United States Patent

[11] 3,540,501

[72] Inventor Karl-Erik Arnold Jonsson
Gavle, Sweden

[21] Appl. No. 852,521
[22] Filed June 23, 1969
Continuation-in-part of application Ser. No. 703,372, Feb. 6, 1968, abandoned.
[45] Patented Nov. 17, 1970

[73] Assignee Brundell Och Jonsson AB
Gavle, Sweden
a corporation of Sweden

[32] Priority June 24, 1968
[33] Sweden
[31] 8,517/68

[54] MEANS FOR CUTTING TREES
11 Claims, 7 Drawing Figs.

[52] U.S. Cl. 144/34
[51] Int. Cl. A01g 23/02
[50] Field of Search ..... 144/2(21), 3(4), 34, 34(1—6), 309(34)

[56] References Cited
UNITED STATES PATENTS
1,509,994 9/1924 Carroll 144/34

Primary Examiner—Gerald A. Dost
Attorney—Bauer and Goodman

ABSTRACT: A tree-cutting machine having at least one knife blade movable to and from the operative cutting position against the tree. The principal direction of the cutting edge line of said knife blade forms an angle of at most 70° to the axis of a shaft about which the knife blade may be pivotally mounted to be movable to and from said operative position. In a cross section perpendicular to its cutting edge, said knife blade is curved into an arc having a radius equal to the distance from said shaft. The device may utilize at least two knife blades movable to and from each other about the pivot shaft, or may utilize only one knife blade with a countersupport.

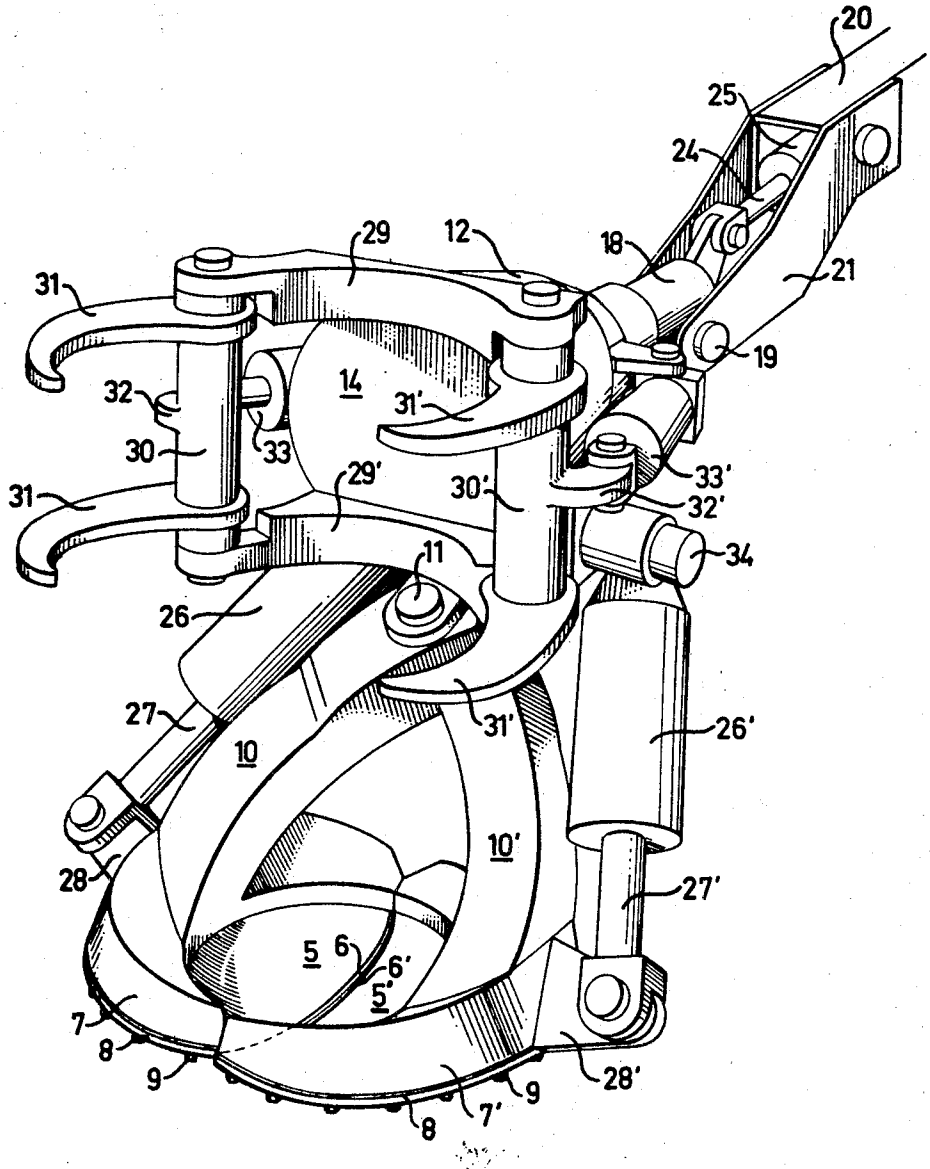


Fig.1

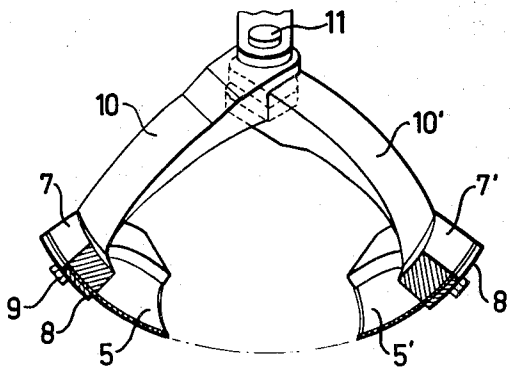


Fig.2

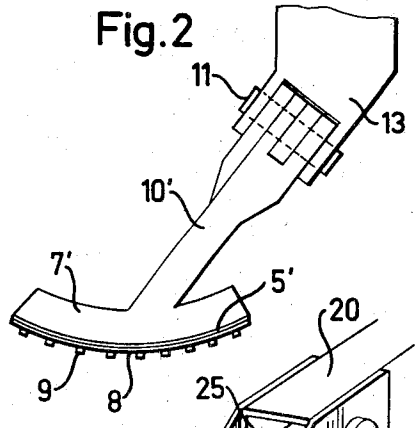
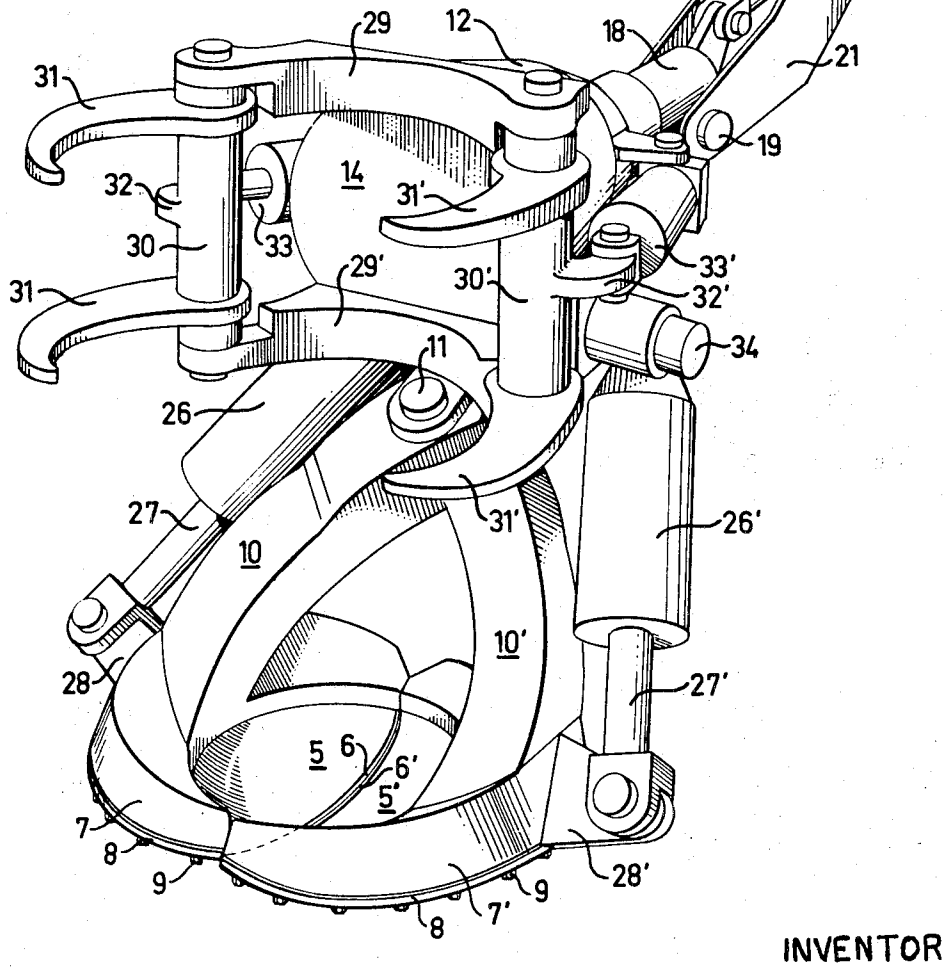


Fig.3



INVENTOR
Karl-Erik A. Jonsson
by Green Marechal & Jr

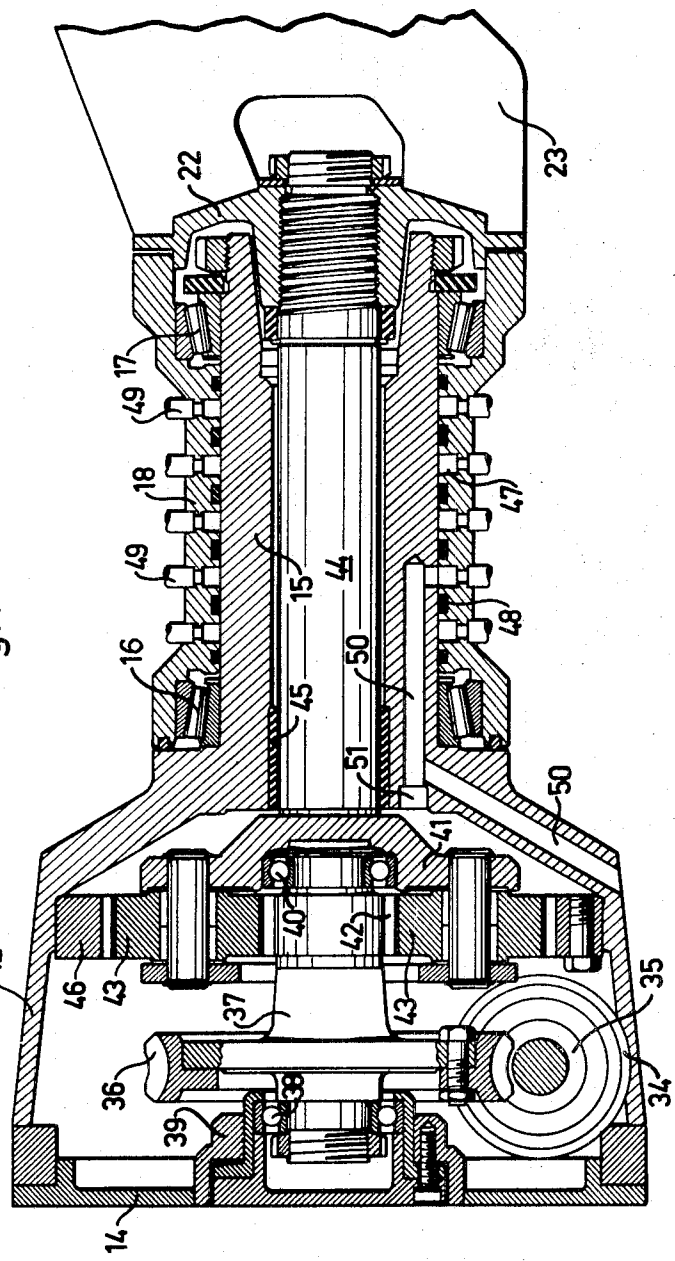


Fig.4

INVENTOR
Karl-Erik A. Jonsson
by
Greer Maréchal Jr.

Fig. 5

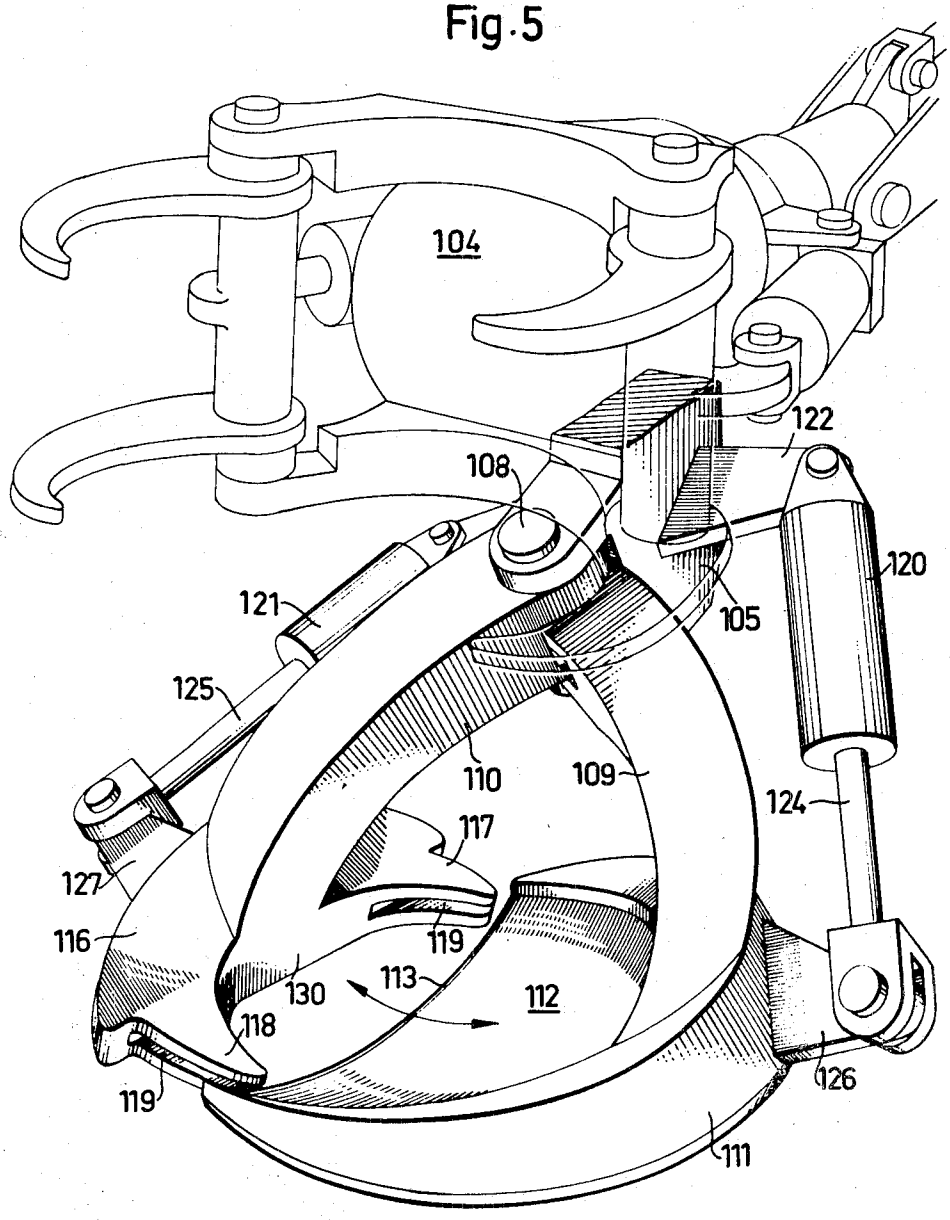

104
122
108
120
121
105
125
110
109
124
117
127
116
119
130
113
112
118
119
126
111

Fig.6

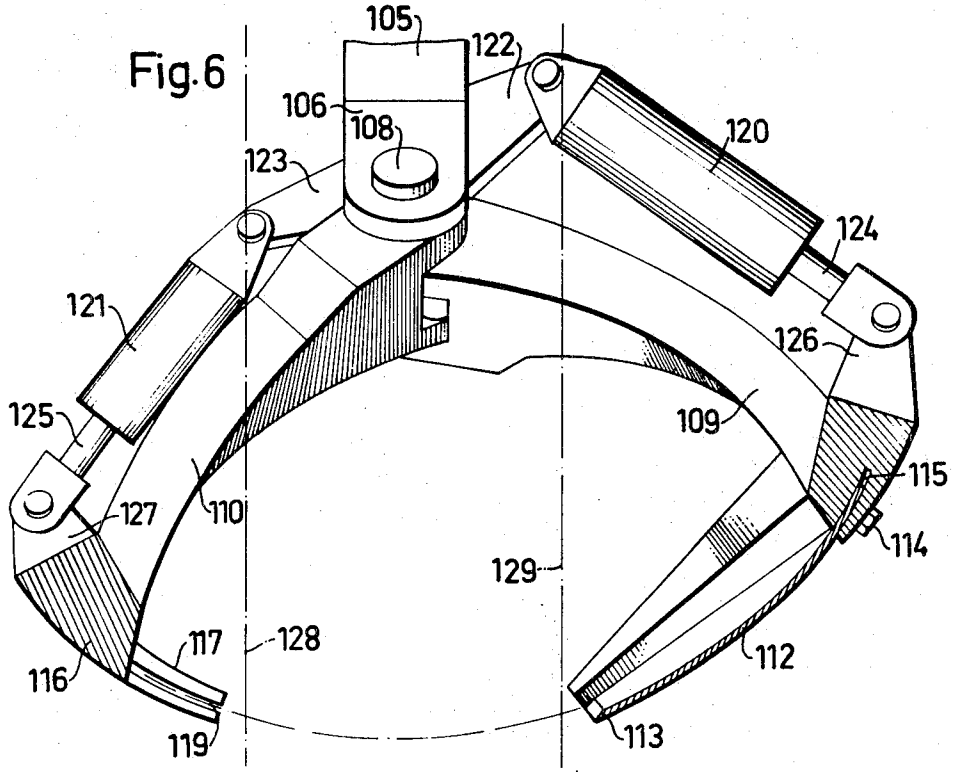
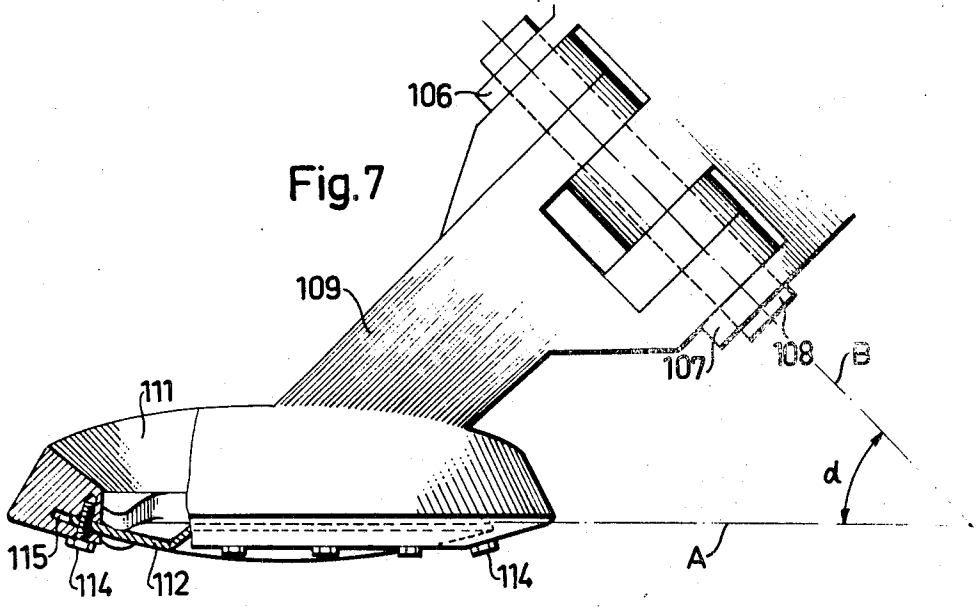

105
122
106
108
120
123
124
121
126
125
109
115
127
110
114
129
117
128
112
116
119
113

Fig.7


106
109
107
108
B
111
d
115
114
112
114
A

MEANS FOR CUTTING TREES

BACKGROUND OF THE INVENTION

The present invention is a continuation-in-part application of U.S. Pat. Ser. No. 703,372, filed Feb. 6, 1968 and now abandoned.

Machines have been proposed for cutting trees in forest harvesting, particularly having cutting means of the type comprising two power-driven knife blades arranged to be moved to and from each other about a common shaft which is carried by a holder. Generally the holder is, in turn, mounted in the outer end of a crane beam which is supported by a truck or a similar vehicle.

Similarly to the legs of conventional shears, the knives of these cutting means have been movable in a common plane, and the trees have thus been felled by a straight cut crosswise to their longitudinal direction. However, especially when cutting thick trunks, the power required is very great and has necessitated correspondingly heavy dimensions of tools and driving means so that, as a whole, the apparatus has become weighty and unhandy.

The object of the present invention is to provide improved tree-cutting machines which are more efficient in their power utilization and which also provide a cleaner cut with less waste produced.

SUMMARY OF THE INVENTION

The present invention provides machines for cutting trees in which at least one knife blade is movably mounted on a holder and power means are provided to move the knife blade into and out of operative cutting position. The knife blade is preferably attached to an arm which is pivotally mounted on a shaft carried by the holder. Alternative knife blade-mounting may be utilized to achieve the same movement of the knife blade, *i.e.*, that obtained if it were pivoted about a shaft carried by the holder. The principal direction of the cutting edge line of said knife blade forms an angle at most 70° to the axis of said shaft. The knife blade is curved in a section which is perpendicular to its cutting edge to form an arc having a radius substantially corresponding to the distance from the shaft. The apparatus may contain oppositely mounted knife blades, each movable as if they were pivoted about the same shaft, or may contain one knife blade and an opposed countersupport.

In one preferred embodiment of the invention utilizing two opposed knife blades, each of the knife blades is curved in a cross section perpendicular to the cutting edge to form an arc having a radius substantially corresponding to the distance from the shaft. Further, the principal direction of each of the cutting edge lines forms an angle of at most 70° to said shaft.

When knives shaped and arranged in this way are moved onto each other to cut a trunk crosswise to its length, each point on either of the edges will thus move in an arcuate path having its greatest inclination to the ground plane in the outer limit position of the knife. This means that the edges penetrating a trunk from two opposite sides are at least initially directed at an angle to the grain of the wood, and the demand of power for the cutting will consequently be smaller. Theoretically, the best effect would be obtained, if the edges were parallel to their pivot shaft, *i.e.*, at the angle zero, but in practice such a device would involve other problems, and an angle of about 40°—50° is preferred. The edges may be straight, in which case each knife blade is formed as an axial segment of the envelope surface of a cone, but in a preferred embodiment the knife blades are also curved in parallel to the edges thus together forming a bowl. The stumps left at the cutting of a tree will consequently exhibit a bowl-shaped cut surface.

Another advantage of the new device is that the end of the cut trunk will be less split than in the case of cutting perpendicularly to the grain, and hereby some inches of valuable wood is saved on each tree. A further yield of wood may be obtained in that the curved knife blades may be caused to engage the tree closely to the ground so that the concave section surface will for its greater part be located below the ground.

In another preferred embodiment of the invention obtaining the same desirable effects, the two knife blades are substituted by a single knife blade of similar curvature, said single blade being then caused to cooperate with a countersupport pivotable around the same shaft. When cutting a trunk with this device, the knife blade and the countersupport are swung simultaneously into engagement with diametrically opposed points on the surface of the trunk, and when the countersupport is then stopped, the knife blade continues to cut through the cross section of the trunk. In the same way as in the opposed knife blade device described hereinbefore, the rear edge of the knife blade is conveniently arcuate and secured to a frame member of corresponding arcuate shape. The countersupport may be designed as a fork partly encircling the trunk, and the legs of said fork may be provided with slits receiving the end portions of the knife blade.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross section through the cutting tools;

FIG. 2 shows one of the tools, as seen from the rear;

FIG. 3 is a perspective view of the cutting device mounted at the end of a crane beam;

FIG. 4 is an axial section through a head supporting the various elements;

FIG. 5 is a perspective view of the single knife blade machine viewed obliquely from the front in partially opened position having phantom lines indicating a tree holder mounted at the end of a lifting arm and carrying the cutting surface together with the gripping members;

FIG. 6, partly in section, is a perspective view of the cutting device gripping a trunk which is shown by dash-and-dot lines; and

FIG. 7 is a side view of the single knife-cutting device in a plane parallel to the pivot shaft.

DETAILED DESCRIPTION OF THE INVENTION

In the opposed knife blade device of FIGS. 1—3, the knife blades consist of substantially semicircular steel plates 5,5′ which are a little curved in such a way that together they form a bowl, when their cutting edges 6 and 6′, respectively, are in contact with each other. The semicircular rear edge portions of the plates 5,5′ are secured to the lower sides of correspondingly arcuate frame members 7 and 7′, respectively, by means of curved strips 8 and bolts 9. When the cutting edges 6,6′ are in contact, as shown in FIG. 3, the frame members 7,7′ form a closed ring which determines the maximum thickness of a tree to be cut.

The frame members 7,7′ are fixed to arms 10,10′ pivotally mounted on a common pivot shaft 11 which is carried by a bracket 13 projecting from the lower side of a head 12. As shown in FIG. 2, the arms 10,10′ extend at right angles from the shaft 11 but are inclined in relation to the frame members 7,7′ and the blades 5,5′ in such a way that an acute angle arises between said shaft 11 and any tangent to one of the curved cutting edges 6,6′. As an example, the angle between shaft 11 and the central tangent, *i.e.*, the principal direction of the edge, may be about 40°—50°. This angle between shaft 11 and the principal direction of the cutting edge is the angle α of the single knife device of FIG. 7. In FIG. 1, the two cutting tools described are shown in a starting position in which the knife blades 5,5′ are moved from each other.

The mounting head 12 carrying the shaft 11 by means of the bracket 13 consists of a housing circular in cross section. At its front the housing has a flat end wall 14, and the rear end is connected to a cylindrical member 15 having a reduced diameter (FIG. 4). By means of roller bearings 16,17 this member 15 is rotatably journaled in a sleeve 18 provided with two aligned pivots 19 (FIG. 3) which project diametrically in opposite directions. The pivots 19 are pivotally mounted in a fork-shaped end portion 21 of a crane beam 20 in such a way

that the sleeve 18 together with the head 12 may be rotated in a vertical plane. To perform this rotation, a cap 22 closing the rear end of the sleeve 18 has a protruding member 23 linked to a piston rod 24 (FIG. 3) which extends from the piston in a double-acting hydraulic cylinder 25 mounted in the crane beam 20.

The knife blades 5,5' are moved to and from each other by double-acting hydraulic cylinders 26,26' linked to ears on the head 12. The piston rods 27,27' of said cylinders 26,26' are linked to ears 28 and 28', respectively, fixed on the outer sides of the frame members 7,7'.

The front wall 14 of the head 12 carries two arcuate brackets 29,29' mounted in parallel and in spaced relationship one above the other. Vertical shafts 30,30' pivotally journaled in the ends of said brackets 29,29' are provided with grab tongs 31,31' projecting radially to grab and hold a tree at the cutting operation. Crank arms 32,32' secured to the shafts 30,30' are linked to piston rods which project from double-acting cylinders 33,33' having their rear ends linked to the head 12. In this way the tongs 31,31' may be moved to and from each other to grab and to release a tree, respectively.

As mentioned, the cylinder 15 connected to the head 12 is rotatable within the sleeve 18, and the head may thus be turned to lay down a felled tree sideways. To perform this rotation a hydraulic rotary motor 34, such as an orbit motor, is mounted eccentrically within the housing 12 with its axis in parallel to the end wall 14. The motor shaft is connected to a worm gear 35 which engages a worm 36. The shaft 37 of said worm 36 has one end journaled in a ball bearing 38 which is carried by a cage 39 mounted centrally in the end wall 14. The opposite end of the shaft 37 is journaled in a ball bearing 40 inserted coaxially in a surrounding planet wheel carrier 41, and a minor gear 42 formed on the shaft inside the bearing 40 engages a number of surrounding planet wheels 43 (preferably three wheels) journaled in the carrier 41. The planet carrier 41 is secured to one end of a shaft 44 extending through the cylinder 15, and the opposite end of said shaft 44 is connected to the cap 22. A packing ring 45 of rubber inserted between the shaft 44 and the surrounding cylinder 15 permits the shaft to rotate in relation to the cylinder.

The planet wheels 43 are in engagement with a surrounding gear ring 46 secured to the inside of the housing 12, and on supply of pressure fluid to the motor 34 the housing or head 12 is thus rotated over the planetary gearing.

For the sake of completeness, it should be mentioned that the inner wall of the sleeve 18 may be formed with a number of peripheral grooves 47 opening onto the wall of the cylinder 15 but sealed in relation to each other by means of rubber rings 48. Each of said grooves 47 communicates with a conduit 49 containing a valve (not shown) by which the groove may be connected to an outlet or to a source of hydraulic pressure (an oil pump). A channel 50 extending from each groove 47 through the walls of the cylinder 15 and of the housing 12 is adapted to be connected to one of the hydraulic cylinders by a conduit, not shown. The channel 50 shown in FIG. 4 has, moreover, a branch 51 ending into the housing 12, whereby the planetary gearing is all the time immersed in oil.

The single knife blade cutting machine is more specifically illustrated in FIGS. 5, 6 and 7. The head 104, which generally corresponds to mounting head 12, has a depending bracket 105 provided with two lugs 106 and 107 (FIG. 7), in which a pivot or shaft 108 is mounted in a position inclined forwardly. Two arms 109, 110 are pivotally mounted on said shaft 108 to be moved towards and from each other. An arcuate or U-shaped frame 111 secured to the end of the arm 109 encloses the rear margin of a correspondingly shaped knife blade 112, the edge 113 of which extends between the outer ends of the frame 111. The arcuate margin of the knife blade 112 is held by screws 114 (FIGS. 6 and 7) in a circumferential slit 115 in the inner side of the frame 111. In any plane perpendicular to the pivot shaft 108 the knife blade 112 is bent such that it forms an arc with a radius corresponding to the distance of the pivot shaft. If desired, the knife blade may be curved like a chute in which case the cutting edge 113 is straight, but in the preferred embodiment the knife blade is bowl-shaped whereby the edge 113 is curved correspondingly in a plane coinciding with the axis of the shaft 108. In the latter case, the center tangent of the cutting edge 113 will determine the principal direction of the edge. As noted hereinbefore, a straight edge (indicated by a dot-and-dash line A in FIG. 7) or the central tangent of a curved edge should form an angle α of at most 70° to the axis B of the pivot 108. Preferably, said angle is between 40° and 50°.

A U-shaped supporting member 116 is secured to the outer end of the second arm 110. The legs 117, 118 of said member 116 are provided with slits 119 adapted to receive knife blade portions 112 located next to the outer ends of the frame 111 when the arms 109, 110 are moved towards each other. The arrangement is clearly to be seen from FIG. 5, where the cutting edge 113 of the knife blade is positioned just in front of the openings of the slits 119.

The knife blade 112 and the supporting member 116 may be moved towards and from each other by means of two double-acting hydraulic cylinders 120, 121 linked to lugs 122 and 123, respectively, projecting from two opposed sides of the bracket 105. In the same way, the piston rods 124 and 125 of the cylinders 120, 121 are linked to lugs 126 and 127, respectively, projecting from the exterior of the frame 111 and the supporting member 116, respectively. As apparent from FIG. 6, where the cutting device is shown in open condition gaping over a tree trunk indicated by dash-and-dot lines 128, 129, the cylinder 121 of the supporting member 116 may be shorter, as the inward movement of the supporting member 116 is stopped when the inner surface 130 located between the legs 117, 118 comes into contact with the trunk. Simultaneously, the knife blade 112 is moved so that the cutting edge 113 engages the opposed trunk portion and on continued supply of pressure fluid the longer cylinder 120 will force the knife blade 112 through the trunk, in that the now stationary supporting member 116 serves as a countersupport.

The head 104 may be moved and rotated utilizing the mechanism disclosed in FIG. 4 for similar movement of mounting head 12.

I claim:

1. A tree-cutting machine comprising at least one knife blade, a holder for said knife blade, and power means to move said knife blade into and out of operative cutting position;

means to move said knife blade with a motion corresponding to that obtained by pivotally mounting said knife blade on a shaft supported by said holder;

said knife blade having a cutting edge, the principal direction of said cutting edge forming an angle of not more than 70° with the axis of said shaft; and

said knife blade being curved in a cross section perpendicular to its cutting edge to form an arc having a radius substantially corresponding to the distance from said shaft.

2. The tree-cutting machine of claim 1 having a holder supporting a shaft, having at least one arm pivotally attached to said shaft, and having said knife blade attached to said arm.

3. The tree-cutting machine of claim 1 wherein said angle is between about 40° and 50°.

4. A tree-cutting machine comprising a holder, a shaft supported by said holder, two power0 power-driven opposed knife blades supported by said shaft, and means for pivotally moving said knife blades to and from each other about said shaft, each of said blades having a cutting edge and being curved in a cross section perpendicular to said cutting edge to form an arc having a radius substantially corresponding to the distance from said shaft, and the principal direction of each of the cutting edge lines forming an angle of at most 70° with said shaft.

5. The tree-cutting machine of claim 4 wherein said knife blades are curved to form a bowl.

6. The tree-cutting machine of claim 5 where the rear edges of said knife blades opposite to the cutting edges are substantially semicircular and are fixed to correspondingly shaped frame members.

7. The tree-cutting machine of claim 6 wherein said angle is between about 40° and 50°.

8. The tree-cutting machine of claim 4 wherein means are provided to move said holder in vertical planes perpendicular to each other.

9. A tree-cutting machine comprising a holder, a shaft supported by said holder, a knife blade and a countersupport for said knife blade supported by said shaft, and power means for pivotally moving said knife blade and said countersupport to and from each other about said shaft, said knife blade having a cutting edge and being curved in a cross section perpendicular to said cutting edge to form an arc having a radius substantially corresponding to the distance from said shaft, and the principal direction of the cutting edge line forming an angle of at most 70° with said shaft.

10. The tree-cutting machine of claim 9 wherein said countersupport comprises a U-shaped member, the legs of which are provided with slits adapted to receive the end portions of said knife blade.

11. The tree-cutting machine of claim 10 wherein said angle is between about 40° and 50°.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,540,501 Dated November 17, 1970

Inventor(s) KARL-ERIK A. JONSSON

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

The first page of the patent, left column, the information relating to priority should read as follows:

--[32] Priority March 20, 1967 and June 24, 1968
[33] Sweden
[31] 3,859/67 and 8,517/68--

Column 3, penultimate line, "of" should be --to--.

Claim 1, line 3, the ";" should be a --,--;
line 6, the ";" should be a --,--;
line 9, the ";" should be a --,--.

Claim 4, line 2, "power0" should be deleted.

SIGNED AND
SEALED
MAR 2 1971

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents