United States Patent [19]

Vit

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[54] **APPARATUS FOR DELIMBING AND LOADING FULL-LENGTH TREES**

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[21] Appl. No.: **153,389**

[52] **U.S. Cl.**.....**144/2 Z,** 144/309 AC

[51] **Int. Cl.**.....**A01g 23/08**

[58] **Field of Search**.....144/2 Z, 3 D, 34 R, 144/309 AC

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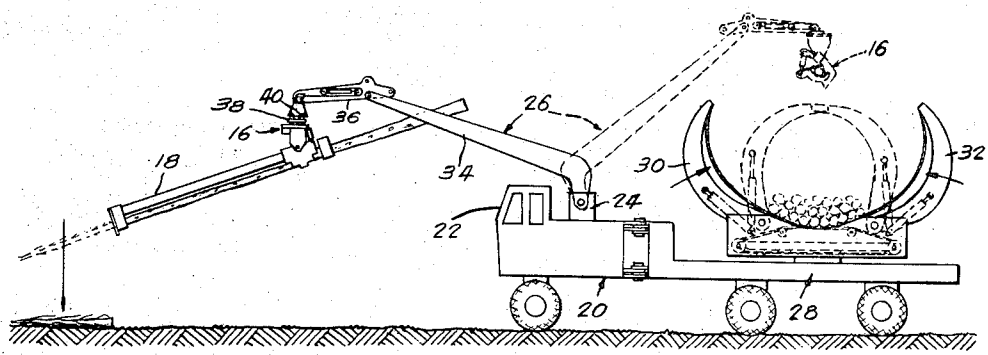
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[57] **ABSTRACT**

A debrancher and forwarder is described wherein a sliding boom debranching apparatus with clamping devices at the end of the boom are provided at the end of a loading crane.

A vehicle can also be provided with a buncer in which a sling is subtended between picoting closing arms and the sling passes over an expanding and retracting piston and cylinder arrangement for tightening or slackening the sling.

7 Claims, 18 Drawing Figures



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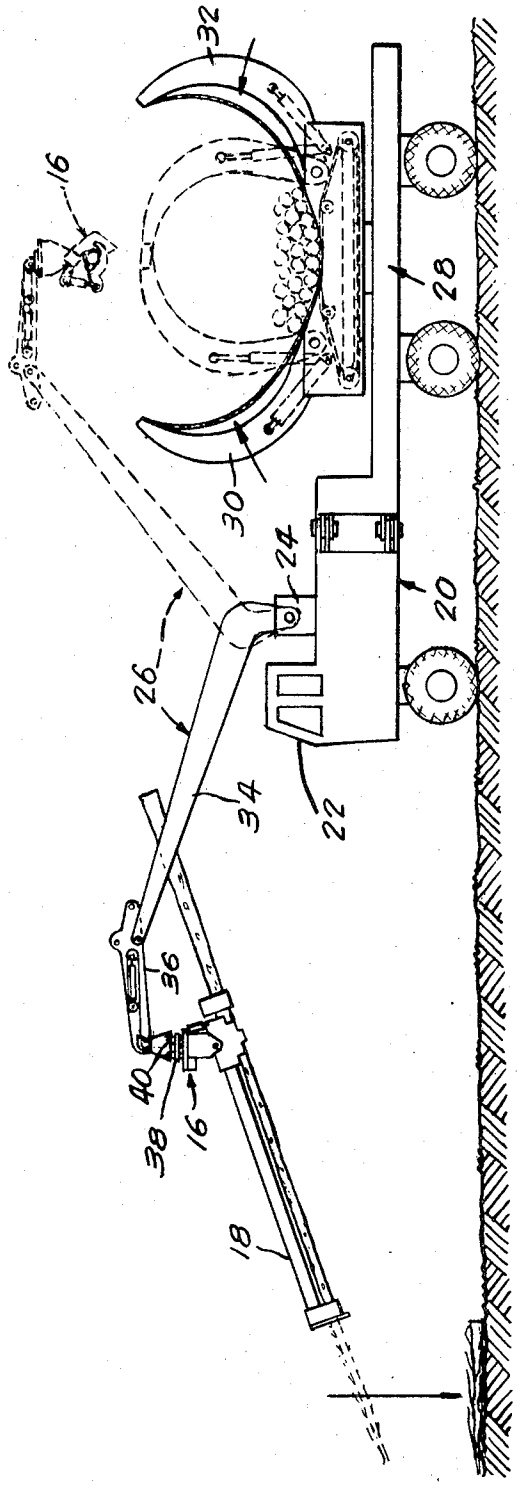


FIG. 1

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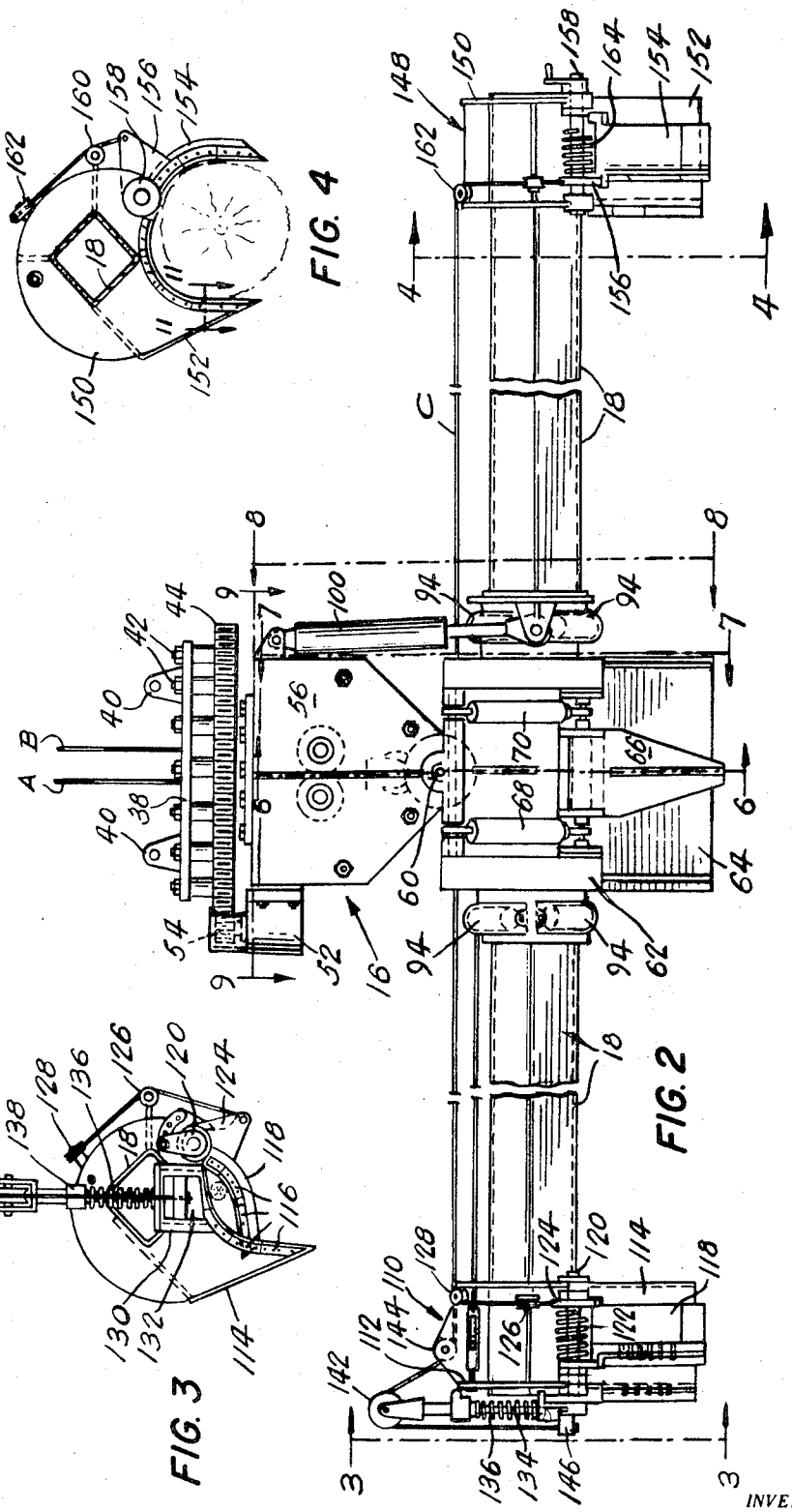


FIG. 2

FIG. 3

FIG. 4

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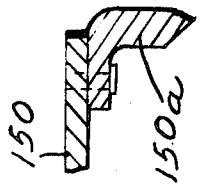


FIG. 11

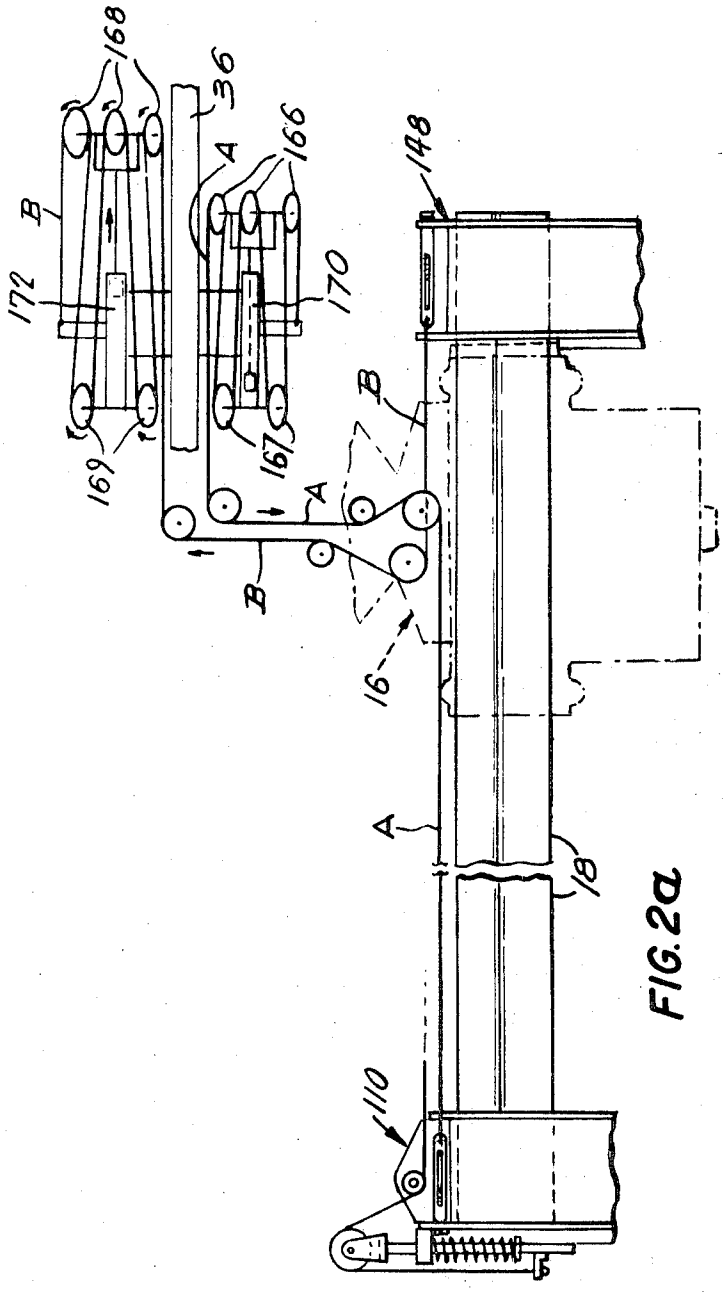


FIG. 2a

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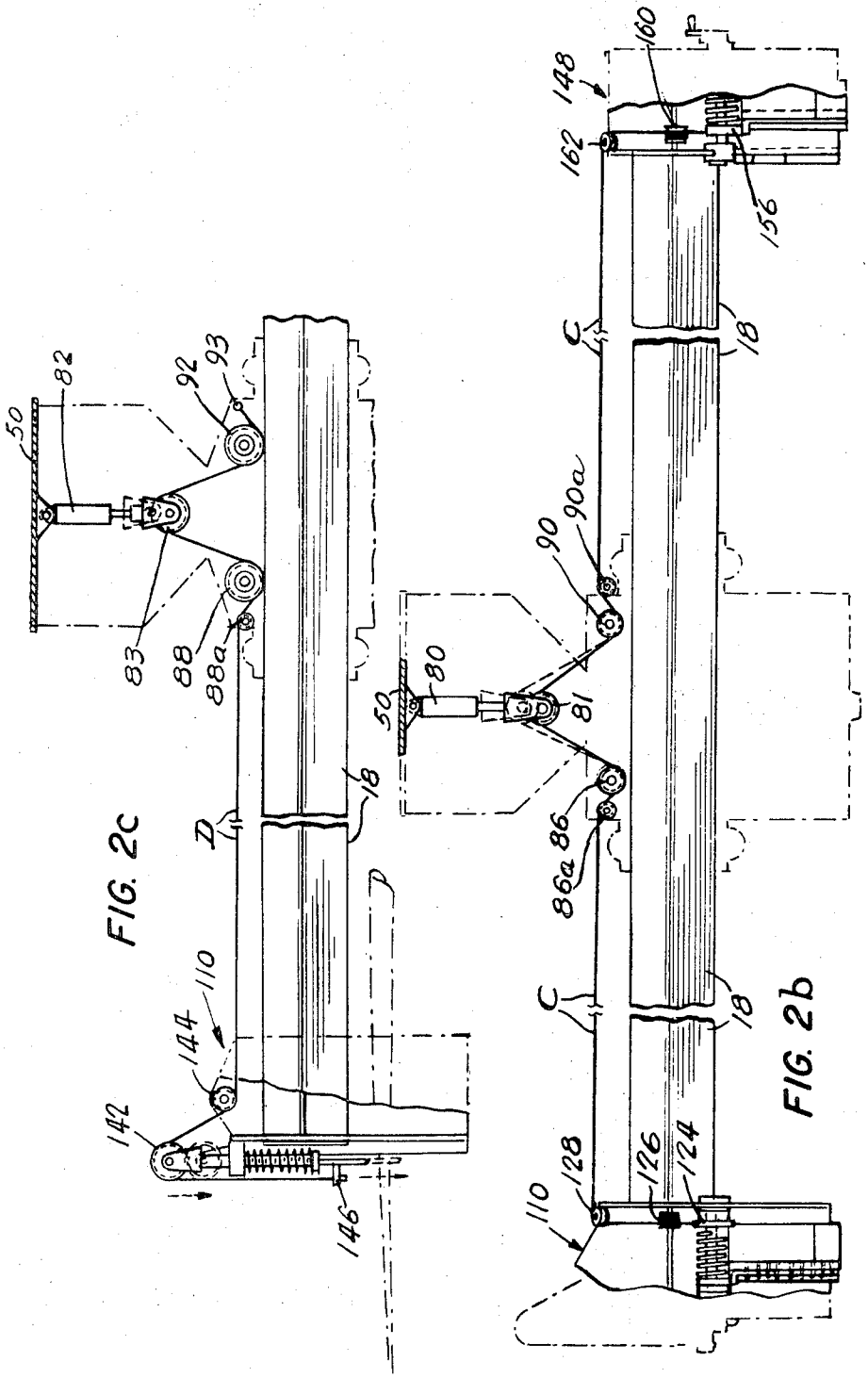
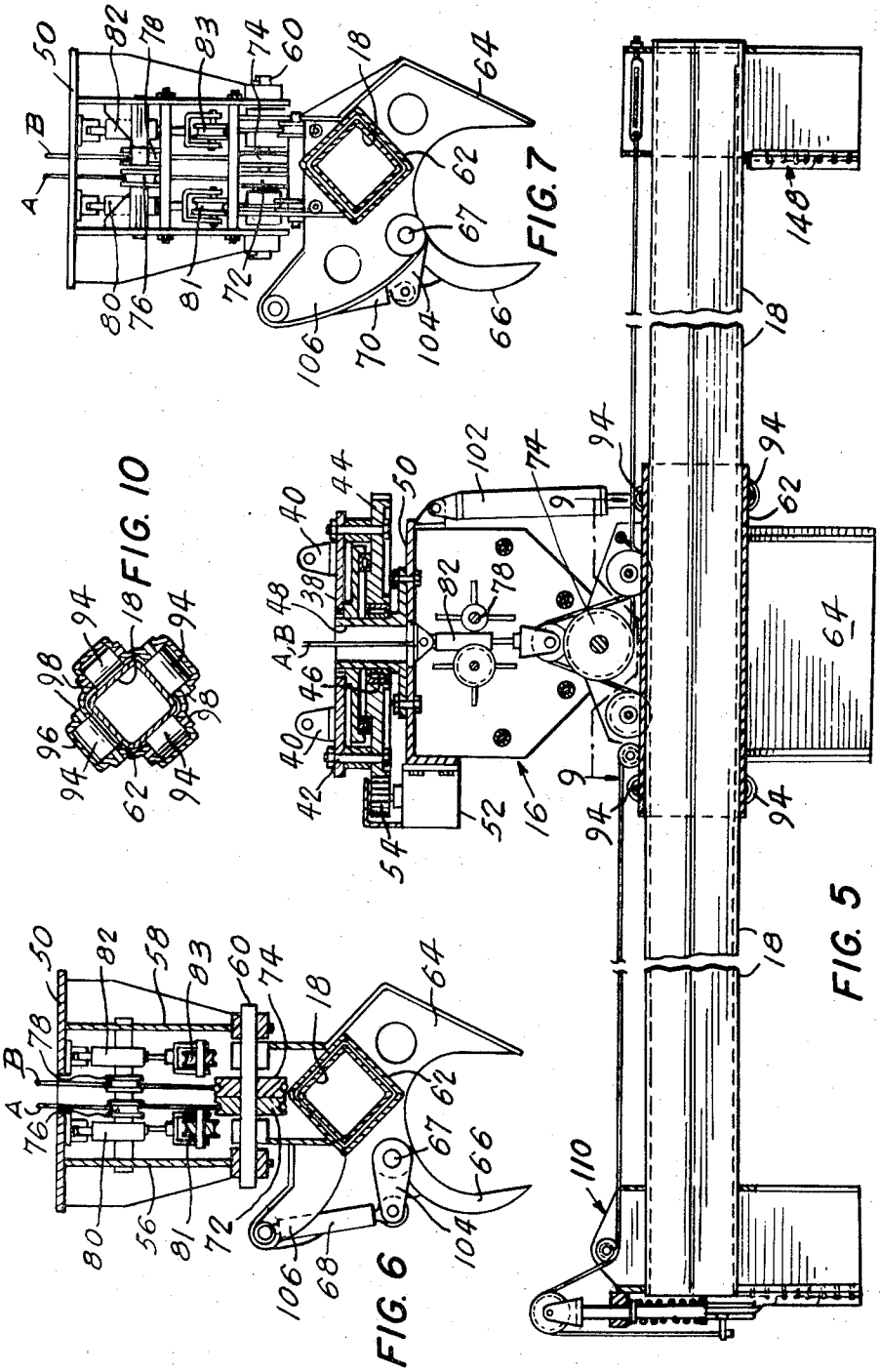


FIG. 2c

FIG. 2b

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FIG. 7
FIG. 10
FIG. 6
FIG. 5
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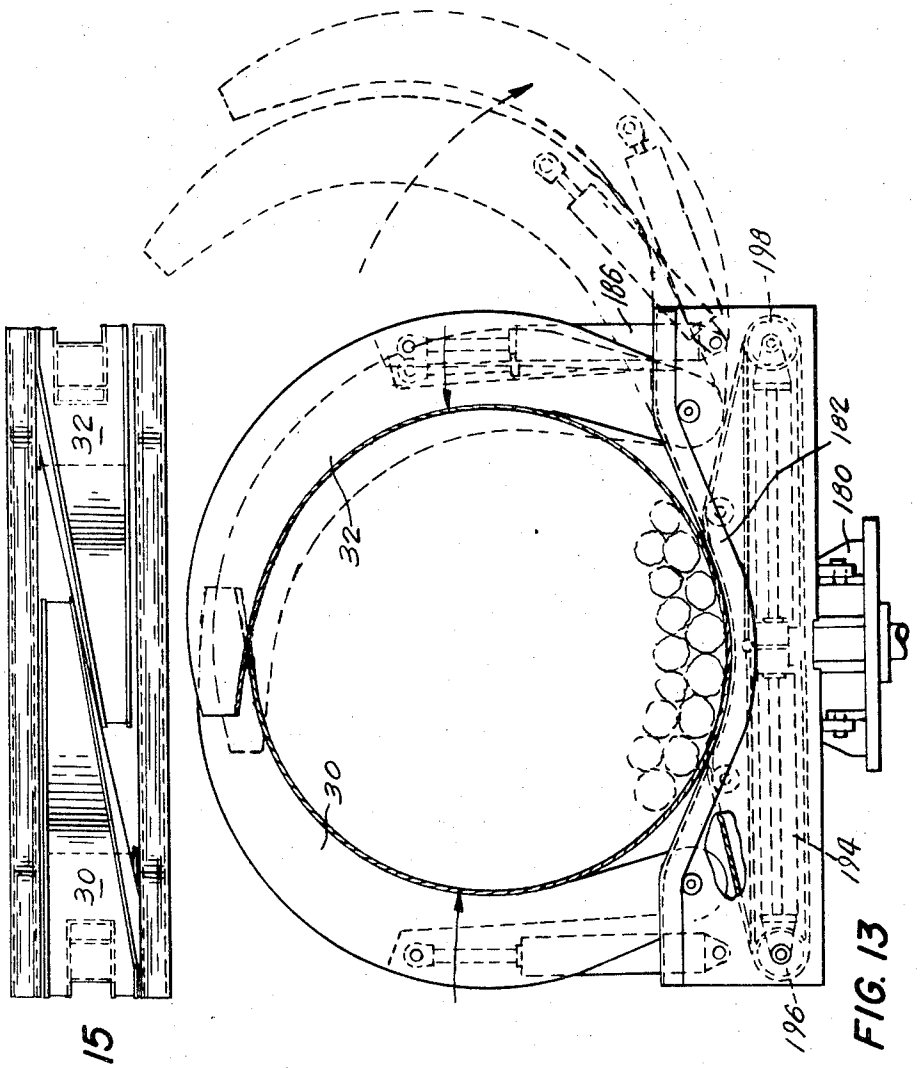


FIG. 13

FIG. 15

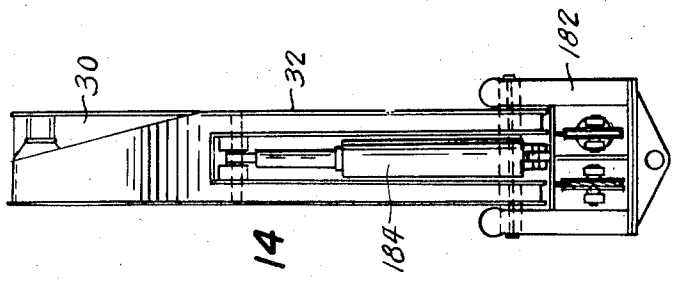


FIG. 14

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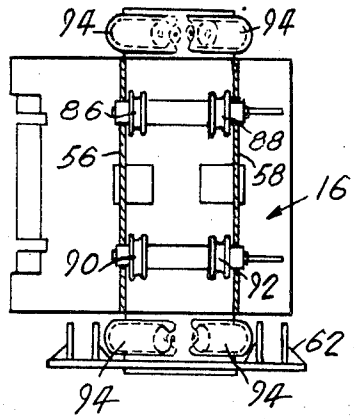


FIG. 9

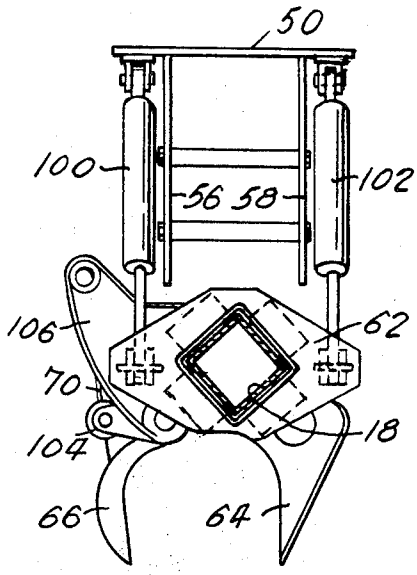


FIG. 8

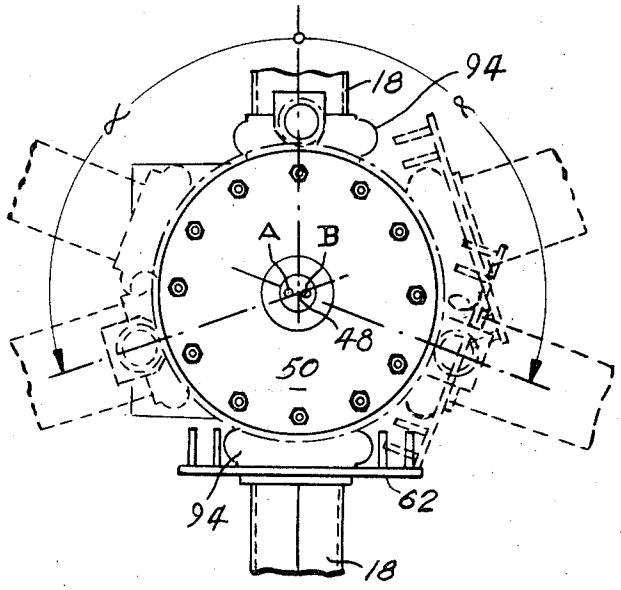


FIG. 12

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APPARATUS FOR DELIMBING AND LOADING FULL-LENGTH TREES

BACKGROUND OF INVENTION

1. Field of Invention

The present invention relates to a tree-harvesting method and apparatus, and more particularly to delimbing felled trees and loading them onto a forwarder.

2. Description of Prior Art

Heretofore, it has been known to delimb felled trees manually and then load the delimbed logs onto a forwarder to carry them from the cutting area to a more central loading area. It has also been known to delimb the trees mechanically, such as is described in Canadian Pat. No. 779,081, Jorgensen, 1968.

However, all of the mechanical delimbers which have been developed to date are characterized by their cumbersomeness and lack of mobility in the sense that in order to delimb or otherwise process the trees, the trees must be brought into alignment with a predetermined processing path on the vehicle, or, in the case of the above-mentioned Canadian Pat. No. 779,081, the machine itself must be brought into alignment with the trunks of the trees. This, of course, greatly reduces the maneuverability of such mechanical delimbers; since, when dealing with tree lengths of 40 feet and over, it is often difficult and time consuming to align either the delimber or the trees so that they can be passed through a proper processing path.

All of these mechanical delimbers must operate very close to the wood-cutting fronts where freshly-cut trees are often strewn about and there are usually piles of branches and many up-standing stumps contributing to reduce the accessibility of the area. Thus, the maneuverability of the machines described in the above patents is greatly reduced by terrain on which is must operate.

SUMMARY OF INVENTION

It is an aim of the present invention to provide a novel delimbing apparatus which has improved maneuverability, as compared to the prior art mechanical methods, in that it is not necessary to align either the mobile vehicle carrying the delimbing apparatus, nor the tree in order to delimb the tree.

It is a further aim of the present invention to provide an apparatus and method of delimbing trees whereby the tree is simultaneously loaded onto a forwarding vehicle while it is being delimbed.

It is a further aim of the present invention to provide an apparatus and method for combining the operations of delimbing and forwarding into a single operation.

A construction in accordance with the present invention comprises a mobile vehicle, a crane mounted on the vehicle, means at the free end of the crane for gripping a felled tree, said means including a carriage, a boom slidably mounted or movable in the carriage parallel to a tree so gripped, delimbing means mounted to the boom adapted to engage said tree while it is engaged by said tree-gripping means, means for slidably moving said boom and delimbing means longitudinally of said tree.

In a more specific embodiment of the present invention, the means at the free end of the crane for gripping the felled tree, including the carriage, is movable in at least two planes relative to the end of the crane. A further feature would be to provide cutting means at one

end of the boom for topping the non-commercial end of the tree, when the tree is being delimbed.

A further feature of a more specific embodiment of the present invention is in mounting the crane and delimbing means onto a forwarding vehicle or a skidder, whereby as the tree length is being delimbed, it may also be loaded simultaneously on the forwarder.

In a further embodiment, the above feature includes a pair of pivoting arms mounted on the rear of the forwarder with a flexible cable tightening loops subtended between the pivoting arms on the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus generally described the nature of the invention, particular reference will be made to the accompanying drawings, showing by way of illustration, a preferred embodiment thereof, and in which:

FIG. 1 is an elevational view of a mobile vehicle on which the delimber crane is mounted, and onto which the pivoting arms of the buncher apparatus are also mounted;

FIG. 2 is a side elevation of the delimber apparatus in detail;

FIG. 2*a* is a schematic view of the delimbing apparatus showing the system of cables for operating the movement of the boom;

FIG. 2*b* is a schematic view of the delimbing apparatus showing the system of cables for operating the clamping and delimbing devices;

FIG. 2*c* is a schematic view of the apparatus for delimbing showing in particular a system of cables for operating the tree-topping apparatus;

FIG. 3 is an end elevation taken along lines 3—3 of FIG. 2;

FIG. 4 is a vertical cross section taken along lines 4—4 of FIG. 2;

FIG. 5 is a longitudinal cross section taken through the delimbing apparatus shown in FIG. 2;

FIG. 6 is a vertical cross section taken along lines 6—6 in FIG. 2;

FIG. 7 is a vertical cross section taken along lines 7—7 of FIG. 2;

FIG. 8 is a vertical cross section taken along lines 8—8 of FIG. 2;

FIG. 9 is a horizontal cross section taken along lines 9—9 of FIG. 2;

FIG. 10 is a vertical cross section taken along lines 10—10 of FIG. 2;

FIG. 11 is a cross-sectional view taken along lines 11—11 of FIG. 4 of a detail therein;

FIG. 12 is a top plan view of the delimbing apparatus;

FIG. 13 is an elevational view of the buncher shown in FIG. 1;

FIG. 14 is a side elevation of the buncher apparatus shown in FIG. 13; and

FIG. 15 is a top plan view thereof.

Referring now to the drawings, particularly to FIG. 1, the delimbing carriage 16, having a sliding boom 18, is shown mounted on a vehicle 20. The vehicle 20 mounts a cab 22, with a crane 26 mounted to a turntable 24 on the vehicle. A trailer 28 is also provided in the present embodiment on which is mounted a pair of pivoting arms 30 and 32 forming a buncher device.

The crane 26 on the vehicle 20 is made up, in this particular embodiment, of two sections 34 and 36 which are hydraulically operable. At the free end of the crane section 36 is the carriage 16.

The carriage 16 includes a turntable support 38 having brackets 40 for connection with the crane section 36.

Referring to FIGS. 2 and 5 through 10, the turntable support 38 is shown as having a central opening and a peripheral crown gear 44 attached to turntable support plate 38 by means of bolts 42. This turntable support also includes bearing 46 engaging a sleeve 48 which is journalled in the central opening.

The turntable 50 is attached to the sleeve 48 and a pair of parallel plates 56 and 58 extend normal to the turntable 50. The turntable 50 also mounts a motor 52 carrying a gear 54 which is adapted to mesh with the crown gear 44 to cause the turntable 50 to rotate relative to the turntable support 38. The plates 56 and 58 subtend a pivot shaft 60 therebetween. The boom carriage 62 is pivotally mounted to the pivot shaft 60 for pivoting movement about the axis of the shaft 60.

The carriage 62 defines an opening therethrough of generally square cross section through which the boom 18 is adapted to pass. A fixed grapple jaw 64 is welded to the carriage 62 and a pivoting jaw 66 is connected to the carriage 62 by means of a shaft 67. A lever 104 is rigid with the pivoting jaw 66 while an arm 106 is fixed to the carriage 62. Piston and cylinder arrangements 68 and 70 extend between the lever 104 and arm 106 to effect a movement of the pivoting jaw relative to the carriage 62. The shaft 60 also mounts a pair of pulleys 72 and 74. Guide pulleys 76 and 78 are mounted in the same plane as pulleys 72 and 74, but spaced higher up between the plates 56 and 58.

A pair of piston and cylinder arrangements 80 and 82 extend in a vertical plane from the turntable 50, between the plates 56 and 58. Both piston and cylinder arrangements 80 and 82 mount freely-rotating pulleys 81 and 82, respectively.

Finally, there are provided, in the carriage 62 in the same plane as the pulleys 81 and 82, opposed pairs of pulleys 86, 88, 90 and 92, as shown in FIG. 9.

The boom 18 is made of extruded tubing which has been formed into a relatively square configuration. The boom 18 passes through the opening in the carriage 62 and is guided therein by means of rollers 94 as shown in FIG. 10. Each roller 94 is journalled on a shaft 98 having square ends which fit between a bracket and bracket cap 96. The square end shafts can be shimmed at the openings formed by the square cap so as to press the rollers 94 closer to the boom 18 as the roller material is worm out. The rollers 94 could be made of hard rubber or an equivalent synthetic material.

At one end of the boom 18, there is provided an end clamp and guillotine section 110. This is made up by means of the flange plate 112 as shown in FIGS. 2 and 3, and a fixed jaw 114 integral with the boom 18. Cutting knives 116, as shown in FIG. 11, are attached to the edge of the fixed jaw. As can be seen, these cutting jaws are L-shaped and the cutting edge when they are mounted to the jaws extends parallel to the boom 18.

There is a pivoting jaw 118 mounted on shaft 120 to the boom 18 for cooperable movement with the fixed jaw 114. Cutting knives 116 are also provided about the exposed edge of the pivoting jaw 118. A tension spring 122 is mounted to the shaft 120 and is effective to keep the pivoting jaw 118 in a closed position, such as shown in FIG. 3.

A bracket 124 extends from the pivoting jaw 118 and pulleys 126 and 128 are located on the boom 18 in line with the clamp 124.

At the end face of the flange plate 112, there is mounted a guillotine slide bracket 130 which effectively receives the guillotine blade 132 and allows it to move in a vertical plane. A guillotine blade 132 includes a shank 134 which extends upwardly from the blade about which is provided a compression spring 136. A sleeve 138 is mounted over the spring towards the top portion thereof and mounts a pulley 142.

Another pulley 144 is mounted on the boom 18 in line with the pulley 142. Finally, there is an anchor bracket mounted on the end flange plate 112 in the same plane with the pulleys 144 and 142.

The other clamp section 148 is provided at the other end of the boom 18. This clamp section 148 includes a flange plate 150, and a fixed jaw 152 similar to the fixed jaw of the section 110 is integral with the boom 18 and a pivoting jaw 154 cooperates with the fixed jaw 152. A bracket 156 is mounted to the pivoting jaw 154. The pivoting jaw 154 is journalled onto a shaft 158 mounted to the boom.

Pulleys 160 and 162 are in line with the bracket 156.

Tension spring 164 is mounted onto the shaft 158 and is effective to normally keep the pivoting jaw 154 in a closed position.

The various pivoting parts of the delimbing apparatus are, in the present embodiment, operated by means of cables. It is evident that, for such an apparatus which is mounted somewhat universally with respect to the vehicle on which it is mounted and especially with the boom 18, mounted in the carriage which is pivotally mounted to a turntable, it could become burdensome to control the clamps 110 and 148 at the ends of means of hydraulic devices in view of the number of hoses and the control of these hoses which would be necessary.

With respect to the delimbing apparatus, there are at least four separate cables identified A, B, C and D. Cables A and B control the movement of the boom 18. Cable A is attached to flange plate 112 and passes about the pulley 72 and then up by the guide pulley 76 than through the hollow sleeve 48 to the block and tackle arrangement on the side of the crane section 34. The block and tackle arrangement includes three pulleys 166, connected to the piston of piston and cylinder arrangement 170 while the cylinder is fixed to the crane section 34. Two pulleys 167 are also fixed to the crane section or the cylinder 170. The cable A passes over the series of pulleys and is then fixed to the crane section 38.

Cable B is fixed at one end to the flange plate 150 and passes over the pulley 74 up through the turntable by guide pulley 78 through the hollow sleeve 48 and to the other side of the crane section 38 to a separate block and tackle arrangement which is similar to that represented by 166 and 167. The pulleys in the block and tackle arrangement associated with cable B are identified 168 and 169, on either side of the piston and cylinder arrangement 172.

Cable C is attached at one end to bracket 124, operating the pivoting jaw 118 over the pulleys and then passes over the pulleys 126 and 128 underneath the pulley 86, shown in FIG. 9, and then over the pulley 81, shown in FIG. 7, down underneath the pulley 90 and on to pass over the pulleys 162 and 160, and the other end

of cable C is attached to the bracket 156 on pivoting jaw 154.

Cable D is fixed at one end to the anchor 146 over the pulley 142 on shank 134 down under guide pulley 144 towards and under pulley 88, then over pulley 83, connected to the piston and cylinder arrangement 82, then underneath pulley 92 and it is fixed at a point 93 to the carriage 62.

OPERATION

The delimbing carriage can be aligned with any tree merely by operating the necessary controls relating to the motor 52 so as to rotate the turntable 50 relative to the crown gear 44 on the turntable support 38. Also, by operating the piston and cylinder arrangements 100 and 102, the boom can be set at any desired angle. It is noted, however, as shown in FIG. 12 that the rotation of the boom is limited to an angle of approximately 110° identified by ω. This is in order not to twist the cables A and B which have come up through the sleeve 48.

Now that the structure of the delimbing apparatus has been described, the operation thereof will now be given, always in reference to the cables A, B, C and D, which are shown schematically in FIGS. 2*a*, 2*b* and 2*c*.

Referring to FIG. 2*a*, the boom is made to slide through the carriage 62 by means of the cables A and B. When it is required to close the boom, that is, to bring the guillotine clamp section 110 adjacent the carriage 62, the piston arrangement 170 is actuated to extend, thereby pushing out the block and tackle pulley 66 and shortening the cable A. This shortening of the cable A will, of course, pull in the boom, since cable A is attached to the flange plate 112. In the meantime, cable B is being extended by the fact that the boom is extending on the opposite side of the carriage 62. This will effectively close the piston and cylinder arrangement 172, since the block and tackle pulleys 168 and 169 will be forced closer together by means of the extending of cable B. If it is required during operation to open the boom, that is, to extend the clamp and guillotine section 110 outwardly, then the opposite operation is done.

The pivoting clamp jaws 118 and 154 are operated by means of the cable C. It is evident that the pivoting clamp jaws 118 and 154 will be maintained in a closed position on a tree or otherwise by means of the tension springs 122 and 164. If it is required to release the tree, then the piston and cylinder arrangement 80 is retracted so as to pull on the cable C, thereby opening the pivoting clamp jaws 118 and 154 simultaneously.

Finally, cable D is pulled by raising the pulley 83 by means of piston and cylinder arrangement 82, thereby shortening the effective length of the cable D, which presses the pulley 142 and shank 134 downwardly, thereby causing the guillotine blade 132 to move downwardly across the opening formed by the jaws.

In the field, the crane is operated to maneuver the delimbing apparatus over the length of a fallen tree and with the pivoting grapple jaw 60 in an open position, as well as pivoting jaws 118 and 154. Of course, the grapple jaw 60 can be open and closed by means of piston and cylinder arrangements 68 and 70. The boom 18 would be in a closed position as described above, and, of course, the guillotine blade 132 would be retracted.

The crane would then be operated to lower the delimbing apparatus on the tree at a point where the clamping section 148 would be at the trunk end of the tree just at the beginning of the branches.

The cable C would then be relaxed to close the pivoting clamps 118 and 154 onto the tree under the pressure of the tension springs 122 and 164. The cable B would then be shortened by extending the piston and cylinder arrangement 172 so as to move the boom 18 towards an open position. Once the boom has extended to an open position, assuming the tree is of such length that the portion beyond the clamp section 110 is not commercial, the cable D would then be pulled as described above so as to lower the guillotine blade and cut off the end of the tree.

While this operation is going on, the crane would be operated in such a way as to load the tree onto a proper forwarding equipment.

An embodiment of a suitable forwarding equipment would be in the form of a trailer.

An embodiment of a suitable buncher arrangement is shown in FIGS. 13 through 15, in which there is a pair of pivoting arms 30 and 32 pivoted to a cantilever frame 182 and actuated by means of piston and cylinder arrangements 184 and 186 respectively. The cantilever frame is mounted on a turntable arrangement which can be of conventional construction and is preferably in a position in a plane longitudinally of the vehicle when it is being loaded and, of course, it would be transversal of the axis of the vehicle when the vehicle is forwarding.

Finally, there is a cable E which has one end attached to each upper end of the pivoting arms 30 and 32 and which extends to form a loop and which crosses at the frame and which loops around two spaced-apart pulleys 196 and 198 mounted to a piston and cylinder arrangement 194 which is itself fixed to the frame. When the arms 30 and 32 are open to receive logs, the cable E is preferably slack and, therefore, the piston and cylinder arrangement 194 is retracted. However, when a plurality of trees has been received and it is required to secure the logs or debranched trees which are aligned between the arms, the arms 30 and 32 are closed and the piston and cylinder arrangement 194 is actuated so that it extends and tightens the cable E about the logs which are being bunched between the arms 30 and 32.

As can be seen from the above description, the wood-harvesting operation can be greatly reduced in that the trees which have been severed and are aligned in the field can be picked up by the grapple jaws 64 and 66 and while the crane 26 is operated to load at least the trunk end of the tree onto the buncher represented by the arms 30 and 32 which are in an open position, the tree is being debranched by means of the debranching clamp 110 and 148. Once enough trees have been loaded onto the buncher, the buncher is closed and the vehicle can advance either to another area where there are trees or to a road-side loading station, or the like.

I claim:

1. A delimbing apparatus including a vehicle, a crane mounted on the vehicle, means at the free end of the crane for gripping a felled tree, said means being adapted for movement relative to the crane, said means including a carriage, a boom slidably mounted through the carriage parallel to a tree so gripped, delimbing means mounted to the boom adapted to engage the tree while it is engaged by said tree-gripping means, and means for slidably moving said boom and delimbing means longitudinally of said tree, while said tree is

being gripped by said gripping means, whereby the branches are severed from the tree.

2. An apparatus as defined in claim 1 wherein the carriage is adapted to move at least two planes normal to each other relative to the crane.

3. An apparatus as defined in claim 1 whereby the delimbing means include clamping devices at each end of the boom and each clamping device has a fixed jaw and a pivoting jaw, with debranching knives mounted to the inner edges of the jaws.

4. An apparatus as defined in claim 3 whereby the pivoting jaws are normally held in a closed position against the fixed jaws by means of tension springs mounted on the boom and cable means are provided for opening the pivoting jaws against the action of the springs.

5. An apparatus as defined in claim 4 wherein said cable extends along the boom and passes over or under a pair of opposed pulleys up over a third pulley which is movable to and from the pairs of opposed pulleys for effectively shortening the cable so as to open the pulleys.

6. An apparatus as defined in claim 1 wherein there is a guillotine knife provided at the end of the boom and a cable anchored to one end of the boom passes over the spring-operated knife below a guide pulley and over a second pulley adapted for movement to and from the guide pulley to effectively shorten the length of the cable so as to actuate the movement of the guillotine knife.

7. An apparatus as defined in claim 1 wherein the boom is movable in the carriage by means of cables passing through the carriage towards a position on the crane, whereby the cables are alternately lengthened and shortened by means of reverse block and tackle means operated by hydraulic motors.

* * * * *