Abstract: Mowing head (11) with discs (21) for cutting plants, comprising: a supporting structure (13) defining a front portion (15) of the head (11), which encounters first the product to be cut when the head (11) moves forward on the ground in a working configuration for cutting plants, and a rear portion (17) of the head (11) towards which the cut product is conveyed for being collected or laid on the ground; a cutter bar (19) having rotary discs (21) and associated with the supporting structure (13) at the front portion (15) of the head (11), perpendicularly relative to the advancing direction of the head (11); a conveying assembly (23) for the product cut by the cutter bar (19), adapted to convey the cut product from the front portion (15) of the head (11) towards the rear portion (17) of the head (11); wherein the conveying assembly (23) includes: at least a first, longitudinal conveyor belt (25a, 25b) for conveying the cut product in a direction parallel to the cutter bar (19), i.e. perpendicular to the advancing direction of the head (11); at least a second,
transverse conveyor belt (27) for conveying the cut product coming from said at least a first conveyor belt (25a, 25b) in a direction perpendicular to the cutter bar (19), i.e. parallel to the advancing direction of the head (11).
CUTTING HEAD WITH DISCS FOR CUTTING PLANTS

******

DESCRIPTION

Technical field

The present invention concerns a mowing head with discs. The head according to the invention can be employed, for instance but not exclusively, for cutting and collecting fodder for feeding animals. Moreover, the head according to the invention can be employed either in combination with a self-propelled machine, for instance a self-propelled crop harvester machine, or can be incorporated into a machine arranged to be towed by an agricultural tractor. In the first instance the combined machine is preferably capable of performing cutting and collecting the cut product on board the machine, whereas in the second instance the machine is preferably capable of performing cutting and laying the product having been cut on the ground in windrows.

Prior art

In the agricultural field, machines for cutting plants, typically for cutting fodder, are known, which are provided with a mowing head incorporating a longitudinal cutter bar having at least two rotatable cutting discs, generally provided with radial knives. The discs are arranged with vertical rotation axes and are aligned along a front portion of the mowing head, along an axis perpendicular to the advancing direction of the head.

Self-propelled machines incorporating a mowing head and machines lacking a propelling unit, which are to be towed by an agricultural tractor, are known in the art. US 7716904 discloses an example of self-propelled machine equipped with a mowing head with discs. US 4428181 discloses an example of towed machine equipped with a mowing head with discs.

In both the above applications, the product cut by the cutting discs is conveyed towards the rear portion of the mowing head, for being either collected on board the machine or laid on the ground in windrows.

Currently, on board the mowing head, in order to convey the product cut by the cutter bar with discs, a conveyor roller or an auger longitudinally arranged behind the cutter bar are employed. The cut product, which during the forward movement of the cutter bar is pushed towards the rear portion of the head, encounters the conveyor roller or auger, which conveys the cut product towards the centre of the head and causes it to move forward towards a rear discharge duct or opening. From said duct or opening, the product conveyed reaches a container located on board the machine or is laid on the ground, as the
case may be, with means well known to the skilled in the art.

The prior art heads, equipped with an auger conveyor, have a number of drawbacks related to the fact that the product conveyed by the conveyor is excessively compacted and tends to become accumulated in the conveyor, thereby impairing the proper operation of the head. Thus, the prior art heads demand a frequent maintenance and undergo operation stops due to jamming caused by an excess accumulation of the cut product in the conveying region of the conveyor.

Moreover, a problem encountered when manufacturing cutting heads of the above kind is how to preserve the qualities of the product collected, for instance the structural and nutritional qualities of the fodder.

Thus, it is an object of the invention to provide a solution to the above problems, by providing a mowing head with discs, which is free from the drawbacks of the prior art and which allows preserving at best the qualities of the product collected.

It is another object of the invention to provide a mowing head with discs, which can be both incorporated into a self-propelled machine, such as a self-propelled crop harvester machine, and used in a machine towed by an agricultural tractor.

It is yet another object of the invention to provide a head of the above kind, which is more reliable and requires less maintenance than the prior art heads.

It is a further, but not the last object of the invention, to provide a mowing head with discs, which can be industrially manufactured at low cost.

The above ad other objects are attained by the mowing head as claimed in the appended claims.

*Description of the Invention*

The above objects are essentially attained by means of a mowing head with discs for cutting plants, including:
- a supporting structure defining a front portion of the head, which encounters first the product to be cut when the head moves forward in a working configuration for cutting plants, and a rear portion of the head towards which the cut product is conveyed for being collected or laid on the ground;
- a substantially rectilinear cutter bar with discs, associated with the supporting structure at the front portion of the head, perpendicularly to the advancing direction of the head;
- a conveying assembly for the product cut by the cutter bar, adapted to convey the cut product from the front portion of the head towards the rear portion of the head; characterised in that the conveying assembly includes:
at least a first, longitudinal conveyor belt for conveying the cut product in a direction parallel to the cutter bar, i.e. perpendicular to the advancing direction of the head;

at least a second, transverse conveyor belt for conveying the cut product in a direction perpendicular to the cutter bar, i.e. parallel to the advancing direction of the head.

According to the invention, the cutter bar having rotary discs can be advantageously employed for cutting plants, e.g. plants for feeding animals.

The head essentially includes a supporting structure defining a front portion and a rear portion of the head. Preferably, the supporting structure is made of steel, e.g. box steel.

When the head is in use and moves forward in a working configuration for cutting plants, the front portion encounters first the product to be cut and the cut product is conveyed towards the rear portion of the head for being collected on board a self-propelled machine or for being possibly laid on the ground.

The head according to the invention includes a substantially rectilinear cutter bar with discs, associated with the supporting structure at the front portion of the head and arranged longitudinally and perpendicularly relative to the advancing direction of the head. A conveying assembly for the product cut by the cutter bar with discs is adapted to convey the cut product from the front portion of the head towards the rear portion of the head.

Advantageously, according to the invention, the conveying assembly includes at least a first, longitudinal conveyor belt for conveying the cut product in a direction parallel to the cutter bar, i.e. perpendicular to the advancing direction of the head, and at least a second, transverse conveyor belt for conveying the cut product coming from said at least a first conveyor belt in a direction perpendicular to the cutter bar, i.e. parallel to the advancing direction of the head.

In accordance with a particular embodiment of the invention, the conveying assembly includes at least a conveyor roller or auger, which cooperates with the transverse conveyor belt and is arranged with its rotation axis perpendicular to the advancing direction of said transverse conveyor belt.

Brief Description of the Figures

A preferred embodiment of the invention will be described by way of non-limiting example with reference to the accompanying drawings, in which:

- Fig. 1 is a top perspective view of the head according to the invention;
- Fig. 2 is a bottom perspective view of the head shown in Fig. 1:
Fig. 3 is a top plan view of the head shown in Fig. 1 associated with a conveying device of a self-propelled crop harvester machine;

Fig. 4 is a bottom plan view of the head shown in Fig. 1 associated with a conveying device of a self-propelled crop harvester machine;

Fig. 5 is a side view of the head shown in Fig. 1 associated with a conveying device of a self-propelled crop harvester machine;

Fig. 6 is a top perspective view of the conveying device of a self-propelled crop harvester machine.

Description of Some Preferred Embodiments of the Invention

With reference to the accompanying drawings, the mowing head according to the invention has been generally denoted by reference numeral 1. Head 11 includes a supporting structure 13. Supporting structure 13 preferably includes a framework of box steel and defines a front portion 15 of head 11, which encounters first the product to be cut when head 11 moves forward on the ground in a working configuration for cutting plants, and a rear portion 17 of head 11, towards which the cut product is conveyed for being collected or laid on the ground.

Head 11 further includes a substantially rectilinear cutter bar 19 having rotary discs 21 and associated with supporting structure 13 at the front portion 15 of head 11, perpendicularly relative to the advancing direction of head 11 shown by arrow F1 in Fig. 1. Cutter bar 19 has discs 21 with vertical rotation axes and a set of skids for resting on the ground, and it can be advantageously implemented in accordance with the prior art.

A conveying assembly 23 for the product cut by cutter bar 19 is adapted to convey the cut product from front portion 15 of head 11 towards rear portion 17 of head 11.

In accordance with a preferred embodiment of the invention, conveying assembly 23 includes a pair of side longitudinal conveyor belts 25a, 25b and a transverse conveyor belt 27 located substantially centrally of head 11, between side belts 25a, 25b, at the region where the material conveyed by side belts 25a, 25b arrives.

During the forward movement of mowing head 11 in a working configuration, the product cut by cutter bar 19 with discs 21 is laid onto side belts 25a, 25b. Side belts 25a, 25b convey the cut product towards the centre of head 11 in the converging direction denoted by arrows F2, F3. The material discharged from side belts 25a, 25b is laid onto central belt 27, which conveys the cut product in the direction denoted by arrow F4, opposed to advancing direction F1 of head 11, towards rear portion 17 of head 11. The combined movement of belts 25a, 25b and 27 thus determines conveyance of the cut
product first towards the centre of head 11, in correspondence of belt 27, and hence towards rear portion 17.

In accordance with a preferred embodiment of the invention, a conveyor roller 29 is provided and is located above central belt 27. Conveyor roller 29 includes an auger and is rotatable about a longitudinal axis perpendicular to the advancing direction of head 11. Conveyor roller 29 substantially extends over a length approximately equal to the width of central belt 27 and cooperates with said belt 27 for conveying the cut product towards rear portion 17 of head 11.

Always with reference to the embodiment illustrated, side conveyor belts 25a, 25b and central belt 27 include a respective carpet supported by rotating rollers. The rotating rollers are preferably driven by hydraulic motors through an oleo-dynamic circuit having a pump and a reservoir, both housed within structure 13 of head 11. The rollers supporting side belts 25a, 25b rotate about transverse axes, i.e. axes parallel to the advancing direction of head 11. The rollers supporting belt 27 rotate about longitudinal axes, i.e. axes perpendicular to the advancing direction of head 11.

Referring in particular to Fig. 6, there is shown conveying unit 41 of a self-propelled crop harvester machine. In accordance with a particular embodiment of the invention, supporting structure 13 of head 11 advantageously includes a rear framework 31 allowing connecting head 11 to a self-propelled crop harvester machine in correspondence of conveyor 41. Framework 31 can advantageously have different configurations depending on the crop harvester machine to which head 11 is to be connected. The product conveyed by belt 27, which preferably cooperates with conveying roller 29, is conveyed towards conveying unit 41 and hence into the self-propelled crop harvester machine, as known to the skilled in the art.

Turning back to Figs. 1 to 5, there is shown a front safety protection 51 including a substantially vertical screen 53, preferably made of a flexible material, which is fastened at its top to a horizontal member 55 covering cutter bar 19, thereby avoiding the risk of accidents.

The cutting head as described and shown can undergo several variants and modifications lying within the same inventive principle.
Patent claims

1. Mowing head (11) with discs (21) for cutting plants, comprising:
   - a supporting structure (13) defining a front portion (15) of the head (11) which first encounters the product to be cut when the head (11) moves forward on the ground in a working configuration for cutting plants, and a rear portion (17) of the head (11) towards which the cut product is conveyed for being collected or laid on the ground;
   - a cutter bar (19) having rotary discs (21) and associated with the supporting structure (13) at the front portion (15) of the head (11), perpendicularly relative to the advancing direction of the head (11);
   - a conveying assembly (23) for the product cut by the cutter bar (19), adapted to convey the cut product from the front portion (15) of the head (11) towards the rear portion (17) of the head (11);
   - characterized in that the conveying assembly (23) includes:
     - at least a first, longitudinal conveyor belt (25a, 25b) for conveying the cut product in a direction parallel to the cutter bar (19), i.e. perpendicular to the advancing direction of the head (11);
     - at least a second, transverse conveyor belt (27) for conveying the cut product coming from said at least a first conveyor belt (25a, 25b) in a direction perpendicular to the cutter bar (19), i.e. parallel to the advancing direction of the head (11).

2. Head according to claim 1, wherein the conveying assembly (23) comprises a pair of longitudinal conveyor belts (25a, 25b) and a transverse conveyor belt (27) that is arranged substantially centrally between said longitudinal conveyor belts (25a, 25b), so that the product cut by the cutter bar (19) with discs (21) is conveyed by the longitudinal conveyor belts (25a, 25b) to the central conveyor belt (27) and the product conveyed on the central conveyor belt (27) is conveyed by the latter towards the rear portion (17) of the head (11).

3. Head according to claim 1 or 2, wherein there is provided a rotary conveyor (29) rotating about a longitudinal axis located above the central conveyor belt (27).

4. Head according to claim 3, wherein the rotary conveyor (29) comprises an auger.

5. Head according to any of the preceding claims, wherein the at least a longitudinal conveyor belt (25a, 25b) comprises a carpet supported by rotating rollers with axes that are arranged transversely, i.e. substantially parallel to the advancing direction of the head (11).
6. Head according to any of the preceding claims, wherein the at least a transverse conveyor belt (27) comprises a carpet supported by rotating rollers with axes that are arranged longitudinally, i.e. substantially perpendicular to the advancing direction of the head (11).

7. Head according to any of the preceding claims, wherein the supporting structure (13) comprises a framework made of steel.

8. Head according to any of the preceding claims, wherein the supporting structure (13) comprises a rear framework (31) for connecting the head (11) to a self-propelled crop harvester machine.

9. Head according to any of the preceding claims, wherein the discs (21) rotate about vertical rotation axes when the head (11) is working.

10. Head according to any of the preceding claims, wherein the cutter bar (19) is rectilinear.
A. CLASSIFICATION OF SUBJECT MATTER

INV. A01D34/63 A01D41/14 A01D43/06

ADD.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 7 716 904 B2 (DI EDERICH JR ANTHONY F [US] ET AL) 18 May 2010 (2010-05-18) col umn 1, l ine 5 - col umn 5, l ine 16; figures</td>
<td>1-6,8-10</td>
</tr>
<tr>
<td>Y</td>
<td>US 3 717 981 A (VAN DER LELY C) 27 February 1973 (1973-02-27) col umn 5, l ine 3 - col umn 7, l ine 30; figure 6</td>
<td>1-6,8-10</td>
</tr>
</tbody>
</table>

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

"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) on 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

"*" Special categories of cited documents:

"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

"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

"S" document member of the same patent family

Date of the actual completion of the international search
10 August 2017

Date of mailing of the international search report
28/08/2017

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
Bunn, David
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DE 44 32 663 Al (SAME SPA [IT]) 21 March 1996 (1996-03-21) col umn 1, line 34 - col umn 4, line 38; figures</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>DE 20 2011 101277 Ul (FELLA WERKE GMBH [DE]) 26 September 2011 (2011-09-26) paragraph [0023] - paragraph [0028]; figures 1, 2</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>US 1 297 867 A (KNIGHT WILLIAM L [US]) 18 March 1919 (1919-03-18) page 1, line 84 - page 3, line 8; figures</td>
<td>1</td>
</tr>
<tr>
<td>Patent document cited in search report</td>
<td>Publication date</td>
<td>Patent family member(s)</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>US 7716904 B2</td>
<td>18-05-2010</td>
<td>NONE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2640605 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2847627 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2020841 A2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2684441 A2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2447007 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2007193243 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2009007534 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2009094957 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2009249760 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2010043375 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2010095646 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2011185693 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2012036819 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2012266582 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2013133303 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2007095430 A2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 1810878 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FR 1593947 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 1255163 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 1255909 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 1255910 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NL 6716443 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 3717981 A</td>
</tr>
<tr>
<td>DE 4432663 A1</td>
<td>21-03-1996</td>
<td>NONE</td>
</tr>
<tr>
<td>DE 202011101277 U1</td>
<td>26-09-2011</td>
<td>DE 202011101277 U1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2529614 A1</td>
</tr>
<tr>
<td>US 1297867 A</td>
<td>18-03-1919</td>
<td>NONE</td>
</tr>
</tbody>
</table>