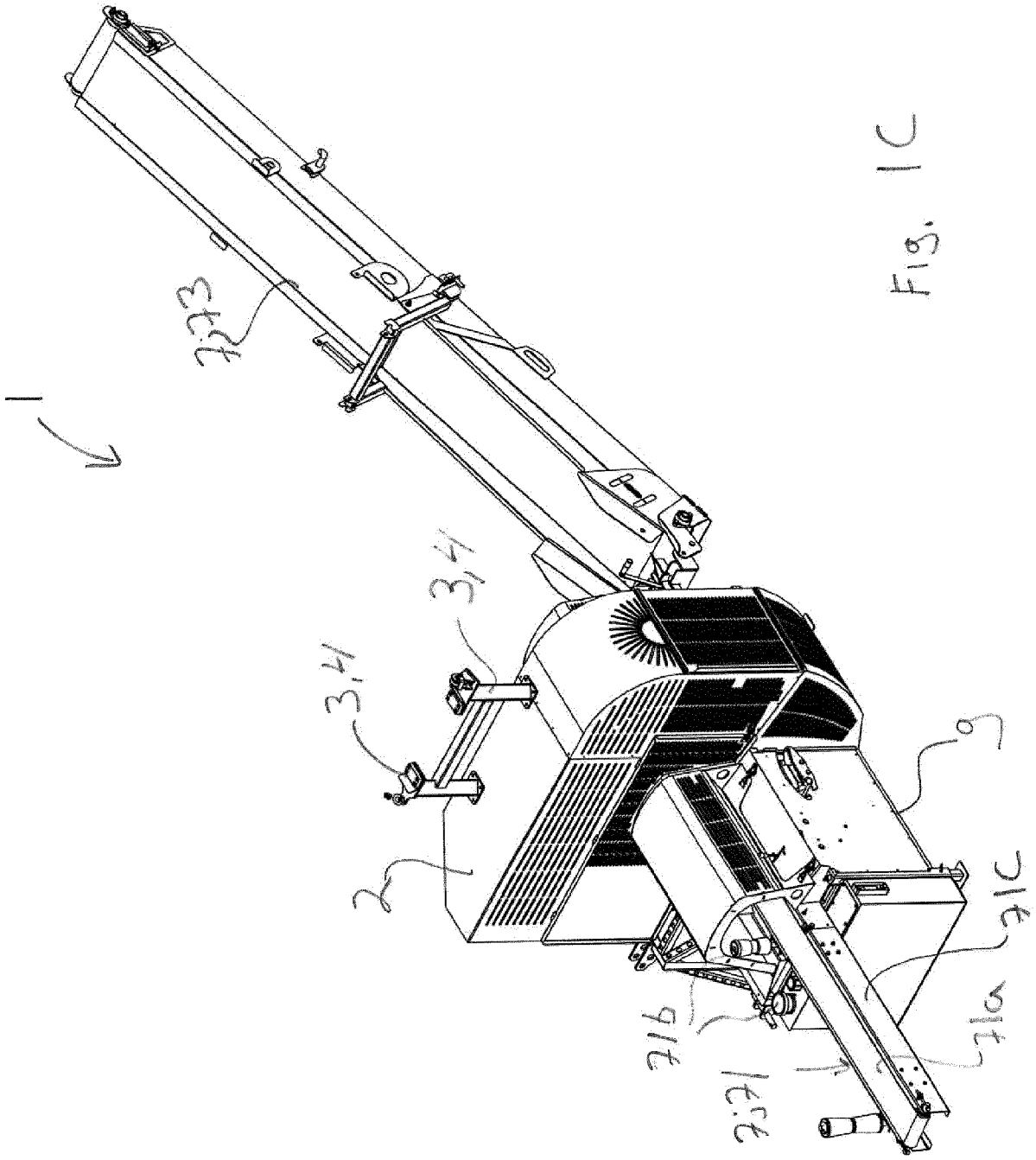


Fig. 1C

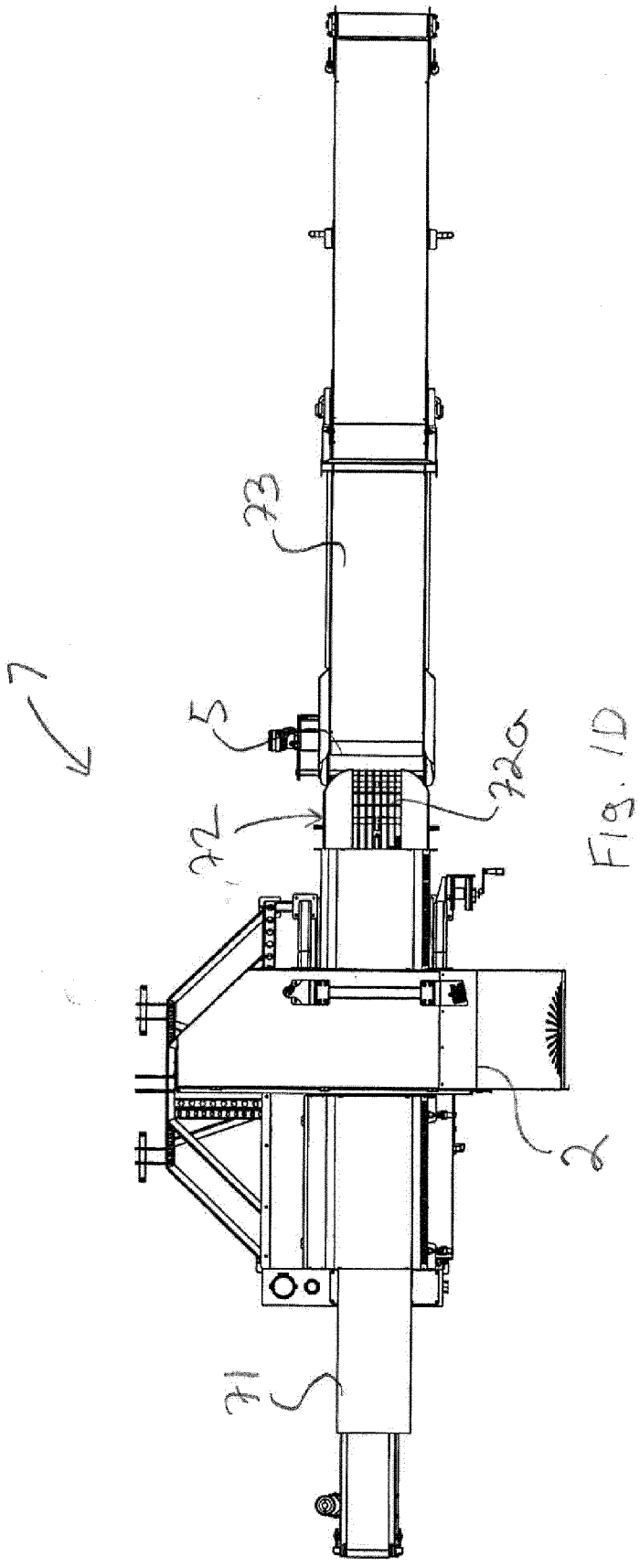


Fig. 1D

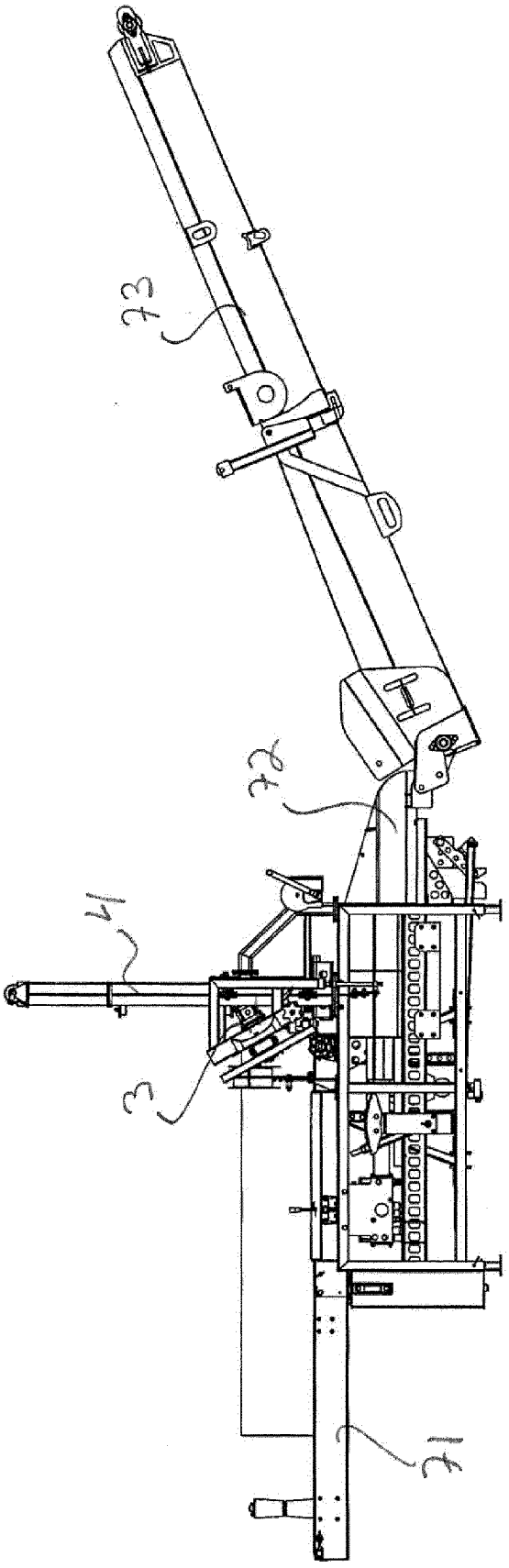


Fig. 2A

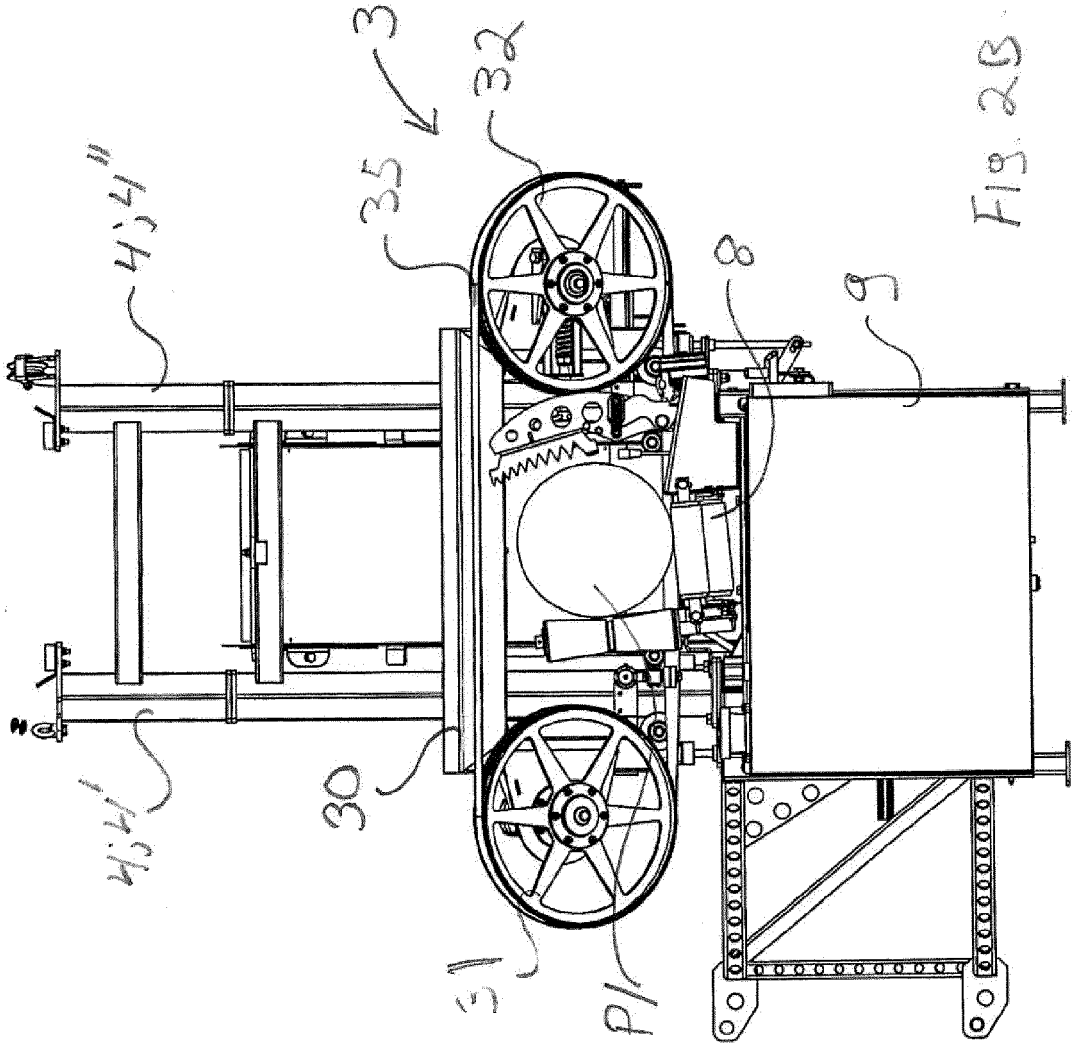


Fig. 2B

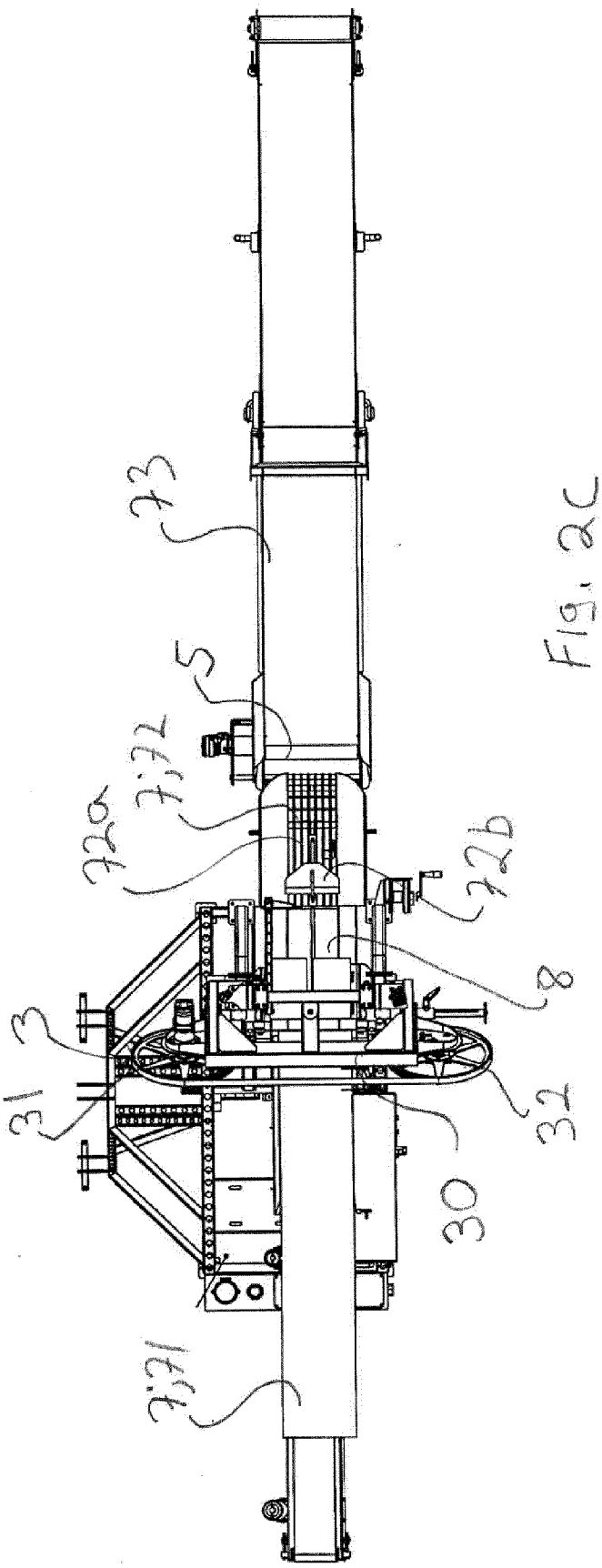


Fig. 2C

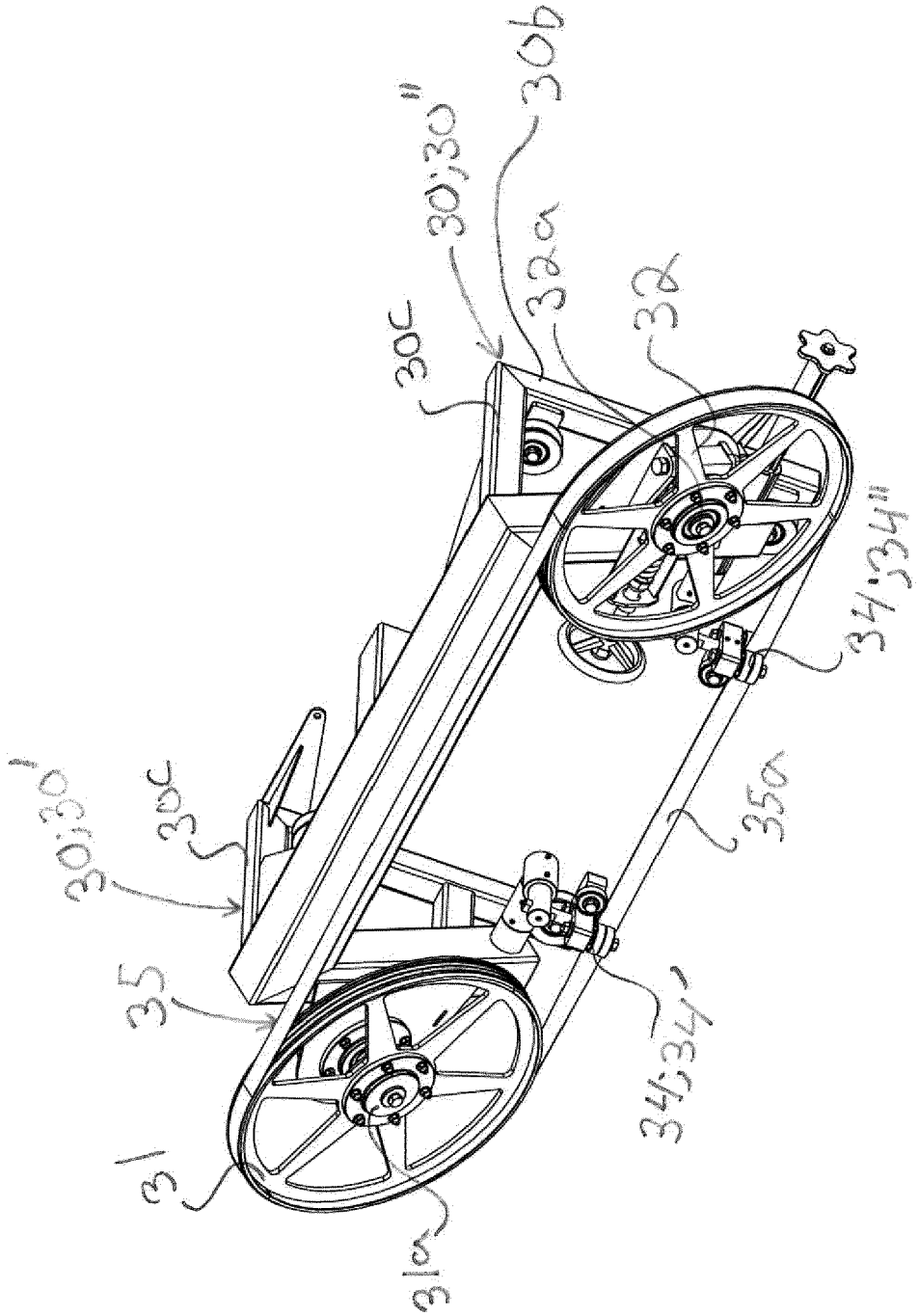


Fig. 3A

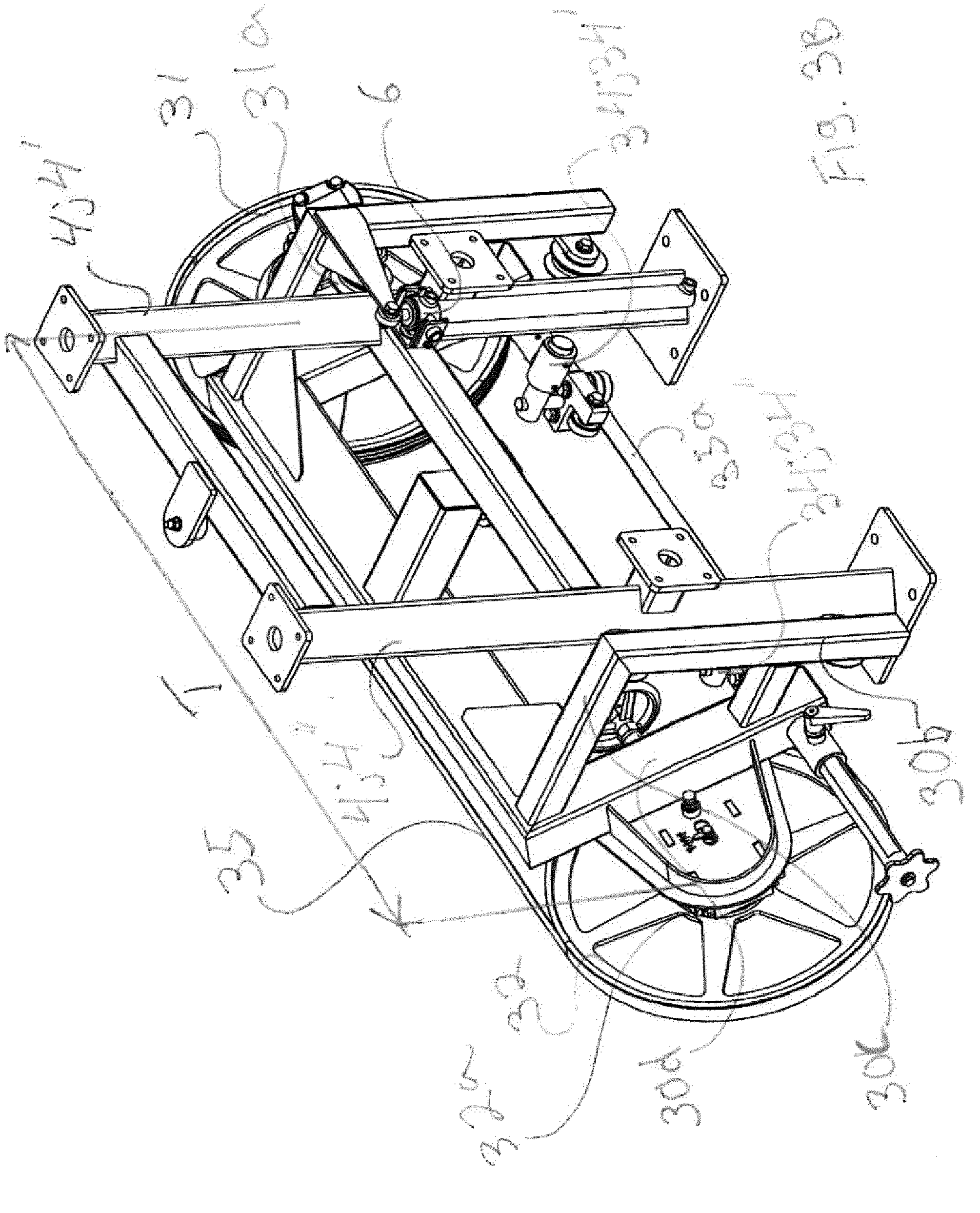


Fig. 3B

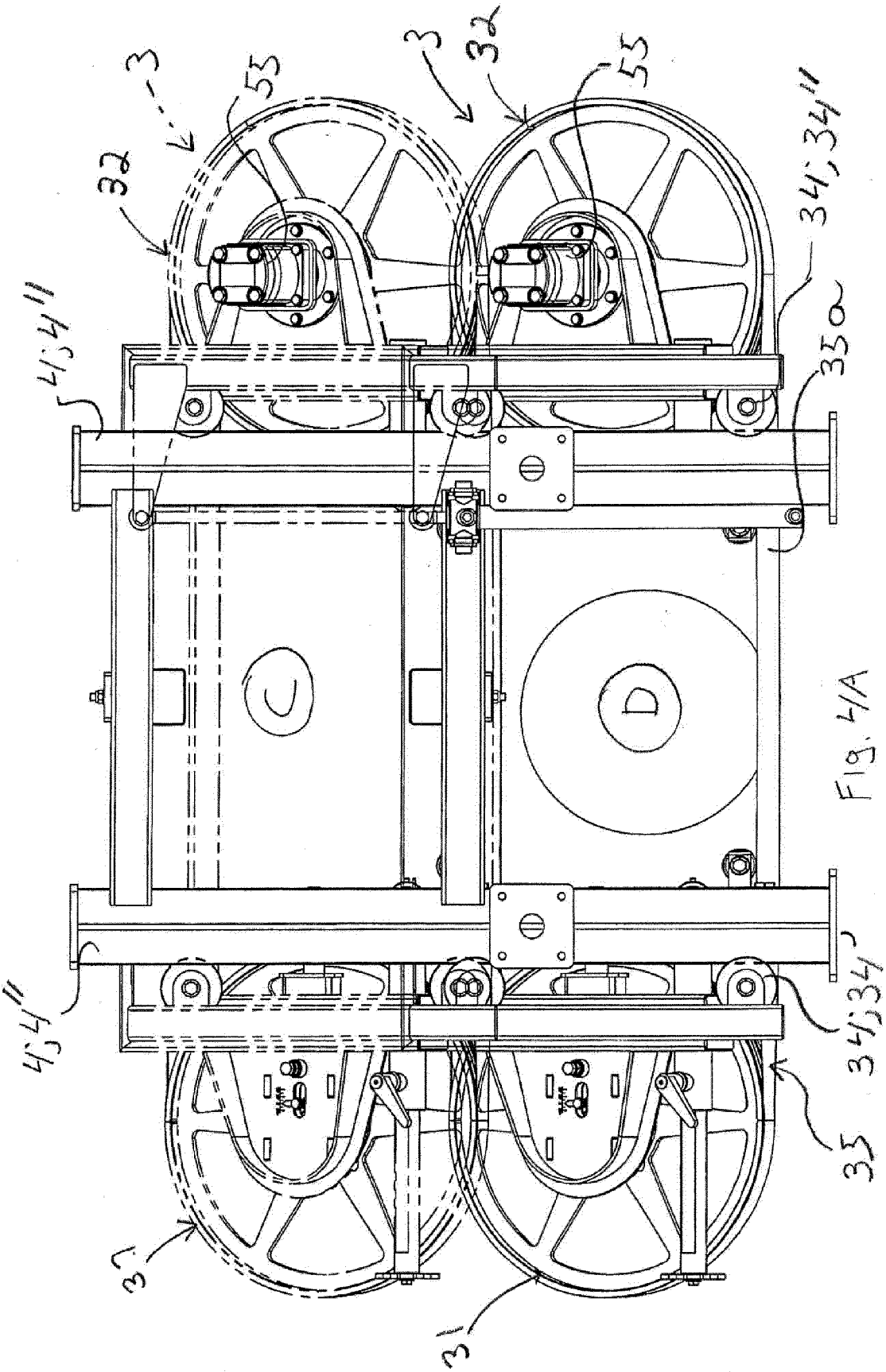


Fig. 4/A

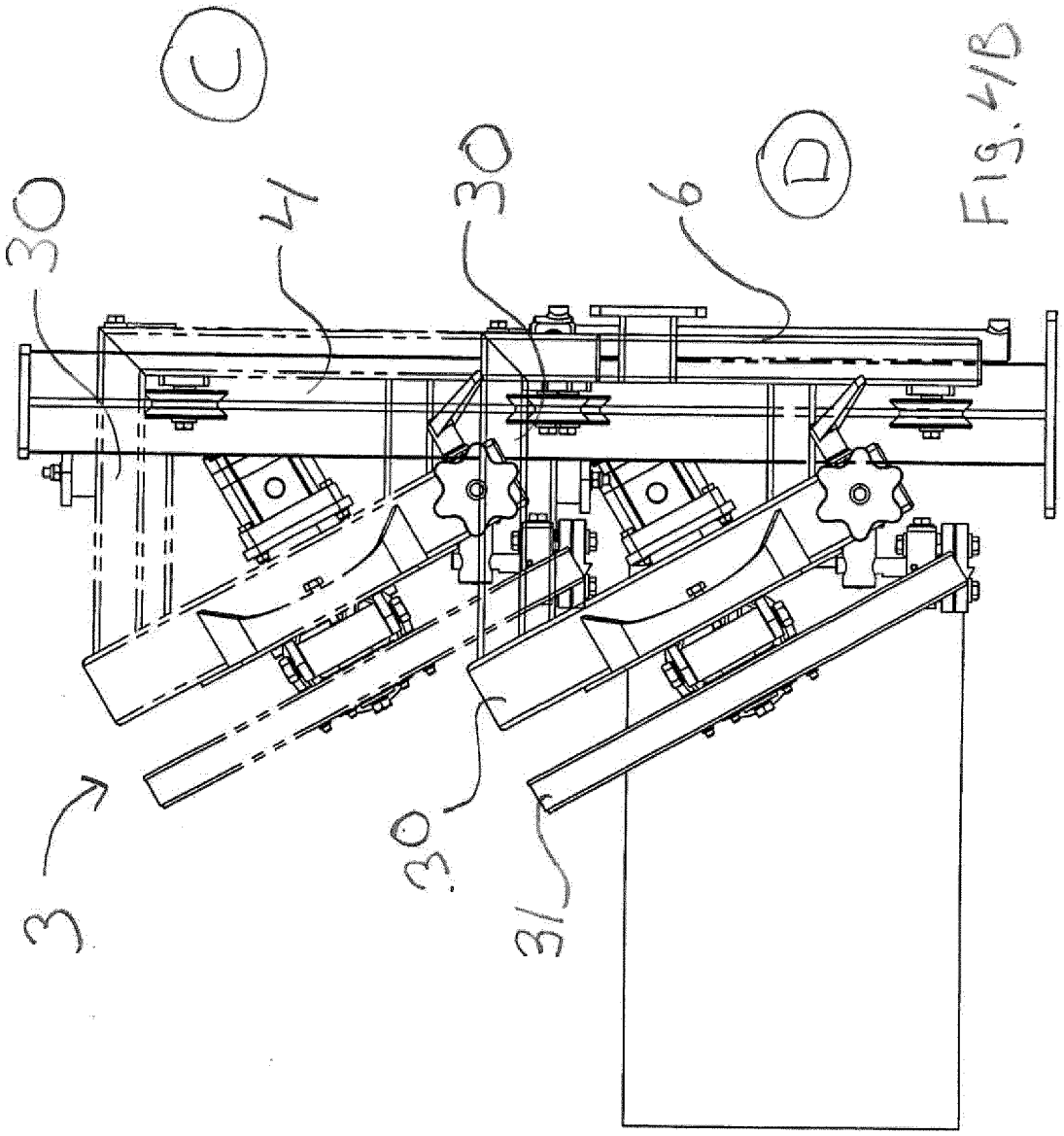


FIG. 41B

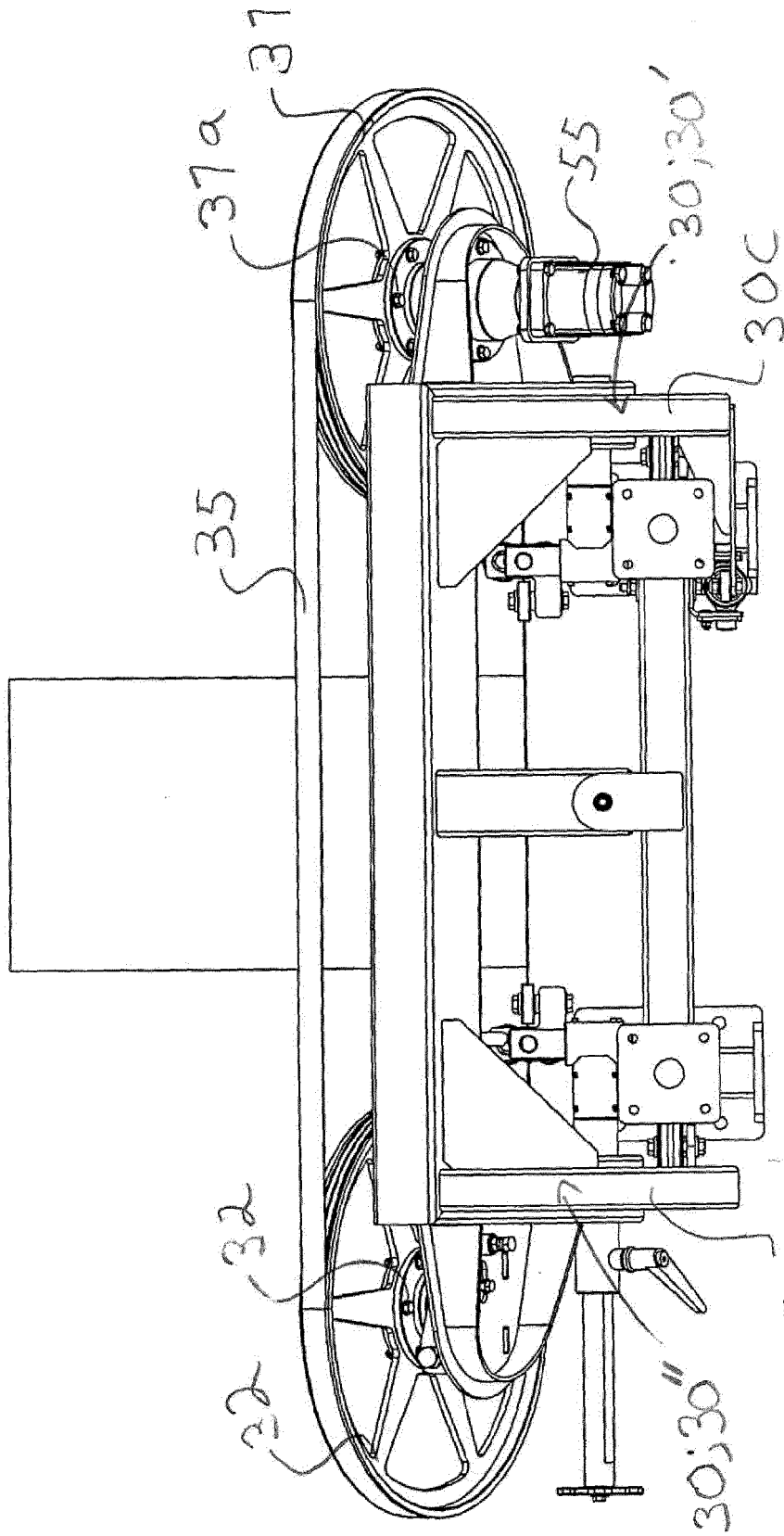


Fig 4C

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EUROPEAN SEARCH REPORT

Application Number
EP 13 16 3057

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 1 001 272 A (HOWARD ARCHIBALD P [US]) 22 August 1911 (1911-08-22) * page 3, line 120 - page 4, line 55; figures *	1-12	INV. B27L7/06 B27M1/00 B27B13/00
Y	EP 2 457 705 A1 (GERHARD STAHLHANDEL GMBH [DE]) 30 May 2012 (2012-05-30) * paragraph [0031]; figures *	1-12	

TECHNICAL FIELDS SEARCHED (IPC)

B27L
B27M
B27B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 November 2013	Vaglienti, Giovanni

CATEGORY OF CITED DOCUMENTS

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14-11-2013

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US 1001272 A	22-08-1911	NONE	
EP 2457705 A1	30-05-2012	DE 102010052642 A1	19-07-2012
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82