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(71) Applicants
Deere & Company, Moline, Illinois 61625, United States of America
(72) Inventors
Robert Eugene Fox
Wendell Dale Reece
(74) Agents
Reddie & Grose

(54) **Cutter wheel for a tillage implement**

(57) The cutter wheel 12 is employed to cut furrows in grassland. The cutter wheel includes a central disc portion 50 with an outer periphery defining a plurality of equally spaced slots, each receiving a tip-holding insert 68. A bullet-shaped tungsten carbide tip 70 is hard soldered or brazed to the tip-holder and the holder 68 is welded to the disc 50. The disc periphery 62 is shaped to allow cutting clearance for the tip, protect the tip from breaking off, and at the same time provide rear support for the tip-holder. The angle at which the tip 70 is connected to the holder 68 is so chosen that the brazed or soldered joint is loaded primarily in compression as the wheel cuts through the soil.

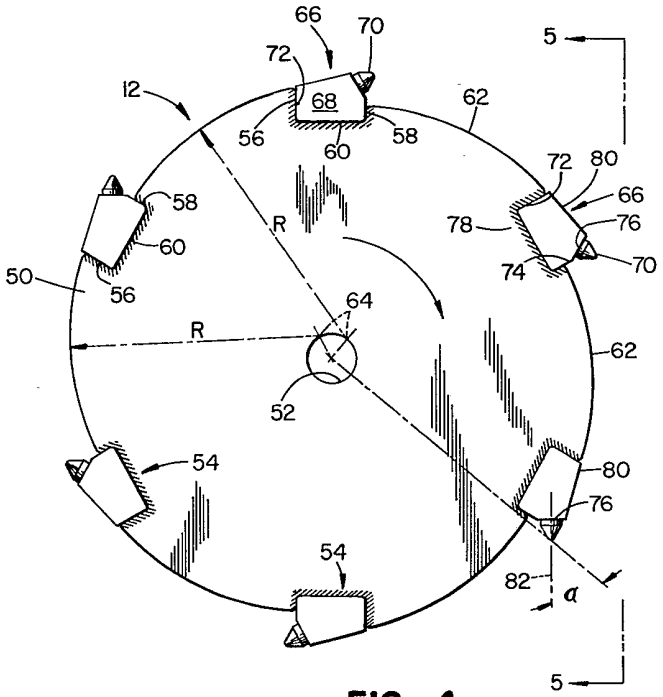

FIG. 4

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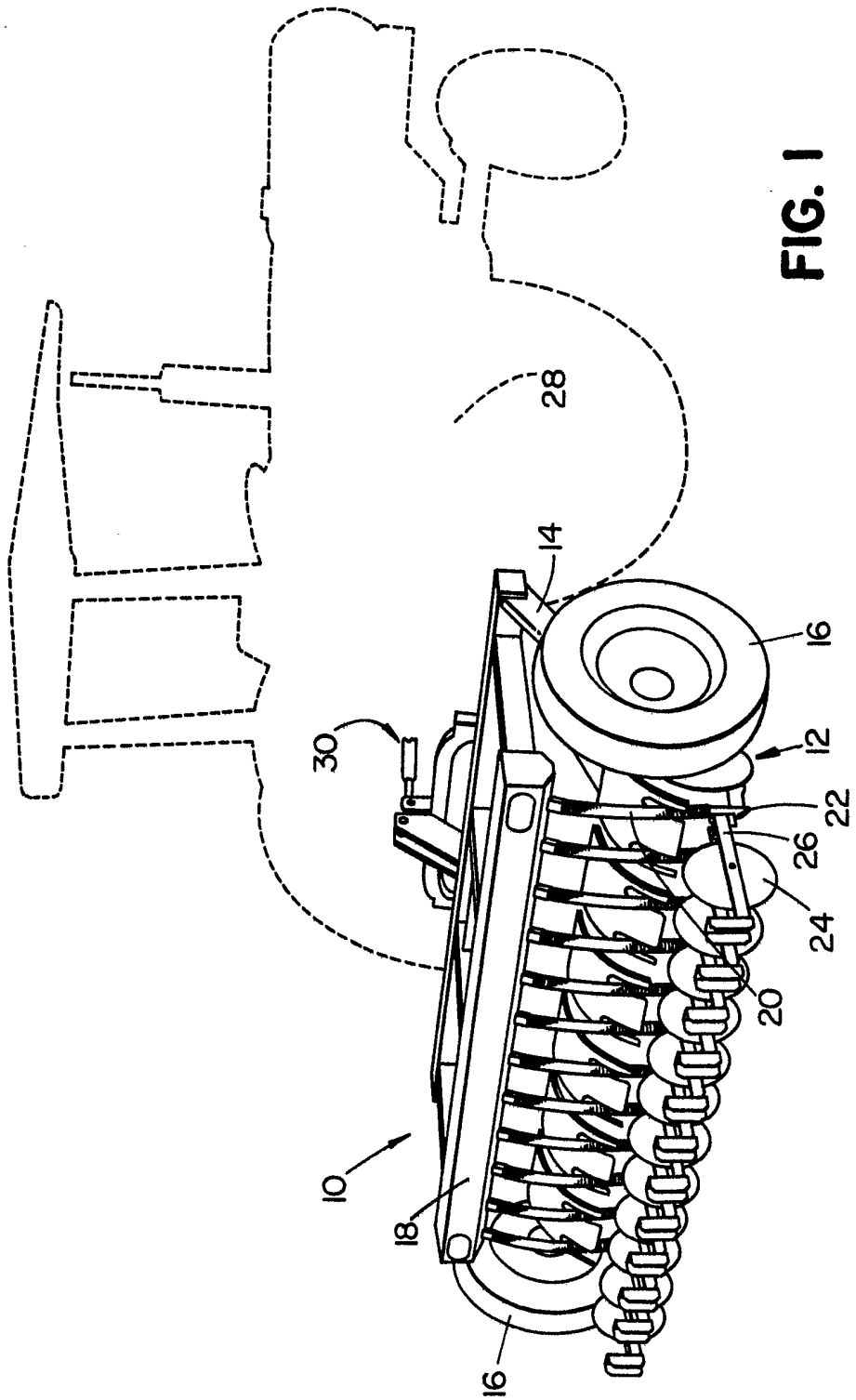

FIG. 1

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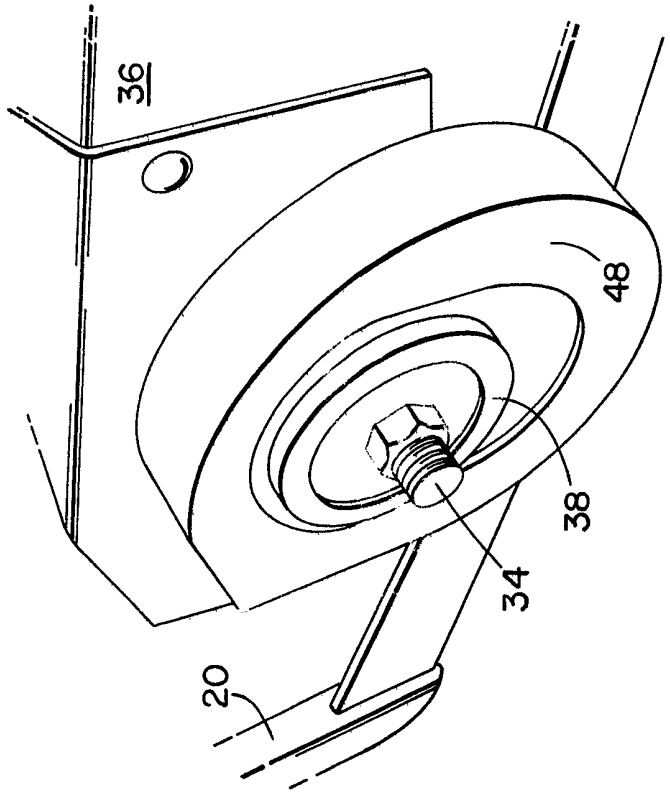

FIG. 3

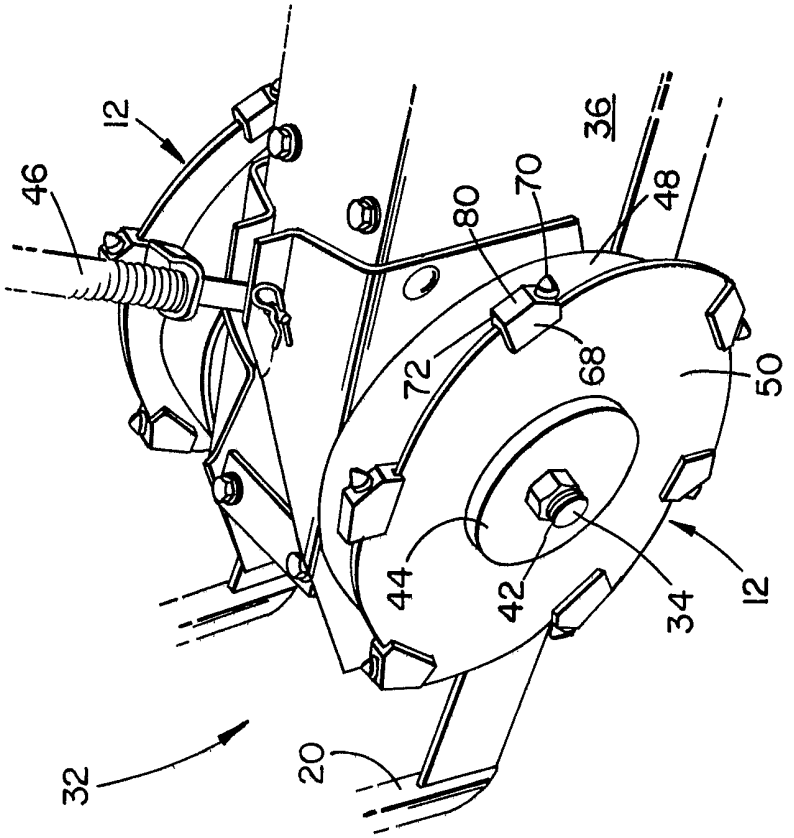

FIG. 2

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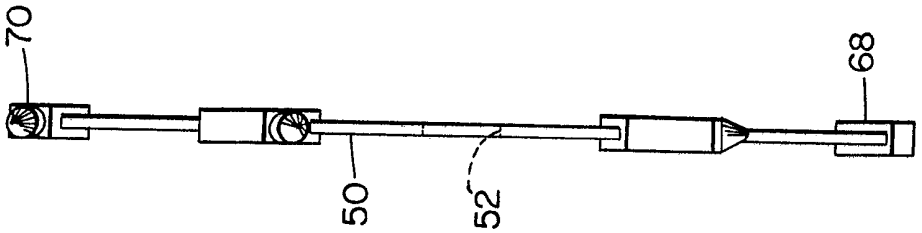

FIG. 5

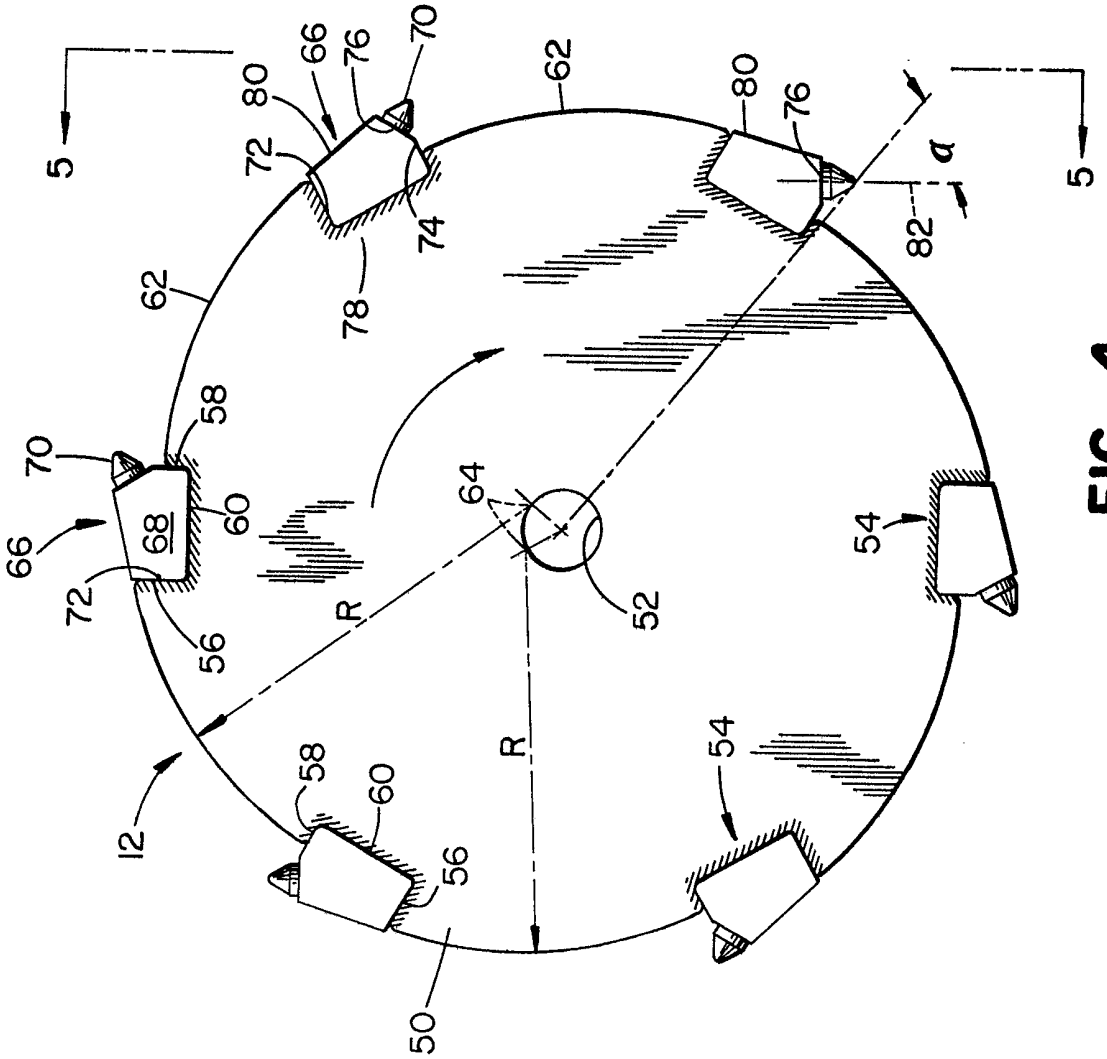

FIG. 4

SPECIFICATION

Cutter wheel for a tillage implement

The present invention relates to a cutter wheel for a tillage implement.

Conventional tillage implements such as the disc harrow, disc cultivator and rotating hoe are not completely suitable for preparing ground for seeding where legumes are to be grown in established grassland.

In order to provide a tillage implement better suited for preparing ground for seeding or grassland renovation where turf is present, towed implements having a series of cutting wheels driven to open a furrow have been developed. Devices of this type are shown, for example, in U.S. patent specifications 4,023,510; 4,043,281; 4,043,404 and 4,051,792. This type of tillage implement is particularly useful where legumes are to be grown in established grass, especially since the ground surface is often uneven or stony and may have grass swards of differing thicknesses thereon. The implement is also useful for interseeding grasses such as rye and wheat into Bermuda grass.

Cutting of the sward and turf mat and provision of a furrow therein has been a continuing problem. Although various cutter wheels have been known and suggested, they have not been completely satisfactory. Wearing of the cutter wheels is a common problem because the wheels are driven in the soil. Additionally the rough, stony terrain often encountered adds to the problem of wear and breakage.

The invention provides an improved cutter wheel for use with a tillage implement.

According to the present invention there is provided a cutter wheel for a tillage implement comprising a disc whose outer periphery is made of sections which are radially set back from their leading to their trailing ends in relation to a predetermined sense of rotation, inclined tip-receiving surfaces, which are inclined rearwardly and outwardly relative to a radial direction, at the leading ends of the said sections, and hardened tip members fixed to the said surfaces by joints which are loaded predominantly in compression when the wheel is rotated in the said sense to cut a furrow in the soil.

The invention will be described in more detail, by way of example, with reference to the accompanying drawings, wherein:–

Fig. 1 is a perspective view of a tillage implement having cutter wheels mounted thereon;

Fig. 2 is a perspective view of a portion of the implement shown in Fig. 1 to illustrate two cutter wheels on a mounting unit;

Fig. 3 is a perspective view of the drive structure for a cutter wheel showing a friction drive and threaded driveshaft upon which the cutter wheel is mounted;

Fig. 4 is a side elevational view of the preferred embodiment of the cutter wheel; and

Fig. 5 is an edge view of the cutter wheel shown in Fig. 4.

As shown in Fig. 1, a tillage implement 10 carries a row of cutter wheels 12 and includes a frame 14 on gauge wheels 16. The frame 14 carries a seed box 18. Seed tubes 20 lead from seed gates below the box 18 to seed delivery tubes 22. Trailing each tube 22 is a press wheel 24 carried by an arm 26. The implement 10 is connected to a tractor 28 by a conventional three-point hitch 30.

As shown in Fig. 2, the cutter wheels 12 are mounted in pairs on supports 32. A drive shaft 34 is supported by a casing 36 pivotally connected to a transverse rod (not shown) near the front of the frame 14. The drive shaft 34 is driven by a drive chain and sprocket located within the casing 36. The chain and sprocket is powered in a conventional manner through shafts and a gear box from the tractor power take-off shaft. A friction hub 38 (Fig. 3) is preferably mounted on the shaft 34 for rotation therewith. A nut 40 threaded on the threaded end of shaft 34 secures the cutter wheel 12 between a hub 44 and the friction hub 38 for rotation with the shaft 34.

Each support 32 is biased downwardly by a down pressure spring 46. Depth skids maintain the cutter wheels 12 at the proper cutting depth and are adjustable up or down to set the depth for various seed and soil conditions.

A more detailed discussion of the foregoing structure and a general description of operation of the implement may be found, for example, in U.S. patent specifications 4,043,404; 4,043,281 and 4,023,510. An alternative skid arrangement is shown in U.S. patent specification 4,051,792.

The cutter wheel 12, as seen in Figs. 4 and 5, includes a disc-like main body 50 with a central shaft hole 52. The body 50 includes a plurality of insert receiving slots 54 equally spaced about the periphery. Each slot is defined by a rear wall 56 facing generally in the direction of rotation, an opposed forward wall 58, and a generally flat bottom section 60. The bottom section 60 is approximately perpendicular to a line extending radially from the centre of the body through the midpoint of the section 60.

Between consecutive slots 54 are arcuate sections 62, each with the same radius of curvature R but having different centres 64 of their radii of curvature. The centres are equispaced about the hole 52, as can be seen in Fig. 4. The trailing part of each arcuate section 62 is thus set back radially relative to the leading part and this provides the slots 54 with rear walls 56 of greater depth than the forward walls 58. In the preferred embodiment, six slots 54 are provided, equally spaced about the periphery.

Each slot 54 receives a cutter-tip assembly 66 made up of an insert 68 and a cutting tip 70. The lower portion of the insert 68 conforms to the shape of the slot 54 to fit snugly therein. The rear portion 72 of the insert is equal in depth to the rear wall 56. The front portion 74 of the insert is greater in depth than forward wall 58 and includes a somewhat beveled tip-receiving face 76 inclined back from the plane of the front portion 74. The cutting tip 70, preferably bullet- or cone-shaped and fashioned from a hard material such as tungsten carbide, is brazed or silver soldered to the face of 76. The cutter-tip assembly 66 is positioned in the slot 54 and secured to the main body 50, for example, by welding the insert 68 along the bottom and walls of the slot as indicated at 78.

When the assembly 66 is connected to the body 50, the top 80 of the insert 68 is generally aligned with the following arcuate section 62 and extends that contour in a straight line to the tip-receiving face 76. The point of the tip 70 extends forwardly in the direction of rotation beyond the plane of the front portion 74 and above the trailing end of the next arcuate section 62. As is evident from Fig. 4, the shape of the disc 50 allows cutting clearance for the tip 70 while providing substantial back support for the insert 68 along the rear wall 56 of the slot 54. The disc and insert configuration provides better protection for the tips 70 against obstacles than a conventional deep gullet configuration. Using deep gullets, the tips 70 were found to break off more easily than in the above configuration wherein the outer diameter of the disc 50 tends to hit the obstacle before the tip contacts it.

The angle of the face 76 and the direction in which the tip 70 points, indicated by line 82, are so chosen that the brazed or soldered connection between the insert 68 and the tip is loaded primarily in compression to reduce the possibility of breaking the connection. In the preferred embodiment, the angle α between the axis 82 of the tip 70 and a line extending radially from the centre of the disc 50 through the point of the tip is considerably greater than 0° but less than 90°. If the angle α is too small, the tip 70 will be wrenched radially outwardly as it contacts the soil. On the other hand, if α is too large, the apex of the tip 70 will be urged radially inwardly upon contact with the soil.

As seen in Fig. 5, the width of the base of tip 70 is approximately equal to the width of the insert 68. The tip 70 can have various shapes, such as conical, pyramidal, or wedge, and preferably terminates in an apex extending generally in the direction of rotation. A satisfactory furrow can be cut using a tip base width of approximately 16 mm. The disc 50 is formed from a sheet of metal, typically 6 mm thick, and each cutter-tip assembly 66 is located in its corresponding slot 54 so that it projects equally either side of the disc. Alternatively, the inserts can be offset with respect to the disc, alternately one way and the other, to increase the width of the furrow cut by cutter wheel 12 for a given width of tip 70. The inserts 68 can be made wider or narrower than the tip width as long as they provide adequate support for the tip. If the inserts are wider, the relatively soft material quickly wears and tapers to conform to the width of hardened tip 70. In another embodiment, the disc 50 can be formed directly with tip-receiving portions to eliminate the inserts 68. The entire wheel can be cast or fashioned from sheet metal and the tips 70 connected at the proper angle on the tip-receiving portions by a suitable method such as soldering or brazing.

In a working embodiment of the present invention, a 30 cm cutter wheel is provided with each arcuate section 62 having a radius of curvature R equal to about 13 cm. The centre of each radius R is located on the periphery of a 25 mm hole 64. Each insert 68 is about 16 mm wide and is welded to a 6 mm thick disc 50. Six inserts are equally spaced about the periphery of the disc. Each tip-receiving face 76 is inclined back at approximately 25° from the front portion 74 of the insert 68. A bullet-shaped tungsten carbide tip 70 is brazed to each face 76 with the angle α being approximately (± 10%) 53°. With the above configuration, the tip connections are loaded primarily in compression as the cutter wheel cuts a furrow. When an obstacle such as a stone is encountered, it is contacted by the outer periphery of the disc 50 before the tip 70 reaches it, thus protecting the tip. The incidence of tip breakage is greatly reduced by using the above configuration rather than, for example, providing a deep gullet forward of the tip.

In operation, the cutter wheels are lowered to contact the ground and are rotated at a relatively high speed, preferably about 630 rpm. The tips 70 dig into the ground to cut a furrow therein, the maximum depth of which is determined by the setting of the depth skids 48 and is generally between 12 mm and 65 mm. The furrow cut has a width approximately equal to or slightly wider than the width of the cutting tip 70. Seed is deposited in the furrow from the seed tube 20 and packed at the bottom of the furrow by the press wheel 24.

The hardened tips 70 provide long lasting cutting teeth. The shape of the disc 50 provides cutting clearance for the tips 70 while protecting them from obstacles and providing backing for the inserts 68 when used. By properly positioning the tips 70 with respect to the rotating disc 50, the joints between the tips and the inserts or disc are loaded primarily in compression during the tilling operation further reducing connection fatigue which would result in the breaking off of the tips.

CLAIMS

1. A cutter wheel for a tillage implement comprising a disc whose outer periphery is made up of sections which are radially set back from their leading to their trailing ends in relation to a predetermined sense of rotation, inclined tip-receiving surfaces, which are inclined rearwardly and outwardly relative to a radial direction, at the leading ends of the said sections, and hardened tip members fixed to the said surfaces by joints which are loaded predominantly in compression when the wheel is rotated in the said sense to cut a furrow in the soil.

2. A cutter wheel according to claim 1, wherein the tip members are fixed by hard soldered or brazed joints.

3. A cutter wheel according to claim 1 or 2, wherein the tip members are made of tungsten carbide.

4. A cutter wheel according to claim 1, 2 or 3, wherein each tip member is of pointed form.

5. A cutter wheel according to claim 4, wherein each tip member points along a line making an angle with the radius of the wheel through the tip which angle is much greater than 0° but less than 90°.

6. A cutter wheel according to claim 5, wherein the angle is 53° ± 10%.

7. A cutter wheel according to any of claims 1 to 6, wherein each said section is an arc of a circle, the centres of the arcs being offset from the centre of the wheel to set back the trailing ends radially relative to the leading ends.

8. A cutter wheel according to any of claims 1 to

7, wherein there are six equally spaced tip members.

9. A cutter wheel according to any of claims 1 to 8, wherein each tip member is fixed to an insert, which provides the tip-receiving surface, and is fixed into a slot at the leading end of the corresponding said section.

10. A cutter wheel according to claim 9, wherein the slot and insert are so dimensioned that the outer edge of the insert continues the peripheral line of the section following the insert but is radially set out from the trailing end of the next section.

11. A cutter wheel according to claim 9 or 10, wherein each slot has forward and rear walls extending approximately radially and a bottom approximately normal to the radial, and the insert is shaped to fit in the slot.

12. A cutter wheel according to any of claims 1 to 11, wherein each tip member overhangs the trailing end of the preceding said section.

13. A cutter wheel for a tillage implement substantially as hereinbefore described with reference to, and as illustrated in Figs. 4 and 5 of the accompanying drawings.

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