

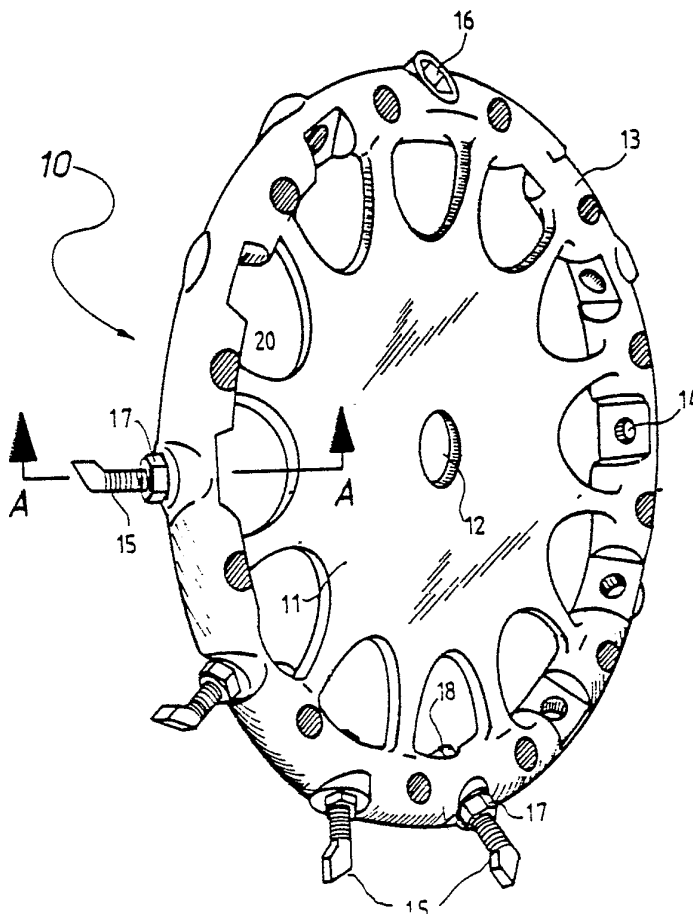
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/AU87/00053 (22) International Filing Date: 24 February 1987 (24.02.87) (31) Priority Application Number: PH 4763 (32) Priority Date: 24 February 1986 (24.02.86) (33) Priority Country: AU (71)(72) Applicant and Inventor: WILSON, James [AU/AU]; 45 Lucan Avenue, Aspley, QLD 4034 (AU). (74) Agent: T.G. AHEARN & CO.; 79 Eagle Street, Brisbane, QLD 4000 (AU). (81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BG, BR, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), HU, IT (European patent),		JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US. Published <i>With international search report.</i>
(54) Title: CUTTING TOOL		

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(57) Abstract

A cutting tool (10) of generally circular shape is made by investment casting. Removable teeth (15) are secured in through-holes (14) in an annular support (13) and may be removed by removing locking nuts (18). The teeth (15) are angled transversely relative to the plane of the hub (11) so that their respective cutting edges overlap to give a resultant cut wider than the annular support (13).



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CUTTING TOOL
-----FIELD OF THE INVENTION

THIS INVENTION relates to improvements to cutting tools and in one particular embodiment to cutting tools for use in apparatus for cutting or grinding tree stumps or the like.

BACKGROUND ART

In my Australian Patent No. 531,374 and my corresponding U.S. Patent No. 4,441,534 I disclosed apparatus for cutting or grinding tree stumps which is driven by a chain saw drive motor and which includes a multi-toothed cutting disc for cutting or grinding tree stumps. Preferably and in order to achieve a wider cut, the cutting disc is supported at an inclined angle relative to the shaft so that it undergoes oscillation in use. This arrangement, while being relatively effective, results in wastage of power from the drive motor. Another disadvantage of such arrangements is that the tungsten tipped tooth portions of the cutting disc tend to be frequently broken or damaged in use, necessitating repair which results in downtime of machine and/or high costs.

OUTLINE OF THE INVENTION

It is an object of the present invention to overcome or alleviate at least some of the above disadvantages by providing an improved cutting tool which has a plurality of replacement teeth and which may be efficiently employed to cut or grind tree stumps or the like. Although the the tool of the present invention is particularly suited to apparatus of the type disclosed in my aforesaid patents, it will also be realised that it may be applied to other types of machines for cutting or grinding trees or other substances.

With the above and other objects in view, this invention resides broadly in a cutting tool comprising a support portion adapted to be rotated in

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use, said support portion being an annular external surface and wherein a plurality of replaceable cutting teeth are disposed on said surface and placed circumferentially there-around. Preferably the cutting teeth are arranged so that the cutting edges thereof transversely overlap so that a wide cut may be achieved. Preferably also the cutting teeth include threaded shanks which threadedly engage with nuts retained in the support body so as to be easily replaceable in the event of damage.

BRIEF DESCRIPTION OF DRAWINGS

In order that the invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention wherein:-

Fig. 1 is a perspective view of a cutting tool according to the present invention;

Fig. 2 is a plan view of the tool illustrated in Fig. 1;

Fig. 3 is a sectional view showing details of the cutting teeth along line A-A of Fig. 1;

Figs. 4, 5 and 6 illustrate respective side, front and plan views of a preferred form of cutting teeth;

Figs. 7 and 8 illustrate two forms of apparatus for use with the cutting tool described with reference to Figs. 1 to 6.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Fig. 1, there is illustrated a cutting tool 10 according to the present invention which is adapted to be rotated in use and engage with timber such as a tree stump to cut or grind away at least portion thereof. As shown, cutting tool 10 includes a disc-like hub 11 provided in this instance with a central aperture 12 to permit the tool to be affixed to a rotating shaft or the like and an annular

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support portion 13 supported co-axially by the hub 11. The annular support portion 13 may comprise a section of pipe of suitable diameter, however it will be realised that many other suitable arrangements may be employed. For example, the hub 11 and annular support 13 may be cast in one piece. In the present embodiment the hub 11 and the annular support portion 13 have been made from an alloy metal using an investment casting technique to cast the hub 11 and annular support portion 13 as an integral body.

A plurality of through-holes 14, in this instance twelve, are formed in the annular support portion 13 to receive respective cutting teeth 15, preferably of the type illustrated in Figs. 4 to 6. Each through-hole 14 has an outwardly facing hexagonal nut receiving housing 16, the nut housing 16 being adapted to receive a nut 17 of an assembled cutting tooth 15, a portion of the threaded shaft of which passes through through-hole 14 and is secured by a lock nut 18 on the inner side of support portion 12.

As shown more clearly in Fig. 2, the through-holes 14 are preferably offset transversely so that the cutting teeth 15 overlap. To ensure a full width cut so as to obtain maximum penetration of the cutting tool in use, at least some of the teeth are angled outwardly of the opposite sides of the annular support portion 13. In addition, the hub 11, as shown in Fig. 1 is provided with a plurality of cut-out portions 20 aligned with each cutting tooth through-hole so that access may be readily gained to the lock nuts 18 to permit removal of the teeth as desired. This arrangement will facilitate use of ring spanners or the like for this purpose.

It will be realised that by providing a hexagonal nut receiving housing 16 that it will be only necessary to use a spanner on the inner nut in order to remove a cutting tooth from or secure a

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cutting tooth in its operative position. Similarly, the protruding length of the cutting tooth may be adjusted using the nut and thread arrangement which is illustrated in cross-sectional view in Fig. 3. As
5 can be seen in Fig. 3, the threaded rod shank portion 19 is slidable in through-hole 14 and nut 17 is prevented from rotating by housing 16 and lock nut 18 may be screwed tightly up against spring washer 21.

Referring to Figs. 4, 5 and 6 there is
10 illustrated a cutting tooth 15 which preferably includes a threaded shank portion 19 formed of unbreakable steel or the like surmounted by square section support portion 22 which in use preferably supports a tungsten tip 23. The top of the square
15 section 22 is illustrated with a truncated portion and this truncated portion 24 may be cut at a variety of angles which serve to restrict cutting to the tungsten tip rather than the square section support.
Preferably the tungsten tip 23 is affixed to the
20 support portion 22 by brazing. It will be realised however that many other different constructions of cutting teeth may be used for the tool.

As noted above, each tooth 15 is engaged with through-holes 14 in the annular support portion
25 13 and preferably locking nuts in combination with spring washers are employed to lock cutting teeth in position. It will thus be realised that each tooth 15 may be simply replaced in the event of wear in the tip portion 23. In addition, the external hexagonal nut
30 17 is secured in a hexagonal housing so that only the internal nut need be removed to enable replacement of the tooth.

Whilst the above tool incorporates twelve removable teeth, it will be realised that any number
35 of teeth may be supported on the annular support portion 13 as desired. Furthermore it will be seen from Fig. 2 that the teeth in this embodiment are

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arranged in two arrays of six teeth, each array extending from the centre to the respective opposite sides of the support portion 13 so that clearance is achieved on each side. In an alternative arrangement the threaded shanks may be replaced by unthreaded shanks which may be locked in position on the annular support by means of keys or the like which may also be arranged to locate the cutting tips in their required cutting attitude.

10 In use the tool 10 is mounted on a rotatable shaft such as the tool shaft of the apparatus disclosed in my aforesaid Australian and U.S. patents and driven by a chain saw motor and associated coupling. Sponge rubber washers are placed on
15 either side of the tool as vibration dampers. The tool 10 is then engaged with a tree stump and rapid grinding and cutting of the stump will occur. If damage occurs to any tooth 15, it may be easily removed and replaced. Of course, the hub and rim 13
20 may be of solid one-piece construction as desired and any suitable configuration to carry the tools in a circumferentially spaced transversely overlapping arrangement.

Of course it will be realised that the hub
25 and annular support portion 13 may be cast in one piece or formed in any other suitable manner. In one particular arrangement the annular ring 13 is eliminated and defined by an extension of the hub 11 and provided with a plurality of circumferentially
30 spaced mounts for the cutting tools 14, each mount being angled to provide the desired cutting pattern in the manner shown in Fig. 2. Again in this arrangement suitable cut-outs are provided in the hub 11 inwardly of the cutting tool mounts to permit detachment and
35 replacement of the respective tools if necessary.

As stated above, the tool 10 is particularly suited for use in apparatus disclosed in my above

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Australian and U.S. patents and that shown in Fig. 7 hereto. In the apparatus of Fig. 7 the cutting blade 31 is replaced by the tool 10 and of course there is no necessity to have the tool mounted in inclined fashion on the shaft 31'.

5 With the inclusion of tool 10 the cutting end 37 tends to have increased kick when being used so it is desirable to balance the unit about pivot support 38 so that end 37 is heavier than end 39 although still retaining the manoeuvrability afforded by easy pivoting of the whole unit by a user. Hence the centre of gravity of the unit is preferably forward of pivot 38.

10 In a further modification of the tool shown in Fig. 8 the member 32 of Fig. 7 which supports the guide pulleys 33 for the drive belt 34 may be eliminated and drive to the cutting tool 10 achieved internally of the member 35. For this purpose the member 35 may be of extended length to support directly the drive motor and the drive belt for the tool 10 is disposed with the hollow member 35 and guided by respective internal pulleys which maintain tension thereon. In this arrangement the member 35 may comprise an aluminium box section provided with the bearings 40 at one end for supporting the shaft 31' and further provided with pivotal support means 38 for supporting the upstanding member 36. In one suitable belt drive arrangement as shown in Fig. 8, the drive belt 41 from the chain saw motor directly drives a pulley 42 mounted on an adjustable plate 43 which may be moved to vary belt tension.

25 The pulley 42 is mounted on a shaft which carries another pulley aligned with the box section 35. A belt extends from this latter pulley through the box section 35 and about a pulley mounted on the tool shaft. Suitably spaced opposed idler pulleys are mounted within the box section 35 to maintain belt

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tension. Preferably two intermediate idler pulleys force the opposed belt section inwardly to form an intermediate narrowing of the belt. The box section 35 also includes spaced lateral supports 44 for securing a protective cover (not shown).

5 In a further use of the present invention, the tool 10 may be arranged to provide a "raking" function for cleaning away debris, detritus and chopped small roots etc. while preserving the cutting
10 teeth 15. In this application, cutting teeth 15 would be replaced by hardened headless bolts or hardened steel threaded rods so that the teeth 15 may be preserved exclusively for stump grinding.
15 Alternatively, two tools 10 may be provided; one for cutting or grinding and one for raking about a tree stump. It will be realised that cutting teeth 15 may be damaged during raking by rocks or other hard material in the soil adjacent a stump. It is
20 therefore desirable to provide a secondary tool 10 for the purpose of digging or raking and use the tungsten tipped teeth exclusively for the stump grinding work.

25 Whilst the above has been given by way of illustrative example of the invention, it will of course be realised that many modifications and variations may be made to the above described embodiment by persons skilled in the art without departing from the broad scope and ambit of the invention as is herein set forth.

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CLAIMS

1. A cutting tool for use with an apparatus of the type described in U.S. Patent No. 4,441,534 including a rotatable hub, said hub having an external annular surface, said external annular surface having a plurality of circumferentially spaced replaceable cutting teeth.
2. A cutting tool as defined in claim 1 wherein said hub and said external annular surface comprise an integral moulded substantially planar circular body.
3. A cutting tool as defined in claim 2 wherein said external annular surface includes a plurality of teeth receiving means, said teeth being securable in said teeth receiving means such that at least two of said teeth inscribe transversely spaced cutting arcs.
4. A cutting tool as defined in claim 3 wherein each said tooth receiving means includes a through-hole extending from an outer aperture on said external annular surface to an inner aperture, said inner aperture being accessible through an opening in said hub.
5. A cutting tool as defined in claim 4 wherein each said tooth comprises a longitudinal support, said longitudinal support supporting a cutting portion at one end, said one end extending from said outer aperture, the other end of said longitudinal support extending from said inner aperture into said access opening.
6. A cutting tool as defined in claim 5 wherein said longitudinal support comprises a threaded rod, said threaded rod being secured in said through-hole by a locking nut, said locking nut being adjustable through said access opening.
7. A cutting tool as defined in claim 6 wherein said outer aperture includes a housing, said housing being adapted to receive a non-circular portion of

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said tooth, said non-circular portion of said tooth being fixed against rotation when operatively positioned in said housing.

8. A rotating cutting tool support, said support having a generally planar hub and being of a defined maximum thickness, said hub being provided with a plurality of circumferentially spaced cutting tool mounts, each said tool mount being adapted to receive a replaceable cutting tool, said received cutting tools being operatively disposed relative to one another, said relative disposition enabling said cutting tools to make a cut on rotation of said support, said cut exceeding said maximum hub thickness.

9. A rotating cutting tool support as defined in claim 8 wherein said cutting tool mounts include inwardly directed longitudinal through-holes, at least some of said through-holes being transversely angled relative to the plane of said hub, said cutting tools extending from and being contiguous with the longitudinal axis of said through-holes when operatively received by said mounts.

10. A rotating cutting tool support as defined in claim 9 wherein said through holes extend to an inwardly located hub opening, said received tool having a portion extending into said opening, said extending portion being securable in said opening.

11. An apparatus for cutting and/or grinding tree stumps or the like including elongate support means, blade means rotatably mounted at one end of said support means, means at the opposite end of said elongate support means for engaging and supporting drive means, said drive means being adapted to be coupled to said blade means to cause rotation thereof and there being provided ground engageable post means intermediate the ends of said elongate support means and extending upwardly therefrom whereby said post

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means may be manually gripped and manipulated by an operator to move said means towards and away from a stump to be cut or ground, characterised in that said blade means includes a generally circular body, said circular body having a plurality of circumferentially spaced cutting tool mounts, a replaceable cutting tool being mounted in each said mount.

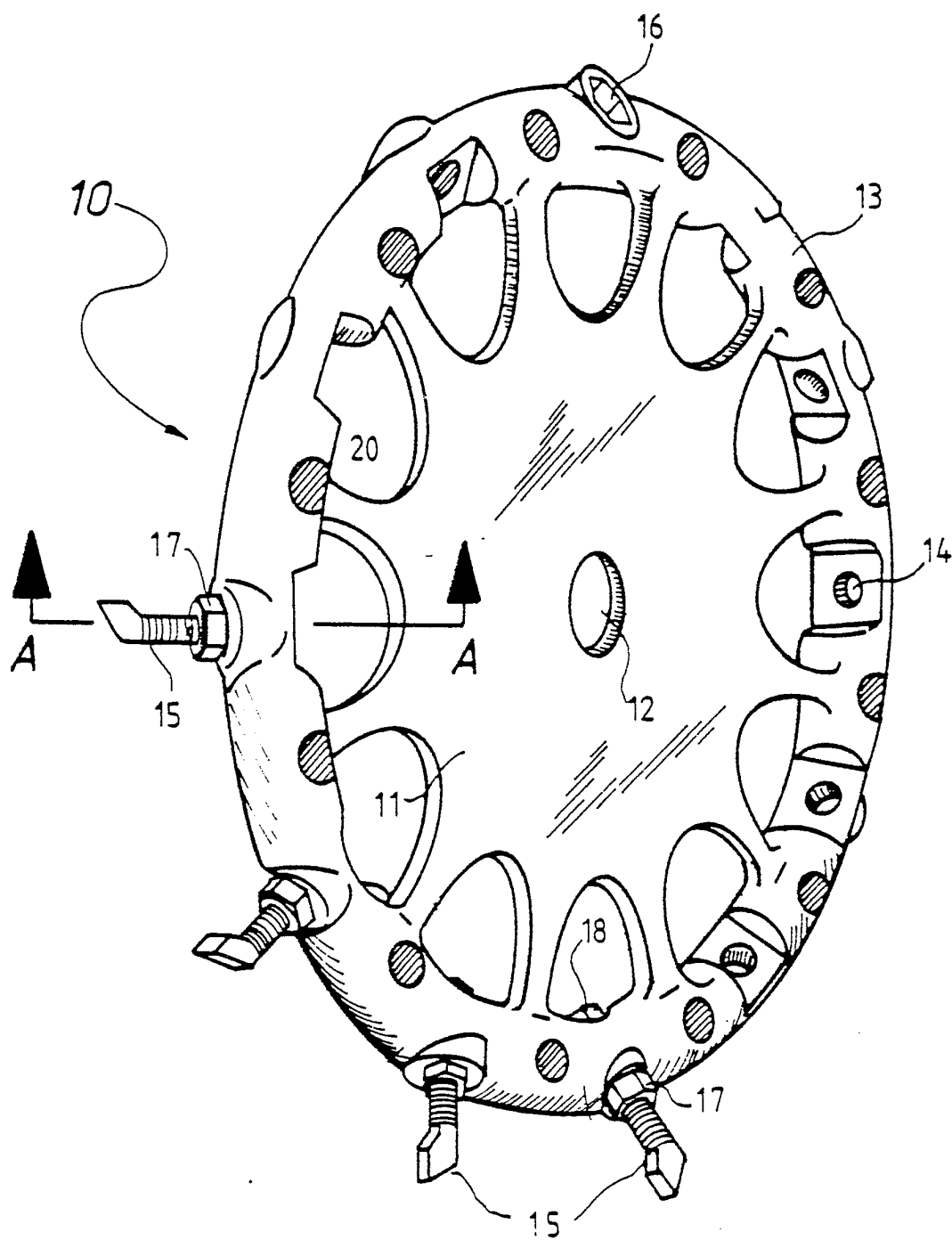
12. An apparatus as defined in claim 11 wherein said elongate support means is pivotable about a pivot on said post means, said pivot being located between the centre of gravity of said apparatus and said drive means.

13. An apparatus as defined in claim 12 wherein said tool mounts include tool securing means, said tool securing means being accessible through openings in said circular body.

14. An apparatus as defined in claim 13 wherein said cutting tools have respective cutting edges, said cutting edges being transversely spaced relative to the plane of said circular body, said relative spacing enabling said cutting edges to make overlapping transversely spaced cuts on rotation of said circular body.

15. A replaceable cutting tooth for use with the apparatus defined in claim 11 comprising a hardened shank, said shank having a threaded portion and a hardened cutting edge secured to said shank.

16. A cutting tool substantially as hereinbefore defined with reference to Figs. 1 to 6 of the accompanying drawings.

**FIG. 1**

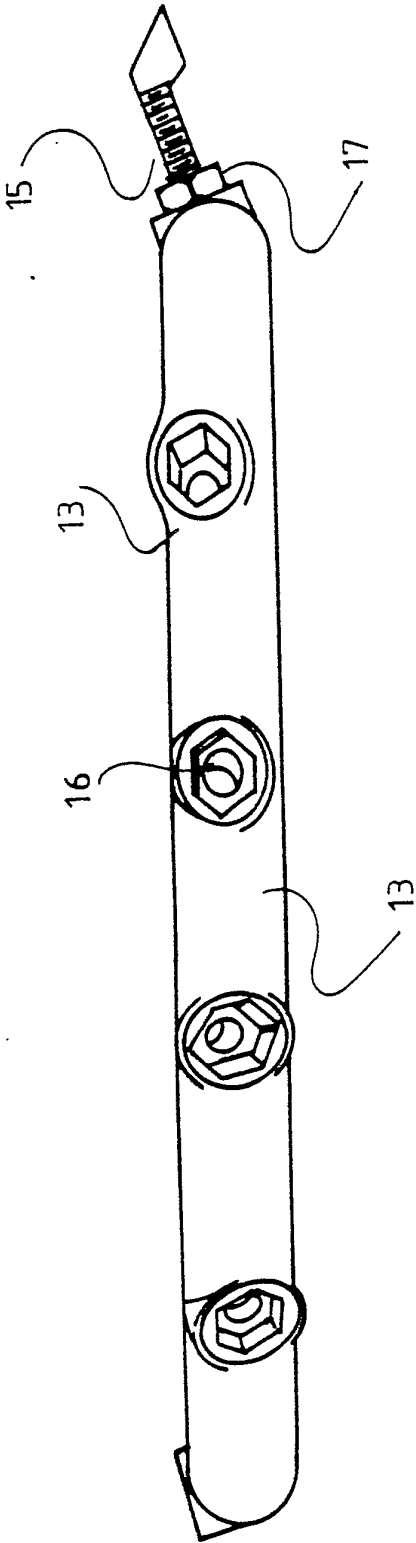


FIG. 2

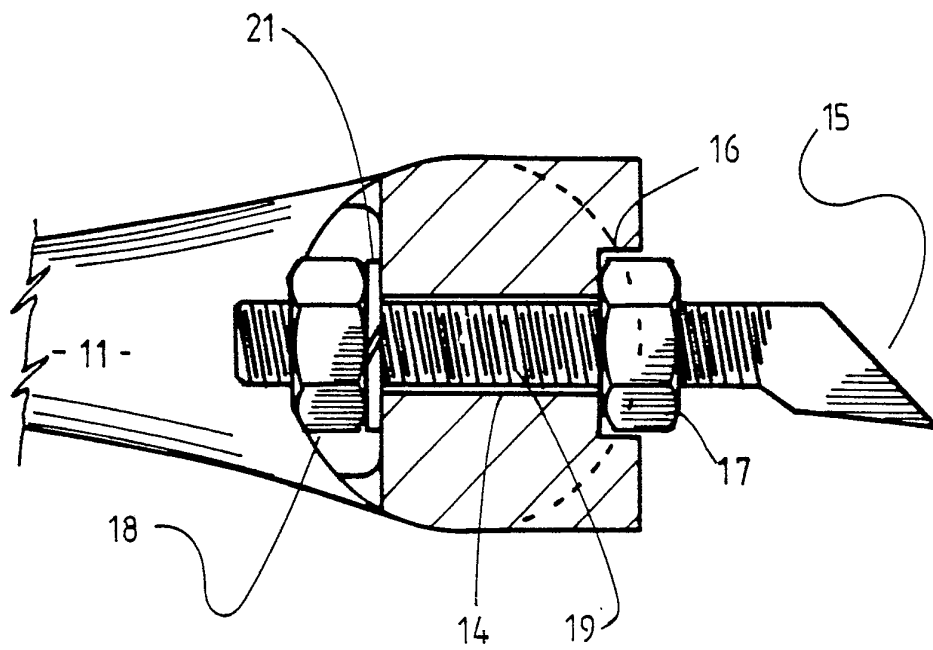


FIG. 3

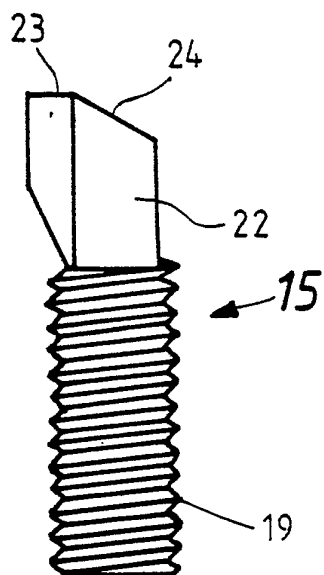


FIG. 4

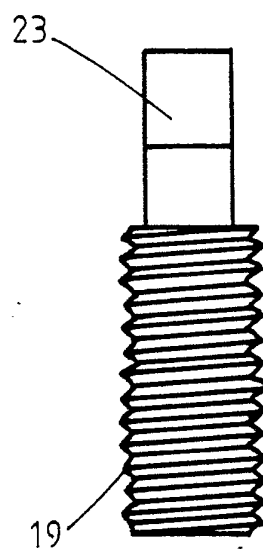


FIG. 5

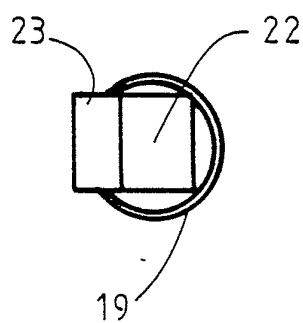
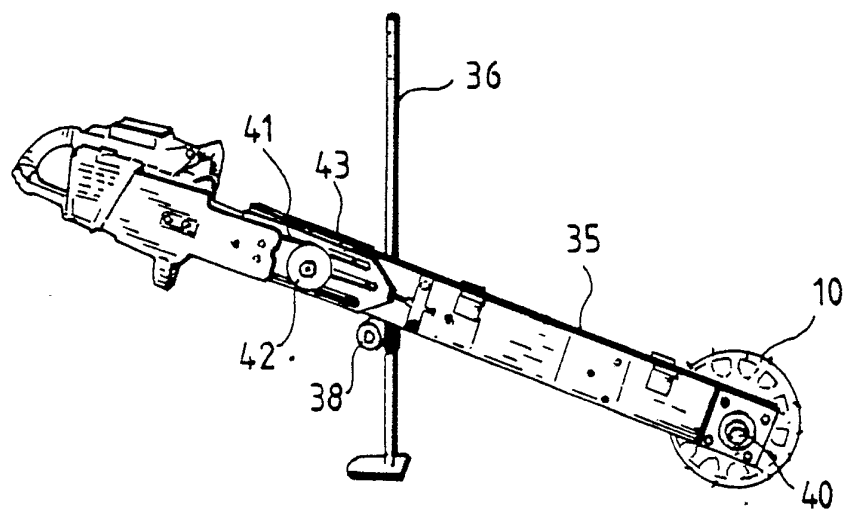
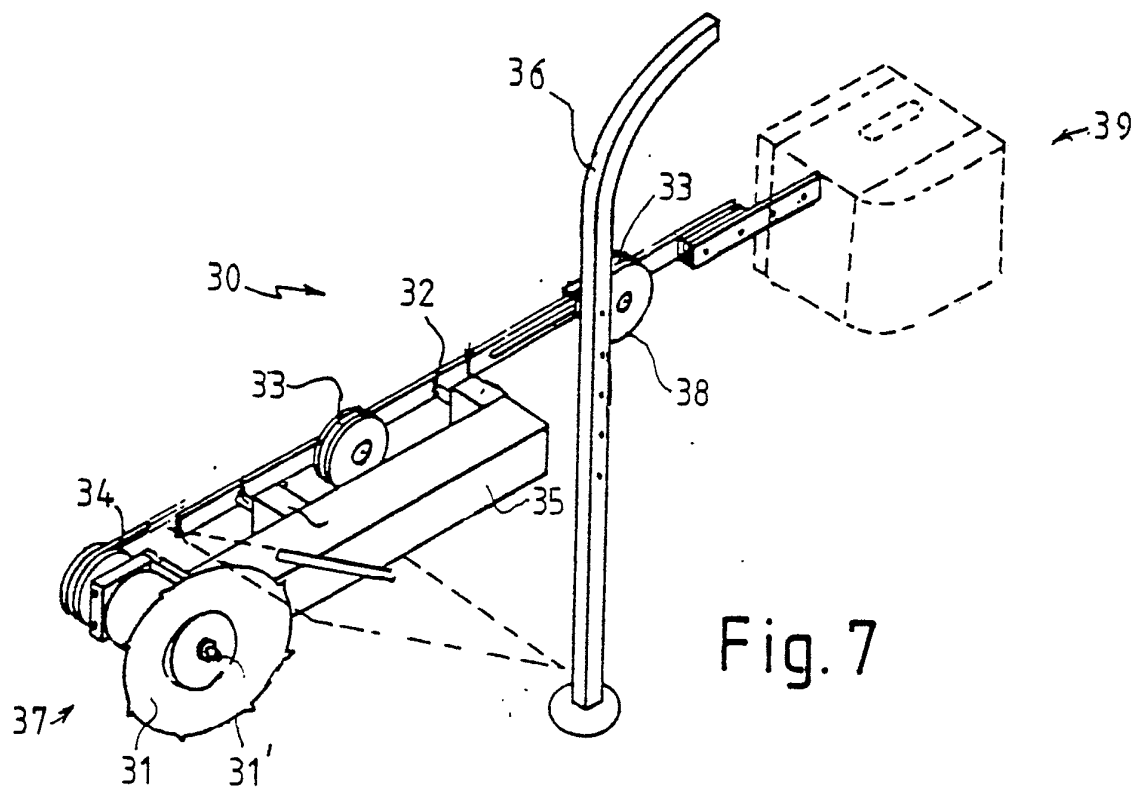


FIG. 6



INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 87/00053

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC Int. Cl.⁴ B26D 1/14, 1/143, 7/26, A01G 23/06																																
II. FIELDS SEARCHED Minimum Documentation Searched ⁷ <table style="width: 100%; border: none;"> <tr> <td style="width: 30%; border-bottom: 1px solid black; font-size: 0.8em;">Classification System</td> <td style="border-bottom: 1px solid black; font-size: 0.8em;">Classification Symbols</td> </tr> <tr> <td style="height: 40px; vertical-align: middle; font-size: 1.2em;">IPC⁴</td> <td style="height: 40px; vertical-align: middle; font-family: monospace; font-size: 1.2em;">B26D 1/14, 1/143, 7/26, A01G 23/06</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸ AU : IPC as above; B26D 1/29			Classification System	Classification Symbols	IPC ⁴	B26D 1/14, 1/143, 7/26, A01G 23/06																										
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table border="1" style="width: 100%; border-collapse: collapse; font-size: 0.9em;"> <thead> <tr> <th style="width: 10%;">Category ¹⁰</th> <th style="width: 70%;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 20%;">Relevant to Claim No. ¹³</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">X</td> <td>US,A, 3797544 (A. VER PLOEG) 19 March 1974 (19.03.74)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>US,A, 3570566 (J.F. McCREERY) 16 March 1971 (16.03.71)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>US,A, 3568740 (L.M. SPEAKMAN) 9 March 1971 (09.03.71)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>US,A, 3364602 (A. RENZAGLIA) 23 January 1968 (23.01.68)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>FR,A, 1427910 (BRODARD et TAUPIN) 3 January 1966 (03.01.66)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>FR,A, 1358364 (M. TOUBEAU DE MAISONNEUVE) 9 March 1964 (09.03.64)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>DE,A, 2213667 (H. and H. BLUM) 4 October 1973 (04.10.73)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>SU,A 1209105 (RURAL ECON RES DES) 7 February 1986 (07.02.86) (Derwent English Language Abstract P13 86-250708/38)</td> <td style="text-align: center;">1,8</td> </tr> <tr> <td style="text-align: center;">A</td> <td>SU,A, 568419 (FORESTRY MECHN INST) 14 December 1977 (14.12.77) (Derwent English Language Abstract P13 E8911A/25)</td> <td></td> </tr> </tbody> </table> (Continued)			Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	US,A, 3797544 (A. VER PLOEG) 19 March 1974 (19.03.74)	1,8	X	US,A, 3570566 (J.F. McCREERY) 16 March 1971 (16.03.71)	1,8	X	US,A, 3568740 (L.M. SPEAKMAN) 9 March 1971 (09.03.71)	1,8	X	US,A, 3364602 (A. RENZAGLIA) 23 January 1968 (23.01.68)	1,8	X	FR,A, 1427910 (BRODARD et TAUPIN) 3 January 1966 (03.01.66)	1,8	X	FR,A, 1358364 (M. TOUBEAU DE MAISONNEUVE) 9 March 1964 (09.03.64)	1,8	X	DE,A, 2213667 (H. and H. BLUM) 4 October 1973 (04.10.73)	1,8	X	SU,A 1209105 (RURAL ECON RES DES) 7 February 1986 (07.02.86) (Derwent English Language Abstract P13 86-250708/38)	1,8	A	SU,A, 568419 (FORESTRY MECHN INST) 14 December 1977 (14.12.77) (Derwent English Language Abstract P13 E8911A/25)	
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¹⁰ • Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family																																
IV. CERTIFICATION <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; font-size: 0.8em;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border-bottom: 1px solid black; font-size: 0.8em;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="height: 40px; vertical-align: middle; font-size: 1.2em;">20 May 1987 (20.05.87)</td> <td style="height: 40px; vertical-align: middle; font-size: 1.2em;">(02.06.87) 2 JUNE 1987</td> </tr> <tr> <td style="border-bottom: 1px solid black; font-size: 0.8em;">International Searching Authority</td> <td style="border-bottom: 1px solid black; font-size: 0.8em;">Signature of Authorized Officer</td> </tr> <tr> <td style="height: 40px; vertical-align: middle; font-size: 1.2em;">Australian Patent Office</td> <td style="height: 40px; vertical-align: middle; font-size: 1.2em;"> A.D. LISSAMAN </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	20 May 1987 (20.05.87)	(02.06.87) 2 JUNE 1987	International Searching Authority	Signature of Authorized Officer	Australian Patent Office	A.D. LISSAMAN																						
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Australian Patent Office	A.D. LISSAMAN																															

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A SU,A, 552046 (FORESTRY MECHN RES) 19 April 1977
(19.04.77) (Derwent English Language Abstract
P13 K6974Y/48)

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 87/00053

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Members			
DE	2213667	CA	975660	FR	2177018
		US	3931841	US	3937261
				US	3868980

END OF ANNEX