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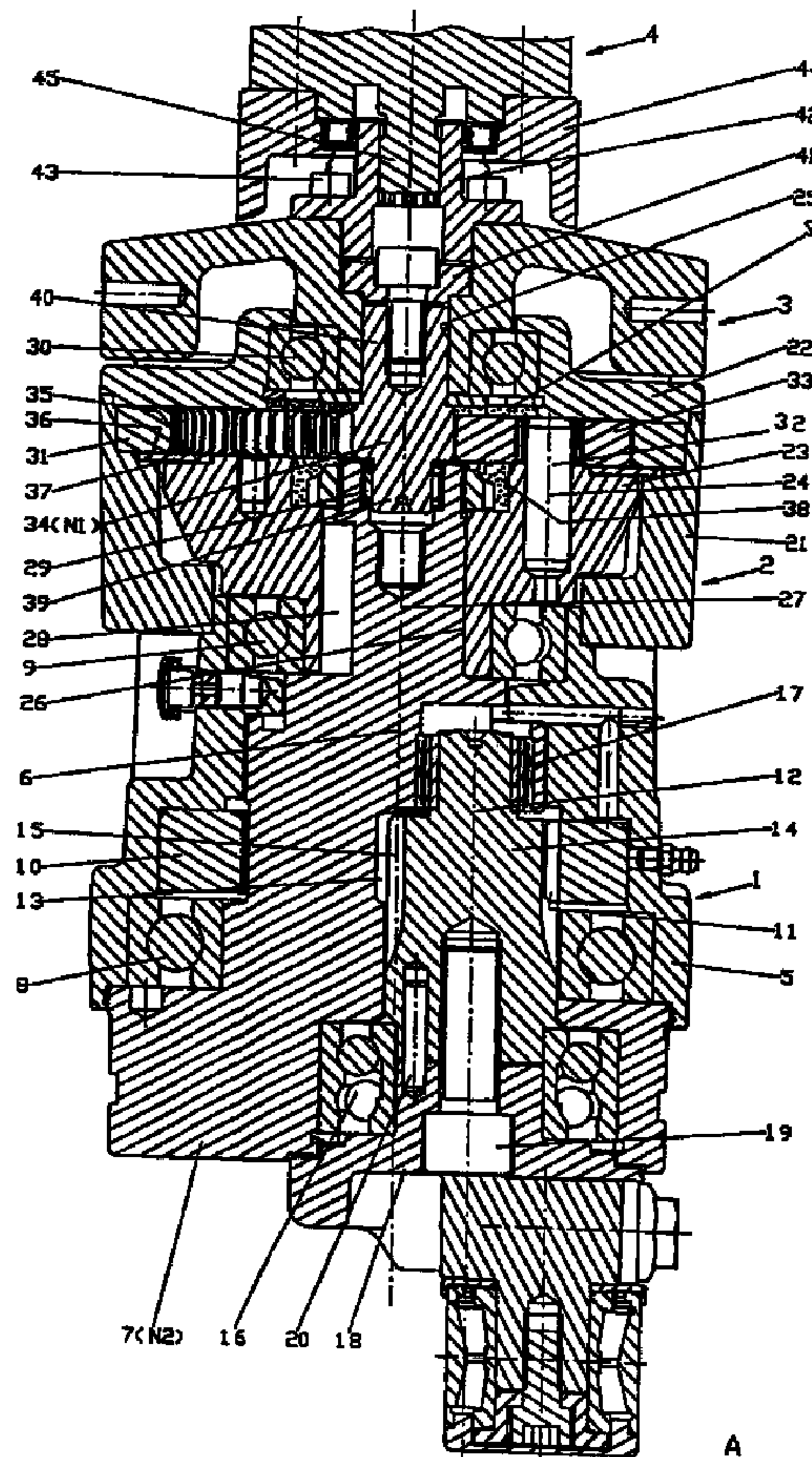
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(57) Abrégé/Abstract:

Drive unit for oscillatingly driven mowing sickles comprising a first transmission unit 1, having a first housing 5, which forms a first axis 6, having a rotor 7, which is rotationally supported in the first housing 5 around the first axis 6, having a first internal gear wheel

(57) **Abrégé(suite)/Abstract(continued):**

10, fixed in the first housing 5 and provided with an internal toothing, having a toothed pinion 14, which is rotationally supported in the rotor 7 around a second axis 12, wherein the second axis 12 is radially off-set to the first axis 6 and wherein the toothed pinion 14 forms the output element of the drive unit and meshes with the first internal gear wheel 10, a second transmission unit 2, which output 34 is non-rotationally connected to the rotor 7 of the first transmission unit 1 and which is formed as a step-down gear, a motor 4, having an output shaft 45, which rotationally drives the second transmission unit 2, which rotational speed N1 is reduced by the second transmission unit 2 formed as a step-down gear, to the rotational driving speed N2 of the first transmission unit 1.

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Drive unit for a mowing sickle

Abstract

Drive unit for oscillatingly driven mowing sickles comprising a first transmission unit 1, having a first housing 5, which forms a first axis 6, having a rotor 7, which is rotation-
5 ally supported in the first housing 5 around the first axis 6, having a first internal gear wheel 10, fixed in the first housing 5 and provided with an internal toothing, having a toothed pinion 14, which is rotationally supported in the rotor 7 around a second axis 12, wherein the second axis 12 is radially off-set to the first axis 6 and wherein the
10 toothed pinion 14 forms the output element of the drive unit and meshes with the first internal gear wheel 10, a second transmission unit 2, which output 34 is non-rotationally connected to the rotor 7 of the first transmission unit 1 and which is formed as a step-down gear, a motor 4, having an output shaft 45, which rotationally drives the second transmission unit 2, which rotational speed N1 is reduced by the
15 second transmission unit 2 formed as a step-down gear, to the rotational driving speed N2 of the first transmission unit 1.

Fig. 1

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Drive unit for a mowing sickle

Description

The invention relates to a drive unit for oscillatingly driven mowing sickles, which for example are used in harvesting machines, like combine-harvesters or similar machines. In these mowing sickles are used, which provide working width, in the order of 6 to 18 meters.

These mowing sickles are driven by drives of different construction. Especially advantageous for mowing sickles with large mowing widths, i.e. there where a high power is required, are such drive units, which comprise a transmission unit, which converts the rotational movement directly into a reciprocating movement and are directly coupled to the mower head of the mowing sickle, to drive this oscillatingly.

Such a transmission unit is for example described in DE 36 15 058 C2 and has a housing, which forms a first axis. The transmission unit comprises a rotor, which is rotationally supported in the housing around the first axis and which is driven by a power source. In the housing, an internally toothed gear is attached stationary, i.e. this does not rotate in relation to the housing. The rotor is held in bearings in the housing. On the rotor itself, further, a toothed pinion gear wheel is rotationally supported around a second axis. The second axis is radially off-set to the first axis. The toothed pinion gear forms the driving element of the transmission and meshes with the internally toothed gear wheel.

In praxis, such a transmission unit is for example driven via a belt drive by a motor. Additionally a flywheel mass is often provided, to be able to handle also suddenly

appearing loads.

Such drive units require, however, a large space. If a hydraulic motor should be arranged directly to the transmission unit, bulky construction sizes result. Hydraulic motors are, however, suitable in connection with the above described transmission unit only for low rotational speeds, i.e. are, because of the high consumption volume, only suitable for harvesting machines, which have an extensive hydraulic system.

The invention is based on the object, to provide a drive unit for an oscillatingly driven mowing sickle, which is small concerning required space, so that the usable working width is more advantageous and which is suitable for high power requirements.

This object is solved according to the invention by a drive unit comprising

- a first transmission unit,
 - having a first housing, which forms a first axis,
 - having a rotor, which is rotationally supported in the first housing around the first axis,
 - having a first internal gear wheel, retained in the first housing and provided with an internal toothing,
 - having a pinion, which is rotationally supported in the rotor around a second axis, wherein the second axis is radially off-set to the first axis and wherein the pinion forms the output element of the drive unit and meshes with the first internal gear wheel,
- a second transmission unit,
 - which output is non-rotationally connected to the rotor of the first transmission unit and
 - which is formed as a step-down gear,
- a motor,
 - having an output shaft, which rotationally drives the second transmission unit,
 - which rotational speed is reduced by the second transmission unit, formed as a step-down gear, to the rotational driving speed of the first transmission unit.

Of advantage is, that, because a second transmission unit is provided in addition, motors can be used, which need to have a distinctly reduced power compared to the construction with only one transmission unit. Namely, fast running hydraulic motors or electromotors can be selected, which rotational drive speed is in the range of 3000 to maximal 4000 revolutions per minute. The second transmission unit can vary in design, e.g. can be a spur gear transmission or planetary gear transmission, and which converts because of its design this high rotational drive speed effectively into a lower rotational speed, which can be used for driving the first transmission unit. In the second transmission unit, the gear ratio between the toothed pinion gear and the rotor is selected such, that on the driving side a linear movement is provided, by which the mowing sickle can be driven directly linearly in a reciprocating manner.

An especially advantageous construction and mode of operation is achieved by a structure, which is characterised in

- that the second transmission unit
 - comprises a planet carrier, non-rotationally connected to the rotor of the first transmission unit and rotating with the same around the first axis and which carries at least one planet gear, toothed on the outside and which is rotationally supported on the planet carrier around a third axis, which is arranged radially off-set to the first axis,
 - has a second internal gear wheel provided internally with a toothing and which is held stationary and with which the at least one planet gear meshes,
 - has a sun gear, which meshes with the at least one planet gear, and
- that the output shaft of the motor drives rotationally the sun gear of the second transmission unit.

Of advantage in this construction is, that fast running hydraulic motors or electromotors can be used, which only have a small construction volume. The additional second transmission unit is by means of its construction especially space saving and can be positively connected to the first transmission unit. Advantageous is as well, that also the motor can be directly integrated into the drive unit. Preferably three planet gears are provided.

In an embodiment it is provided, that the second transmission unit has a second housing, which is attached on the first housing and which accommodates the planet carrier with the at least one planet gear, the second internal gear wheel and the sun gear.

In this case it is of advantage, that the separate housing allows for the second transmission unit, to use the first transmission unit for example in combination with normal, i.e. common drives, which are dimensioned such, that the power is provided, which is sufficient for direct driving the mowing sickle by the first transmission unit.

It is however also possible, that the second transmission unit has a housing portion, which is formed integrally with the first housing and which accommodates the planet carrier with the at least one planet gear, the sun gear and the second internal gear wheel.

Especially advantageous is an embodiment of the drive unit such, that that the second transmission unit is lubricated by a lubricating grease and that between the planet carrier and the second housing or housing portion, in which the planet carrier is accommodated, a separating disc is arranged, which in the direction towards the first housing seals the chamber, accommodating the second internal gear wheel, the at least one planet gear and the sun gear. Also the first transmission unit can be lubricated by a grease, so that between the two transmission units no perfect seal is necessary, which would be necessary for different lubricants, namely e.g. oils and lubricating grease.

For this case as a lubricating grease a lithium base saponified grease, commonly used in mechanical engineering can be used.

In the structure according to the invention a cooling of the motor, especially an oil cooling, is not necessary, which also can not be provided practically, as hydraulic motors can be used, which only necessitate small oil consumption, to operate the drive unit according to the invention. By means of the separating disc it is ensured,

that the lubricating grease remains in the area or space, in which the gears mesh, i.e. in the chamber in which the second internal gear wheel, the at least one planet gear and the sun gear are arranged.

5 The lubricant can, therefore, not escape in the direction to the first transmission unit or to the outside. Preferred is an arrangement, in which the separating disc is arranged between the second housing or the housing portion and the second internal gear wheel and the planet carrier. Thus, the gap between the planet carrier and the second housing is bridged, i.e. in radial direction relative to the first axis. Further in
10 interaction with the lid of the second housing and the second housing itself a sealed chamber is formed.

Preferably, the separating disc is held non-rotationally on the second housing or on the housing portion, respectively. The relative movement takes place in relation to
15 the planet carrier. This rotates relative to the separating disc.

Furthermore, in an embodiment of the invention it is provided, that between the motor and the sun gear of the second transmission unit, a flywheel is arranged.

20 If the spacial conditions allow it, it is also possible, that the second transmission unit comprises a spur gear, which is non-rotationally connected to the rotor of the first transmission unit and rotates with the rotor around the first axis and a spur pinion gear, meshing with the spur gear and which rotates around a fourth axis arranged parallel to the first axis and is driven by the motor. In this case two ways of arranging
25 the motor are given.

A first embodiment provides, that the motor is arranged parallel to and next to the first transmission unit. In this connection, additionally a flywheel can be provided, which is connected to the toothed pinion gear to rotate therewith and is arranged on
30 the side of the second transmission unit and of the motor facing away from the first transmission unit.

A second arrangement possibility provides, that the motor is coupled parallel to the

second transmission unit and facing away from the first transmission unit. For this, additionally also a flywheel can be provided, which is coupled to the spur pinion gear to rotate therewith and is arranged on that side of the second transmission unit, facing the first transmission unit, next to the first transmission unit.

5

In both embodiments it is possible, that the second transmission unit has a second housing, which is attached on the first housing of the first transmission unit or forms with the same at least partially a unit.

10

For all embodiments the motor can be formed as a fast running hydraulic motor or electromotor. Thus a space saving construction is achieved.

The flywheel provides the necessary power, when load peaks are produced.

15

Preferred embodiments are shown schematically in the drawing.

It shows

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Fig. 1 a first embodiment according to the invention in a sectional view, wherein the motor is arranged centrally above the second transmission unit and wherein the second transmission unit is represented by a planet gear,

25

Fig. 2 a second embodiment in a view, wherein the transmission unit is a spur gearing and the motor is arranged parallel off-set to the first transmission unit, however facing away from the first transmission unit, and

30

Fig. 3 a third embodiment in a view, wherein the second transmission unit is a spur gearing and the motor is arranged parallel off-set to the first transmission unit and next to the first transmission unit.

Fig. 1 shows a sectional view along the first axis of the drive unit.

The first embodiment of a drive unit according to the invention comprises a first transmission unit 1, which is followed by a second transmission unit 2, wherein as a fast running motor a hydraulic motor 4 is provided for driving the second transmission unit 1, which, however, can be substituted by an electromotor. Between the hydraulic motor 4 and the second transmission unit 2, which represents the input transmission, a centrifugal mass in form of a flywheel 3 is arranged.

The first transmission unit 1 has a first housing 5, which forms a first axis 6. In the first housing 5, a rotor 7 is supported in a first bearing 8 and a second bearing 9 distanced thereto rotationally around the first axis 6 and which bearings are provided in form of rolling member bearings.

Furthermore, in the first housing 5 a first internal gear wheel 10 is arranged, which encloses a portion of the rotor 7 and has internally a toothing 11. The rotor 7 has eccentrically relative to the first axis 6, a recess 13, which is open towards its circumference. In this recess 13, a pinion 14 with the toothing 15 is accommodated. This is supported in a third bearing 16 and a fourth bearing 17 arranged distanced thereto in form of rolling member bearings rotationally around a second axis 12. The second axis 12 is radially off-set to the first axis 6 and extends parallel thereto. The toothing 15 of the pinion 14 meshes with the toothing 11 on the internal circumference of the first internal gear wheel 10. The toothed pinion 14 represents the output element. On the toothed pinion 14, an output element 18 is fixed by a screw and connected non-rotationally to the toothed pinion 14 by at least one pin 20. The output element 18 comprises a journal-like element, which engages in a bore of a mowing head, not shown, for driving the mowing sickle.

The second transmission unit 2 connected to the first transmission unit 1 and arranged in front of the first transmission unit comprises a second housing 21, which is connected by means not shown in the drawing, for example screws, securely to the first housing 5 of the first transmission unit 1. Further an arrangement is possible, in which these two housings are formed integrally and therefore, the second housing 21, which in the present example is separate, forms a portion of the first housing 5.

The second bearing 9, which supports the bearing journal 27 of the rotor 7, serves at the same time for supporting the planet carrier 23, which has a bearing bore 26, in which the bearing journal 27 of the rotor 7 is accommodated.

5 The second housing 21 is further closed by a lid 22. This closes the end of the second housing 21 distanced from the first housing 5. On the planet carrier 23, three planet gears 33 are arranged rotationally via bearing pins 32, which rest in bores of the planet carrier 23. The bearing pins 32 form third axes 24 for the planet gears 33, which are arranged radially off-set to the first axis 6 and around which the planet
10 gears 33 rotate. Between the lid 22, the planet carrier 23 and the second housing 21, a chamber 38 is formed, in which the planet gears 33, a second internal gear wheel 31, enclosing the same, and a sun gear 34 are arranged. The chamber 38 is sealed in the direction to the first transmission unit 1 by a separating disc 37, which is held between an abutment face 36 on the second housing and an abutment face 37 of the
15 second internal gear wheel 31 and is additionally supported on an abutment face 35 on the planet carrier 23, so that the gap between the planet carrier 23 and the second housing 21 is sealed. The separating disc 37 is, at the same time, held non-rotationally by not shown means for fixing the second internal gear wheel 31 in form of pins in relation to the second gear housing 21. However, a relative rotational
20 movement is given between the planet carrier 23 and the separating disc 37. The separating disc 37 seals the chamber 38. The grease S can seal the gaps in this area also between the meshing area of the planet gears 33 with the internal toothing of the second internal gear wheel 31 as well as the external toothing of the sun gear 34 and can not escape from the intermediate spaces. A permanent lubrication of the
25 second transmission unit 2 is provided.

The sun gear 34 has a first journal portion 39, which is accommodated rotationally relative to the rotor 7 by interconnection of a fifth bearing 29 in a bore of the bearing journal 27 of the rotor 7. The planet carrier 23 is connected to the bearing journal 27
30 of the rotor 7 via a key 28, so that both rotate together.

The sun gear 34 has a second journal portion 40, which is accommodated in a bore 25 of the flywheel 3. It is supported by a sixth bearing 30 together with the flywheel 3

in the lid 22 of the second transmission unit 2. The flywheel 3 is non-rotationally connected to the sun gear 34. This forms the transmission input for the second transmission unit 2 and is driven with the rotational speed N_1 by the hydraulic motor 4. Its output shaft 45 is connected non-rotationally to the flywheel 3 via a coupling sleeve 42. The coupling sleeve 42 is retained by screws 43 on the flywheel 3. The flywheel 3 is further securely connected to the sun gear 34 via a shaft to hub connection and by a locating disc 41, which is retained by a screw, which engages in a threaded bore of the sun gear 34.

The hydraulic motor 4 rests on a bridge element 44, which is connected to the second housing 21 and bridges the flywheel 3. The fast running hydraulic motor 4 not shown in more detail, rotating with a high rotational speed N_1 of approximately 4000 revolutions per minute, drives the sun gear 34 of the second transmission unit 2 with a rotational input speed N_1 . This is stepped down by the second transmission unit 2 to the rotational speed N_2 , which forms the rotational input speed for the first transmission unit 1. This is the rotational speed N_2 , by which the rotor 7 is driven via the planet carrier 23 and which represents the output element of the second transmission unit 2. The first transmission unit 1 converts the rotational movement of the rotor 2 into a linear movement of the output journal of the output element 18, which is positively connected to the not shown mowing head of the mowing sickle, to drive this reciprocatingly.

By means of the special design of the second transmission unit 2 and especially its sealing, a permanent lubrication is achieved. The second transmission unit is practically free of maintenance requirements. Only the first transmission unit 1 has to be lubricated in intervals. For this a grease lubrication is provided as well.

Fig. 2 shows a further embodiment of the drive unit according to the invention, wherein the first transmission unit 1 also in the embodiment of Fig. 2 corresponds to the construction of the transmission unit 1 of Fig. 1. Therefore, it is referred to the description of Fig. 1.

To the first transmission unit 1, the second transmission unit 102 is coupled, which is

formed differently to the second transmission unit of Fig. 1. The second transmission unit 102 comprises a second housing 121, which is securely connected to the first transmission unit 1 or can even form at least partially a unit therewith. The second transmission unit 102 is formed as a spur gearing. It comprises an externally toothed gear 46, which is non-rotationally connected to the first transmission unit 1 and especially there to the bearing journal 27 of Fig. 1, so that it can drive the rotor 7 of Fig. 1. The gear 46 is driven by a toothed spur pinion gear 47, which is driven by a fast running motor 104, for example a hydraulic motor or an electromotor, which, concerning the rotational speed, is similar to that hydraulic motor described in connection with Fig. 1. The toothed spur pinion gear 47 has also an external toothing and meshes with the gear 46 having a larger diameter, so that a reduction of the rotational speed of the motor 104 is achieved. The toothed spur pinion gear 47 rotates around the fourth axis 48, which also represents the drive axis of the motor 104. It is visible, that the fourth axis 48 is radially off-set to the first axis 6. Furthermore, the motor 104 is arranged at that side of the second transmission unit 102, facing away from the first transmission unit 1. At the side of the second transmission unit 102 facing the first transmission unit 1, the flywheel 103 is arranged on the fourth axis 48, which flywheel 103 is connected to the spur pinion gear 47 in such a way, that it rotates therewith.

Fig. 3 shows a third embodiment of a drive unit according to the invention, wherein this differs from the construction of Fig. 2 only by the arrangement of the motor 204 and of the flywheel 203. The first transmission unit 1 corresponds again to the construction of the transmission unit 1, as it is described in detail in connection with Fig. 1. The arrangement of the second transmission unit 202 and its construction corresponds to that described in connection with Fig. 2, so that for this it is referred to the description of Fig. 2.

The motor 204 is arranged parallel off-set in relation to the first axis 6 and has as a drive axis the fourth axis 48. The motor 204 is arranged, however, to the gearbox housing 221 at the side facing the first transmission unit 1, so that the motor 204 is arranged parallel off-set to the first transmission unit 1 with the first axis 6 aside to the first transmission unit 1.

The flywheel 203 is arranged correspondingly on that side of the housing 221 of the second transmission unit 202 facing away from the first transmission unit 1.

Reference numerals list

1	first transmission unit
2, 102, 202	second transmission unit
3, 103, 203	flywheel
4, 104, 204	motor
5	first housing
6	first axis
7	rotor
8	first bearing
9	second bearing
10	first internal gear wheel
11	toothings
12	second axis
13	recess
14	pinion
15	toothings
16	third bearing
17	fourth bearing
18	output element
19	screw
20	pin
21, 121, 221	second housing
22	lid
23	planet carrier
24	third axis
25	bore
26	bearing bore
27	bearing journal
28	key
29	fifth bearing
30	sixth bearing
31	second internal gear wheel
32	bearing pin

33	planet gear
34	sun gear
35	abutment face on the planet carrier
36	abutment face on the second housing
37	separating disc
38	chamber
39	first journal portion of the sun gear
40	second journal portion of the sun gear
41	locating disc
42	coupling sleeve
43	screw
44	bridge element
45	output shaft of the hydraulic motor
46	gear
47	spur pinion gear
48	fourth axis
N1	rotational speed of the sun gear
N2	rotor speed / rotational driving speed of the first transmission unit
S	grease

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Drive unit for a mowing sickle

Claims

1. Drive unit for oscillatingly driven mowing sickles comprising
 - a first transmission unit (1),
 - having a first housing (5), which forms a first axis (6),
 - having a rotor (7), which is rotationally supported in the first housing (5) around the first axis (6),
 - having a first internal gear wheel (10), retained in the first housing (5) and provided with an internal toothing,
 - having a pinion (14), which is rotationally supported in the rotor (7) around a second axis (12), wherein the second axis (12) is radially off-set to the first axis (6) and wherein the pinion (14) forms the output element of the drive unit and meshes with the first internal gear wheel (10),
 - a second transmission unit (2, 102, 202),
 - which output (34) is non-rotationally connected to the rotor (7) of the first transmission unit (1) and
 - which is formed as a step-down gear,
 - a motor (4),
 - having an output shaft (45), which rotationally drives the second transmission unit (2, 102, 202),
 - which rotational speed (N1) is reduced by the second transmission unit (2, 102, 202), formed as a step-down gear, to the rotational driving speed (N2) of the first transmission unit (1).

2. Drive unit according to claim 1,
characterised in

- that the second transmission unit (2)
 - comprises a planet carrier (23), non-rotationally connected to the rotor (7) of the first transmission unit (1) and rotating with the same around the first axis (6) and which carries at least one planet gear (33), toothed on the outside and which is rotationally supported on the planet carrier (23) around a third axis (24), which is arranged radially off-set to the first axis (6),
 - has a second internal gear wheel (31) provided internally with a toothing and which is held stationary and with which the at least one planet gear (33) meshes,
 - has a sun gear (34), which meshes with the at least one planet gear (33), and
- that the output shaft (45) of the motor (4) drives rotationally the sun gear (34) of the second transmission unit (2).

3. Drive unit according to claim 2,
characterised in

that the second transmission unit (2) has a second housing (21), which is attached on the first housing (5) and which accommodates the planet carrier (23) with the at least one planet gear (33), the second internal gear wheel (31) and the sun gear (34).

4. Drive unit according to claim 2,
characterised in

that the second transmission unit (2) has a housing portion, which is formed integrally with the first housing and which accommodates the planet carrier with the at least one planet gear, the sun gear and the second internal gear wheel.

5. Drive unit according to one of the claims 2 or 3,
characterised in

that the second transmission unit (2) is lubricated by a lubricating grease (S) and that between the planet carrier (23) and the second housing (21) or housing portion, in which the planet carrier is accommodated, a separating disc (37) is arranged, which in the direction towards the first housing (5) seals the chamber (38), accommodating the second internal gear wheel (31), the at least one planet gear (33) and the sun gear (34).

6. Drive unit according to claim 5,
characterised in
that the separating disc (37) is arranged between the second housing (21) and the second internal gear wheel (31) and the planet carrier (23).
7. Drive unit according to claim 5,
characterised in
that the separating disc (37) is held non-rotationally on the second housing (21) or on the housing portion.
8. Drive unit according to one of claims 3 or 4,
characterised in
that the second housing (21) or the housing portion are closed, away from the first transmission unit (1), by a lid (22).
9. Drive unit according to claim 2,
characterised in
that between the motor (4) and the sun gear (4) of the second transmission unit (2), a flywheel (3) is arranged.
10. Drive unit according to claim 1,
characterised in
that the second transmission unit (102) comprises a spur gear (46), which is non-rotationally connected to the rotor (7) of the first transmission unit (1) and rotates with the rotor around the first axis (6) and a spur pinion gear (47), meshing with the spur gear (46) and which rotates around a fourth axis (48)

arranged parallel to the first axis (6) and is driven by the motor (104).

11. Drive unit according to claim 10,
characterised in
that the motor (104) is arranged parallel to and next to the first transmission unit (1).
12. Drive unit according to claim 11,
characterised in
that a flywheel (103) is provided, which is connected to the spur pinion gear (47) to rotate therewith and is arranged on the side of the second transmission unit (102) and of the motor (104) facing away from the first transmission unit (1).
13. Drive unit according to claim 10,
characterised in
that the motor (294) is coupled parallel to the second transmission unit (202) and facing away from the first transmission unit (1).
14. Drive unit according to claim 13,
characterised in
that a flywheel (203) is provided, which is coupled to the spur pinion gear (47) to rotate therewith and is arranged on the side of the second transmission unit (202), facing the first transmission unit (1), next to the first transmission unit (1).
15. Drive unit according to claim 10,
characterised in
that the second transmission unit (102, 202) has a second housing (121, 221), which is attached on the first housing (5) of the first transmission unit (1) or forms with the same at least partially a unit.
16. Drive unit according to one of the claims 1, 2, 9, 11 or 13,

characterised in

that the motor (4, 104, 204) is a hydraulic motor or an electromotor.

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