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(54) Title: TURF TREATMENT

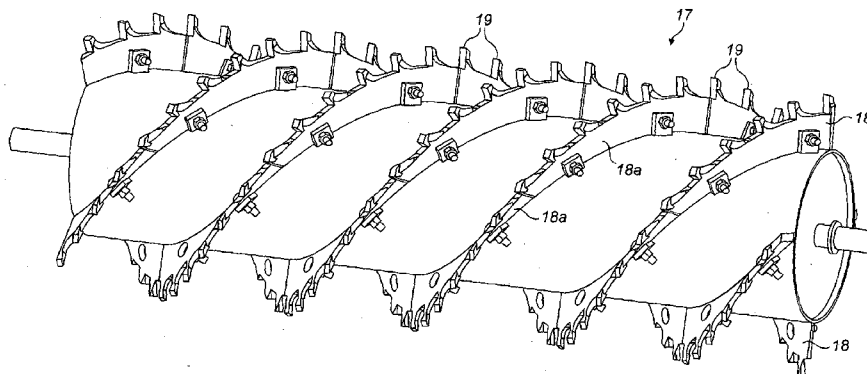


FIG. 4

(57) Abstract: A method for the treatment of turf (11) comprising grass (12) growing in a matrix (15, 16) comprising removing matrix (15, 16) including any thatch and other infestation by blading (18) moving through the matrix (15, 16) to a predetermined depth (d). The method may be used to treat turf (11) reinforced with artificial grass (13). Equipment for carrying out the treatment comprises a bladed rotor (17) rotating about a horizontal axis.



## Turf Treatment

This invention relates to turf treatment, more particularly to treatment of sports playing surfaces such as football, rugby and hockey pitches, and tennis courts which, during the course of a playing season, are subject to wear and tear and also suffer from a build-up of thatch, which is an accumulation of layers of partially decomposed leaves, stems and roots. Diseases and other blights including algae, moss, fungi, and slime mould can invade the turf, and may be made worse by the presence of thatch.

It is usually recommended that thatch be treated by mechanical thatching equipment, an operation usually referred to as scarification, but sometimes known as verticutting, although that term is also used for the process of cutting vertically into the turf using fine blades, sometimes known as turf grooming. It is recommended to carry out scarification in several treatments rather than attempting to remove all the thatch at once, but this is essentially because conventional scarifiers remove thatch in thin furrows, leaving 'ridges' of thatch between them, and so cannot remove all the thatch in one pass.

US6094860 discloses the use of artificial fibre reinforcement for grass turf areas in playing fields subject to heavy wear, and other patents and proprietary systems similarly involve the use of artificial fibre reinforcement.

"Desso® Grassmaster" is a turf reinforcement system in which artificial grass fibres are injected some 20cm deep into a grass surface, projecting some 25mm above the soil. The maintenance of this system, as regards mowing, verticutting and ventilating, is said to be no different from the maintenance of ordinary turf. Mowing, of course, must be carried out with the cutter height at or above the height of the artificial grass fibres, e.g. at 26mm or more if the fibre height is 25mm, otherwise they would be cut or pulled out.

The artificial grass fibres are injected into a matrix of sand, which of course has no nutritional value, and there is only a thin top layer of humus, if indeed any, so the natural grass needs to be treated with fertiliser more than it would if grown in deep soil. This exacerbates problems of disease and infestation, bearing in mind that about 97% of the turf is natural grass. The sand also, over the course of a playing season, compacts more than does the usual substrate of natural, unreinforced turf.

On this, or indeed any, turf, moreover, undesired grasses and weeds such as clover can be a problem. Clover is especially problematic on playing surfaces such as tennis courts, as it tends to be slippery. Weeds are usually treated with systemic herbicides, which take time to act and which may require several treatments over a space of weeks.

The present invention provides an improved method and apparatus for treating turf, including artificial grass-reinforced turf planted in a matrix of sand and/or soil.

The invention comprises a method for the treatment of turf comprising grass growing in a matrix comprising removing matrix including any thatch and other infestation by blading moving through the matrix to a predetermined depth  $d$ .

The depth  $d$  may be determined by sampling the matrix to establish the depth to which it needs to be removed. It may, of course, be estimated on the basis of a greenkeeper's knowledge and experience. If the matrix is badly infected it may be removed to such a depth that all the grass growing in it is removed, so that fresh sand or other matrix material may be applied and the area reseeded. However, it may be sufficient, if the infection has not penetrated too deeply, to remove thatch and matrix down

to a depth above that at which grass roots are found which may then regenerate without the need to reseed.

In some methods for reinforcing turf, artificial grass fibres are attached to a backing buried beneath the surface. US5489317 discloses a permanent backing; US6094860 discloses a biodegradable  
5 backing that may, however, remain *in situ* for two years or more. It will, of course, be important with such systems to ensure that the depth  $d$  is less than the depth at which the backing would be disturbed.

The thatch, grass and matrix may be lifted by a rotor rotated about a horizontal axis with teeth that may be extended below surface level. The blading may be angled with respect to the rotor axis so that there is no or substantially no part of the length of the rotor that does not have blading at some part of  
10 its circumference, and the rotor is rotated at such speed, relative to the rate of traverse over the turf, that no or substantially no part of the turf is left untreated. The blading, and particularly the teeth, may be of some substantial thickness, e.g. 5 - 10 mm. The rotor may be rotated so that the blading moves forwardly through the matrix. The blading may be in the form of hooked teeth, with the hooks facing in the direction of travel.

15 Treatment by such a rotor, whilst it may appear drastic, leaves the matrix level and raked and in a state where it can be instantly re-seeded, possibly with the addition of fresh sand and/or soil.

While it may be surprising that such a rotor can be used to such effect on natural turf, it is even more surprising that it can be done on Desso Grassmaster® and other reinforced turf systems without adversely affecting the artificial grass fibres.

20 Even the regular substrate of natural turf can, after heavy use, such as a tennis court after a tournament, can become compacted. The blading may be made robust enough to cut through such compacted substrate. Compacted sand, of course, will need such robustness and will have a more abrasive effect. The blading may be made wear-resistant as by being tipped with tungsten carbide or another carbide or other wear-resistant material. Blading so tipped can survive treating an area the  
25 size of a football pitch in one or even two passes without noticeable wear, so that the treatment is essentially uniform throughout without the need to change or dress blading during the treatment.

The invention also comprises equipment adapted for the treatment of turf reinforced with artificial grass fibres in a sand or other matrix by removing matrix to a depth  $d$  below the matrix level, comprising a horizontal rotor having blading having peripherally distributed teeth at least of length  $d$ ,  
30 and drive means to traverse and rotate the rotor over the turf, characterised by blade height control means adapted to deploy the teeth up to a depth  $d$  below the matrix level.

The blades may exhibit a saw tooth profile. The teeth may be inclined to the direction of motion, and so dimensioned that there is no, or substantially no, part of the length of the rotor that does not have a  
35 tooth at some part of its circumference. The teeth may be sufficiently narrow, however, that the anchored artificial turf is simply deflected by passage of the teeth, and then springs back, without being removed or damaged. The blades may have tips reinforced against wear with, for example, tungsten or other carbide, and may be hooked.

A typical thickness for the blade is 10mm, but thicknesses of between 5 and 15mm will be found satisfactory. The teeth may be the same thickness as the blading and may be fashioned as if from a  
40 solid blade by removal of U-shaped portions and then twisting the tooth formations left thereby so that the leading edge of the blade is parallel to the rotor axis when mounted thereon, which means it will be square to the direction of its motion through the ground.

5 A rotor having a diameter of, say, 500mm, with helical blading, may have twenty-four teeth on one complete turn of the helix, and may have four helices. A typical rotational speed for such a rotor would be 1000 rpm. Driving the rotor so that the blades move forward through the turf, the blade linear speed through the turf is about 25 metres per second plus, of course, the forward speed of the tractor, which, however, will be only of the order of one metre per second. As the blade advances one metre through the turf, the rotor will rotate some seventeen times, so one metre length of turf of blade width will be subject to the attentions effectively of four times seventeen teeth, or sixty eight teeth, or a blade will dig into the turf every three millimetres, effectively removing all the material intended to be removed.

10 A rotor such as this can remove all material to the desired depth in a single pass, or at most two passes.

15 The helical blade arrangement will push removed material to one side. A helical blade, rotated so that its ground engaging teeth move forward in the direction of tractor travel, will push the material to the driver's right or left, depending on the 'hand' of the helix. A conveyor can be mounted adjacent the end of the rotor towards which the material is pushed to accept the material and elevate it into a companion trailer, drawn by another tractor keeping station with the rotor.

20 An auger-type grass mower is known from EP0974225, which has a similar arrangement of blade for free cutting of grass, which is to say, cutting using the blades as knives, as opposed to cutting against a fixed blade, scissor-fashion. For this purpose the blade is set to the desired height of cut and, if used on turf containing reinforcing artificial grass fibre, would be set to cut just above the height of the artificial grass fibres. The blades also have to rotate quickly, in order to cut the grass, rather than just bend it out of the way. The teeth of that mower are set to the side by bending the blades by approximately the thickness of the metal from which they are made, and the three front edges of the teeth act as cutting edges. They are said to have advantages over another free cutting blade arrangement in EP0328080 in that they further reduce the size of the clippings. By contrast, the teeth of the equipment of the present invention are not configured to cut grass, whether artificial or natural, but to lift thatch, matrix and natural grass from the turf, leaving artificial grass, if present, *in situ*.

The rotor may have double, triple or more helix blading. As in EP0974255, the blade may be made in segments for ease of construction and repair. Four segments can make up a complete turn of the helix

30 A rotor may be made adaptable to different conditions by blading being readily removable and replaceable, so that it can have different densities of teeth. If so, then it would be desirable to have an even number of helices, say four, so that two could be removed, leaving two, so as not to unbalance the rotor.

35 The rotor may be mounted on a chassis adapted for mounting on or towing behind a tractor unit especially one of the kind used for turf treatment and comprising an arrangement for rotating the rotor. The chassis or tractor unit may carry blade height setting means, as well as a transmission to drive the rotor in rotation. The rotor may be associated with a collector for material lifted by the blading.

40 A method for treating turf, and one embodiment of turf treatment equipment according to the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a cross section of turf;

- Figure 2 is a cross section of artificial-grass reinforced turf;  
Figure 3 is an end-on view of a rotor adapted to carry out the method of the invention;  
Figure 4 is a front view of the rotor of Figure 3;  
Figure 5 is a close-up view of a tooth of blading of the rotor of Figure 3, and  
5 Figure 6 is a rear view of a rotor in use.

The drawings illustrate a method for the treatment of turf 11, Figure 1, comprising natural grass 12, sown, particularly in sports surfaces such as tennis courts and football and rugby pitches, in a matrix 15 of sand, silt and clay. The grass roots 12a are connected by rhizomes 12b. Over time and as a result of mowing and wear, the turf acquires an accumulation of dead grass known as 'thatch', and can  
10 also become infested with algae, moss, fungi, slime mould and other problems.

Figure 2 illustrates turf 11 like that shown in Figure 1, which is reinforced with artificial grass fibres 13 which extend a given height  $h$  above turf level 14, typically 25mm. This is usually sown in a matrix 15a of sand with just a thin upper layer 16 of humus, and can be more at risk of infestation through needing to be more heavily fertilised.

15 The artificial grass fibres 13 are injected a depth  $D$ , usually some 20 cm deep, through the humus 16 into the sand 15a.

An infected layer is shown in Figures 1 and 2 by the bracket B.

The treatment method comprises lifting thatch, natural grass 12 and matrix 15, 16 with a horizontal rotor 17, Figures 3, 4, 5, traversed and rotated over the turf 11 and having helical blades 18 having  
20 teeth 19, in which the teeth 19 extend a depth  $d$  below the turf level 14, so that the blades move through the turf 11 pulling out thatch, natural grass 12 and matrix material.

Usually, a treatment to a depth  $d$  at which at least some natural grass, roots, crowns, rhizomes, perhaps some culm, is left in the matrix will suffice, and the grass will grow back. However, when the matrix is badly infected with algae, all the natural grass may be removed by driving the blading  
25 sufficiently deep, and new matrix laid down and reseeded. So long as, when treating reinforced turf, the depth  $d$  is less than the depth of any backing such as disclosed in US5489317 or US6094860, and, in particular with the Desso Grassmaster® system, which does not have a backing, the depth to which the artificial fibres are injected, any artificial grass will remain in place.

30 The teeth 19 extend below turf level 14, and may have a length  $l$  of 50mm or more. The teeth 19 are on blade segments 18a that are bolted to the rotor 17. The blade segments 18a are fashioned from steel or like hard, rigid and wear resistant material, typically 10mm thick.

The depth  $d$  to which the teeth 19 are required to penetrate may be determined by core sampling the matrix, or estimated by the skilled greenkeeper from knowledge and experience.

35 The rotor 17 is mounted on a tractor 41, Figure 6, carrying the rotor 17 in a chassis 42 with a ground roller 43 and a blade height control arrangement 44 adapted to deploy the teeth 19 below turf level 14. The tractor 41 is driven to traverse the rotor 17 over the turf so deployed and has a power take-off transmission 45 to rotate the rotor 17 so that the blades 19 move through the turf 11 pulling out thatch, natural grass 12 and matrix material, soil and/or sand. The rotor is driven so that the hooks 19 drive into the turf as it moves forward. The material lifted from the turf is driven to the right of the tractor

41 by the action of the helical blading and is lifted on an elevator 45 into a trailer 46 drawn behind a second tractor 47.

The height control arrangement 44 is adapted to extend the blades 19 as deep as may be desired into the soil 16.

- 5 The blades 18 have a saw tooth profile, with the saw teeth 19 inclined to the direction of motion, the teeth being so dimensioned that the anchored artificial turf is deflected by passage of the tooth, and then springs back, without being removed or damaged. The teeth 19 have tips 19a reinforced against wear with, for example, tungsten or other carbide, and are hooked in shape. The tips 19a are configured to be square on to the direction (arrow A, Figure 5) at which the tips enter the turf. Teeth  
10 19 are typically 35mm from tip to root ('l' in Figure 5).

- There may be any number of helical blades 18; four are illustrated in Figure 4. There may be three, for example, but if there are four, two of them may be removed to reconfigure the rotor without unbalancing it. Such reconfiguration may be desirable to give more or less intensive treatment, or, for example, to leave furrows in the surface into which treatment media may be introduced, such as  
15 disinfectant, weed treatment, fertiliser and so forth, before backfilling with fresh matrix and perhaps reseeding.

- Treatment can, as described, be carried out using equipment attached as an implement on tractors conventionally used for turf treatment, yet can selectively remove the top surface of turf evenly, ready  
20 for resurfacing without requiring the use of heavy ploughs and graders. A rotor as described can treat a football pitch, with one or at most two passes, in a single day, leaving the surface ready for reseeding.

## Claims:

- 1 A method for the treatment of turf comprising grass growing in a matrix, comprising removing matrix including any thatch and other infestation by blading moving through the matrix to a predetermined depth  $d$ .
- 5 2 A method according to claim 1, in which the depth  $d$  is determined by sampling the matrix.
- 3 A method according to claim 1, in which the depth  $d$  is such that all the grass growing in it is removed.
- 4 A method according to claim 3, in which fresh sand or other matrix material is applied after removal and the area reseeded.
- 10 5 A method according to claim 1 or claim 2, in which thatch and matrix are removed to a depth above that at which grass roots are found,
- 6 A method according to any one of claims 1 to 5, used on turf reinforced with artificial grass, in which natural grass, thatch and/or other infestation is removed without affecting the artificial grass reinforcement.
- 15 7 A method according to any one of claims 1 to 6, in which the thatch, grass and matrix are lifted by a rotor rotated about a horizontal axis with blading with teeth that may be extended below surface level.
- 8 A method according to claim 7, in which the blading is angled with respect to the rotor axis so that there is no or substantially no part of the length of the rotor that does not have blading at some part of its circumference.
- 20 9 A method according to claim 7 or claim 8, in which the rotor is rotated at such speed, relative to the rate of traverse over the turf, that no or substantially no part of the turf is left untreated.
- 10 A method according to any one of claims 7 to 10, in which the blading, and particularly the teeth, are of some substantial thickness, e.g. 5 - 15 mm, typically 10 mm.
- 25 11 A method according to any one of claims 6 to 10, in which the rotor is rotated so that the blading moves forwardly through the matrix.
- 12 A method according to any one of claims 6 to 11, in which the blading is in the form of hooked teeth, with the hooks facing in the direction of travel.
- 30 13 Equipment adapted for the treatment of turf, including turf reinforced with artificial grass fibres, in a sand or other matrix by removing matrix to a depth  $d$  below the matrix level, comprising a horizontal rotor having blading having peripherally distributed teeth at least of length  $d$ , and drive means to traverse and rotate the rotor over the turf, characterised by blade height control means adapted to deploy the teeth to a depth  $d$  below the matrix level.
- 14 Equipment according to claim 13, in which the blades exhibit a saw tooth profile.
- 35 15 Equipment according to claim 13 or claim 14, in which the teeth are inclined to the direction of motion, and so dimensioned that there is no, or substantially no, part of the length of the rotor that does not have a tooth at some part of its circumference.

- 16 Equipment according to any one of claims 13 to 15, in which the teeth are sufficiently narrow that any anchored artificial turf is simply deflected by passage of the teeth, and then springs back without being removed or damaged.
- 5 17 Equipment according to any one of claims 13 to 16, in which the blades have tips reinforced against wear with, for example, tungsten or other carbide.
- 18 Equipment according to any one of claims 13 to 17, in which the blades are hooked.
- 19 Equipment according to any one of claims 13 to 18, in which the rotor has double, triple or more helix blading.
- 10 20 Equipment according to any one of claims 13 to 19, in which the blade is made in segments for ease of construction and repair.
- 21 Equipment according to any one of claims 13 to 20, in which the rotor is made adaptable to different conditions by blading being readily removable and replaceable.
- 22 Equipment according to claim 19, in which the rotor has an even number of helical blades that can be removed in pairs so as not to unbalance the rotor
- 15 23 Equipment according to claim 20, in which the rotor has provision for four helical blades.

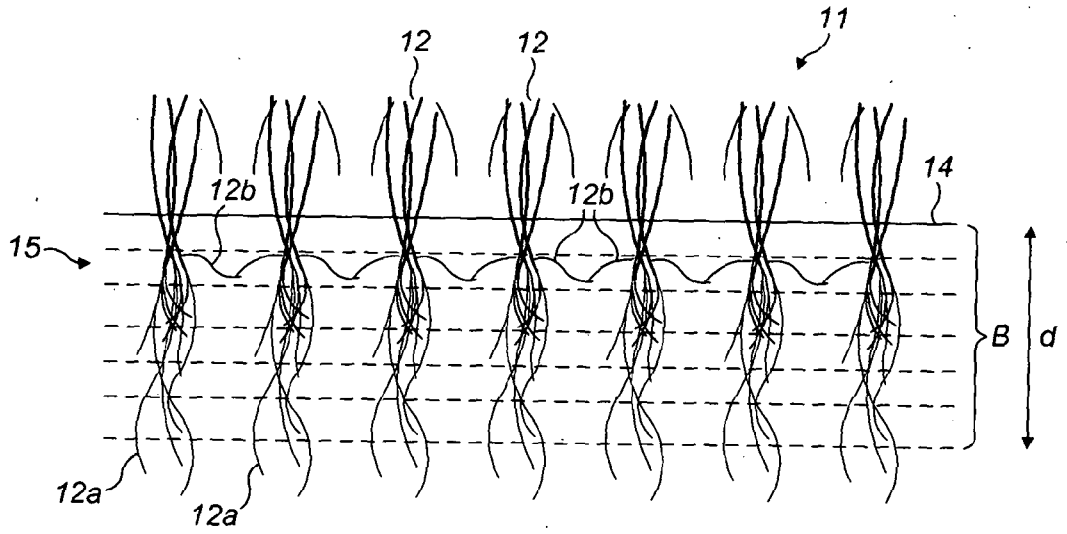


FIG. 1

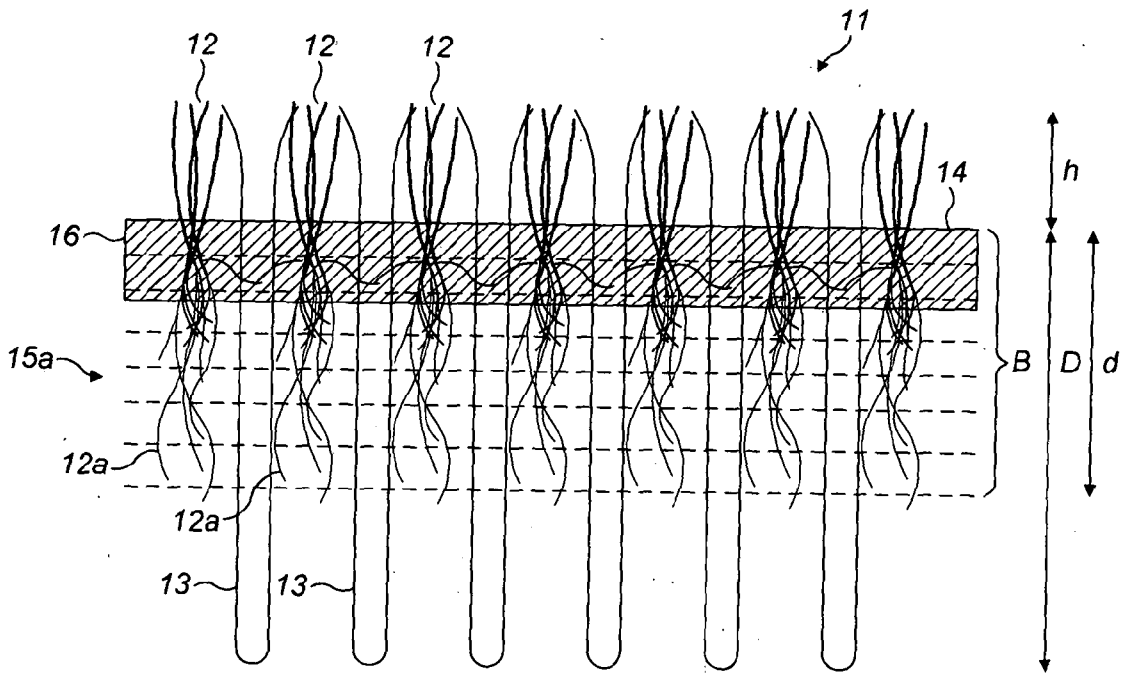


FIG. 2

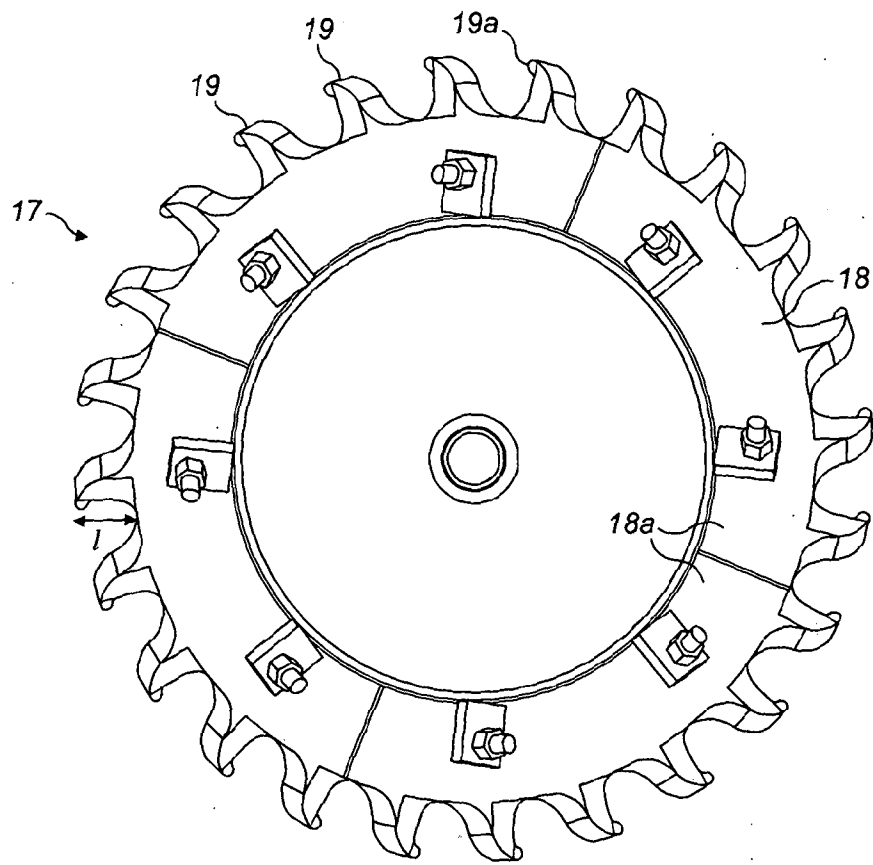


FIG. 3

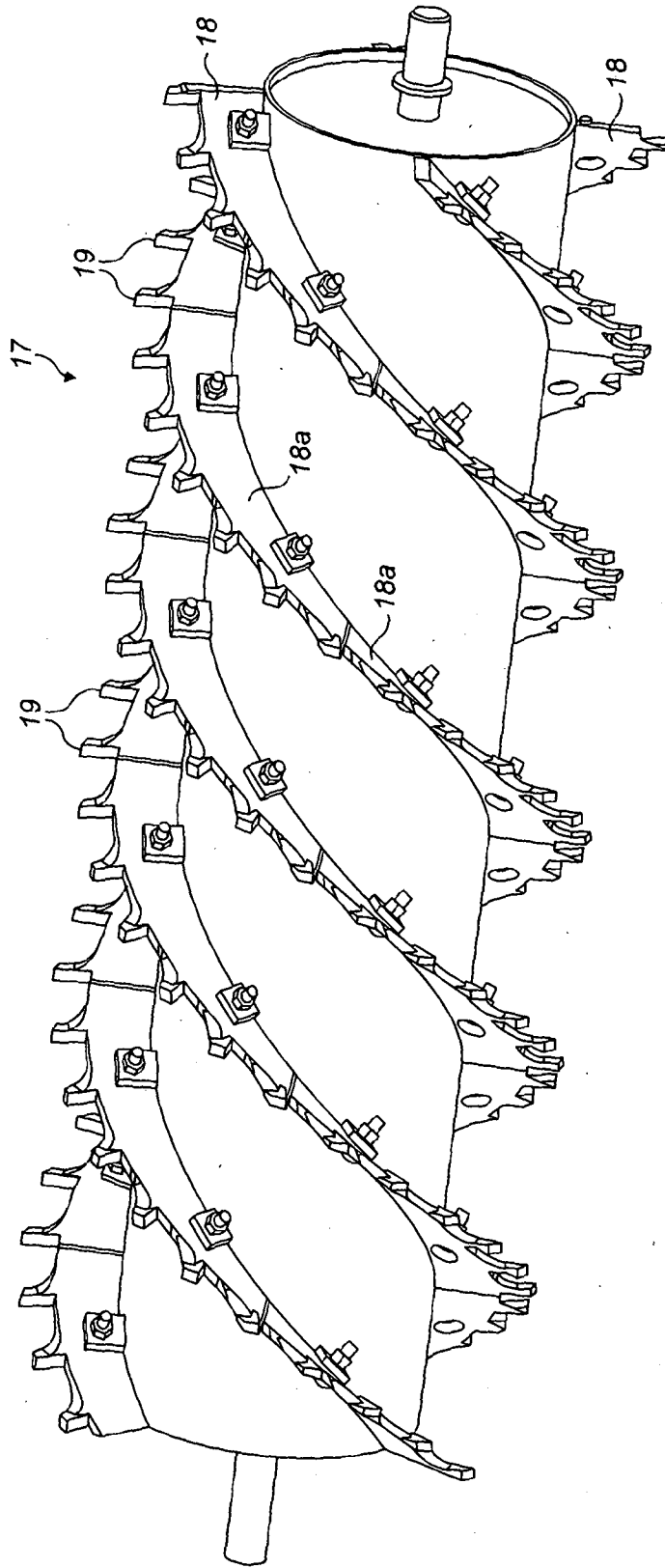


FIG. 4

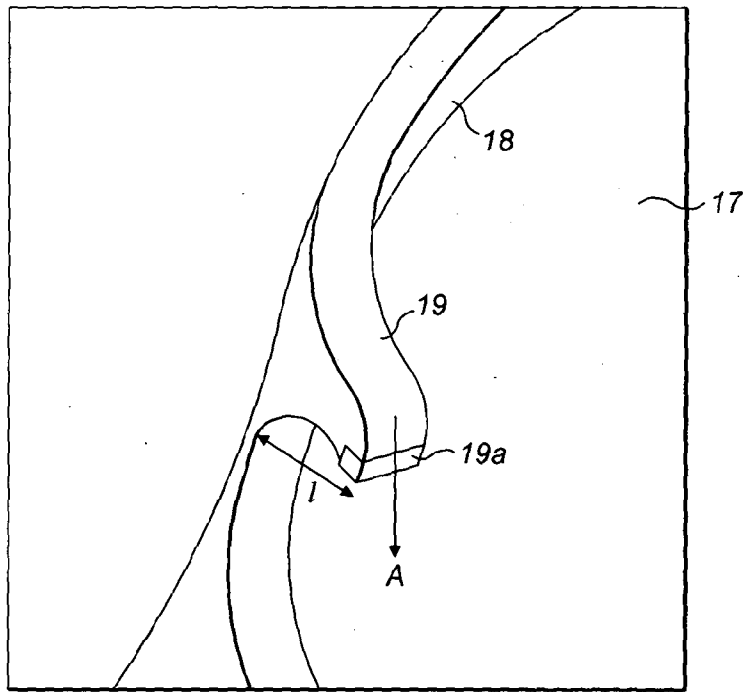


FIG. 5

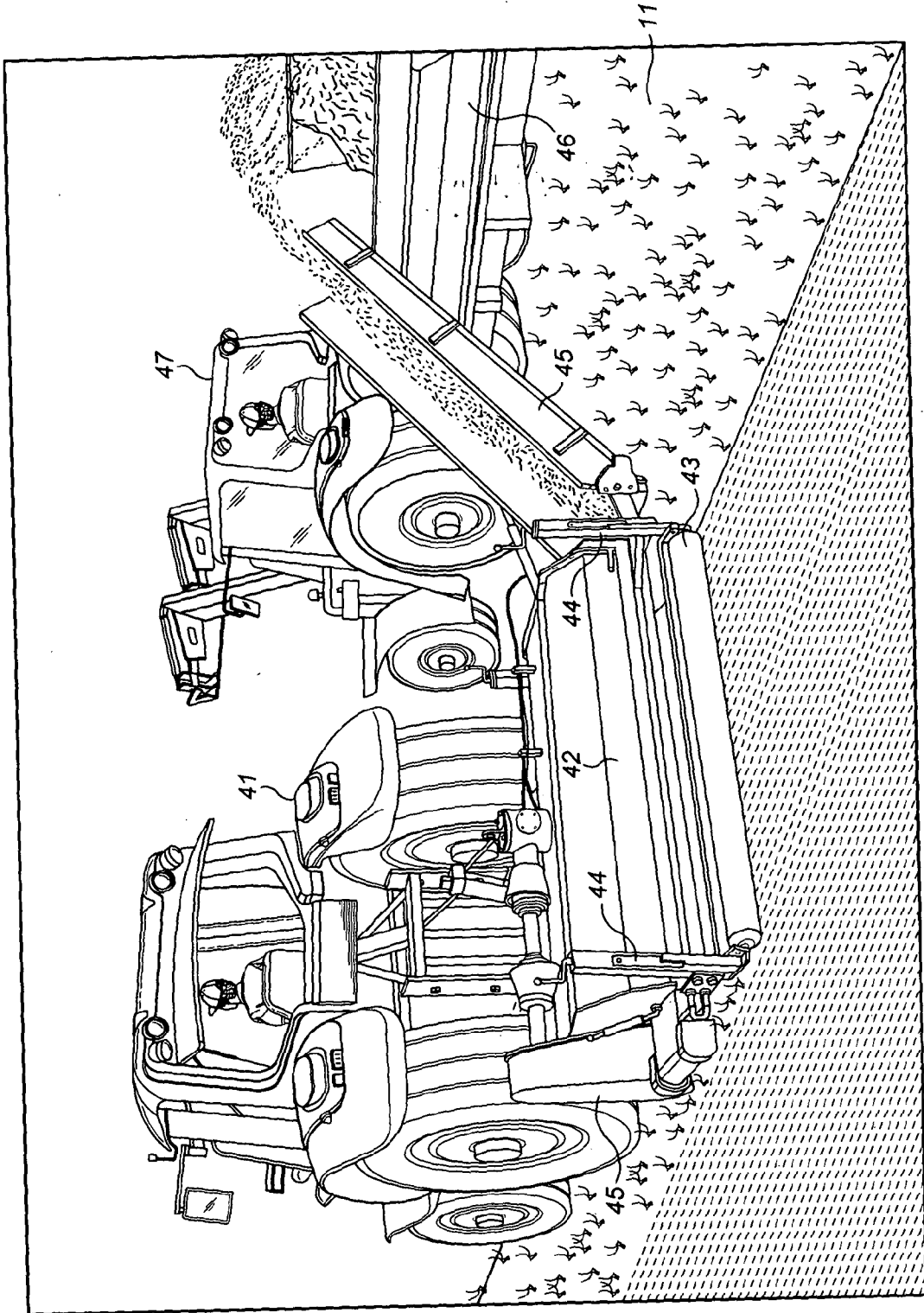


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2012/000678

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A01B45/00 A01B45/02  
ADD.  
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
Minimum documentation searched (classification system followed by classification symbols)  
A01B A01D  
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/076768 A1 (GRADEN IND PTY LTD [AU]; DRYDEN GRAHAM [AU]) 27 July 2006 (2006-07-27) abstract page 1, line 10 - line 18 page 5, line 7 - line 27 claims; figures	1-23
X	DE 195 19 365 C1 (SABO MASCHINENFABRIK GMBH [DE]) 18 July 1996 (1996-07-18) abstract column 3, line 61 - line 67 column 4, line 1 - line 41 claims; figures	1-3,5, 7-21,23
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Further documents are listed in the continuation of Box C.

See patent family annex.

\* 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 application or patent 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 when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search  29 November 2012	Date of mailing of the international search report  10/12/2012
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Oltra García, R
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## INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2012/000678

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 583 005 B3 (WINSTON SUTTLE) 13 June 1989 (1989-06-13)  page 3, line 23 - line 26 page 4, line 1 - line 18 page 7, line 14 - line 26 claims; figures -----	1-3,6,7, 9-11,13, 14,16, 17,19-23
X	AU 412 721 B2 (NORMAN CLIFFORD INGS) 28 April 1971 (1971-04-28)  page 3, paragraph 2 claims; figures -----	1,2,5-7, 9,10,13, 14,16, 17,19-23

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2012/000678

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006076768	A1	27-07-2006	
		GB 2435796 A	05-09-2007
		US 2008229987 A1	25-09-2008
		WO 2006076768 A1	27-07-2006
-----			
DE 19519365	C1	18-07-1996	
		DE 19519365 C1	18-07-1996
		FR 2734449 A1	29-11-1996
		GB 2301012 A	27-11-1996
		NL 1002883 A1	27-11-1996
		NL 1002883 C2	09-10-1997
-----			
AU 583005	B3	13-06-1989	NONE
-----			
AU 412721	B2	28-04-1971	
		AU 412721 B2	28-04-1971
		AU 5750865 A	17-08-1967
-----			