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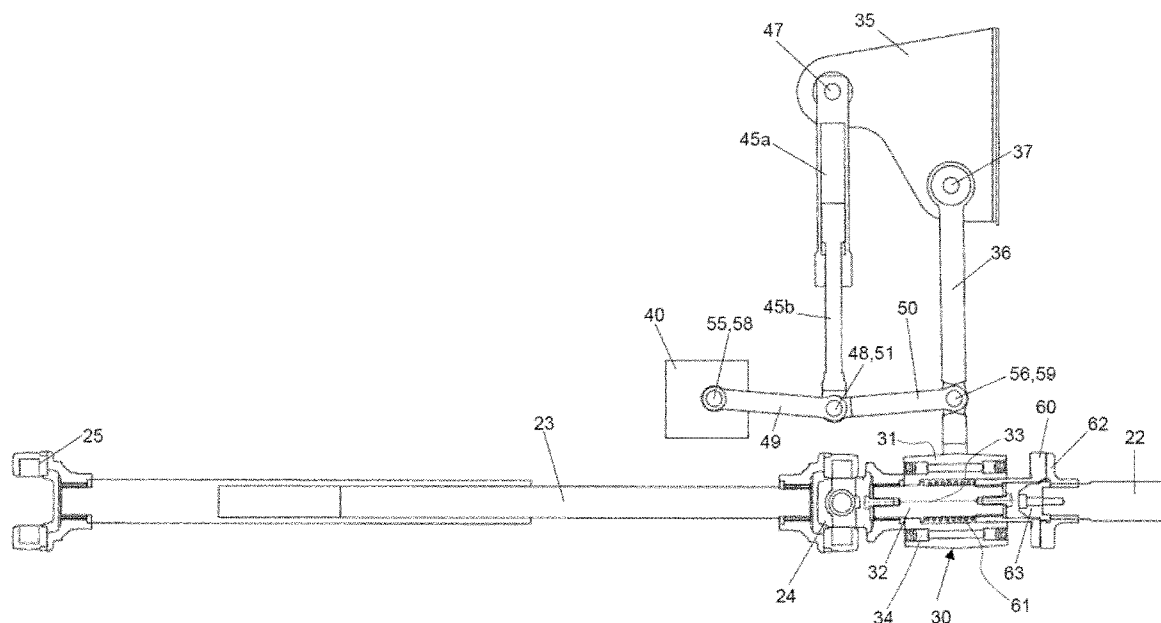


FIG. 3

(57) Abstract: In a combine harvester according to the invention, the driveline coupling mechanism is configured to couple the header driveline to a jackshaft (22) extending from the feeder (8). The mechanism comprises a pendulum arm (36) that is pivotably connected to the header (1). An actuator (45) is furthermore provided for driving a pivoting motion of the pendulum arm (36) about a pivot axis (37) oriented transversely with respect to the jackshaft. At the end of the pendulum arm, a bearing hub (30) is mounted comprising a shaft portion (32) that is rotatably coupled to the header driveline at one end and that comprises one part (60) of a clutch at the other end. The second part (62) of the clutch is mounted on the jackshaft (22). The pivoting motion of the pendulum arm (36), driven by the actuator (45), closes or releases the clutch.



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A HEADER DRIVELINE COUPLING MECHANISM FOR A COMBINE HARVESTER

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Field of the Invention

The present invention is related to combine harvesters, in particular to the driveline for actuating the operation of the header of the combine.

10

Background of the invention

Agricultural combine harvesters are machines designed for harvesting and processing crops such as wheat or corn. Crops are cut from the field on a wide area by the header mounted at the front of the combine. By an auger or a belt system included in the header, the harvested material is brought to a central area
15 of the header, and from there it is transported by the feeder to a threshing mechanism comprising laterally or longitudinally mounted threshing rotors and further to the cleaning section comprising a number of sieves where grains are separated from any remaining crop residue.

A driveline from the combine's power source to the header passes along
20 one side of the feeder where it is coupled to a header driveline oriented transversely to the forward direction of the combine. The coupling of the header driveline to the feeder driveline is done manually in most combines existing today. This is a time-consuming operation which adds to the downtime when a header needs to be released and replaced.

25

Summary of the invention

The present invention is related to a combine harvester equipped with an automatic header driveline coupling mechanism, as disclosed in the appended
30 claims. The mechanism is configured to couple the header driveline to a jackshaft extending from the feeder, and comprises a pendulum arm which is pivotably connected to the header. An actuator is furthermore provided for driving a pivoting motion of the pendulum arm about a pivot axis oriented transversely with

- 2 -

respect to the jackshaft. At the end of the pendulum arm, a bearing hub is mounted comprising a shaft portion that is rotatably coupled to the header driveline at one end and that comprises one part of a clutch at the other end. The second part of the clutch is mounted on the jackshaft. The pivoting motion of the pendulum arm, driven by the actuator, closes or releases the clutch. According to a preferred embodiment, the actuator is part of an actuator assembly further comprising a pair of foldable arms, one of which is pivotable with respect to the header, while the other is pivotably connected to the pendulum arm and wherein the actuator drives the motion of the midpoint between the foldable arms, so that said motion is transferred to the pivoting of the pendulum arm. The advantage of this particular actuator assembly is that it allows to automatically protect the coupling against involuntary release, by driving the midpoint of the foldable arms beyond the outer pivot points of these arms, when the clutch parts are interlocked.

Brief description of the drawings

Figure 1 is a schematic side view of a combine header as known in the art, indicating the position of the header and the feeder at the front of the machine.

Figure 2 illustrates the coupling mechanism according to an embodiment of the invention and its location in a combine harvester.

Figure 3 is a section view of the coupling mechanism shown in Figure 2.

Detailed description of preferred embodiments of the invention

Preferred embodiments will now be described with reference to the drawings. The detailed description is not limiting the scope of the invention, which is defined only by the appended claims. The terms 'front' and 'back' or 'rear' are referenced to the front and back side of the combine harvester. The 'forward direction' of the combine harvester refers not to a single geometrical axis but to the general direction from the rear of the vehicle to the front.

Figure 1 is a schematic image of a combine harvester 10 as known today, comprising a header 1 mounted at the front of the combine. The header comprises knives 2 maintained at a given height above ground level while the combine moves through a field of crops that are to be harvested. A rotating reel 3 guides the crops towards the knives. Cut crops are transported from both lateral

sides of the header towards a central area by an auger 4. The main body 5 of the combine is supported by front and rear wheels 6 and 7 and comprises the threshing rotors and cleaning section generally known by the skilled reader and not depicted as such in Figure 1. From the central area of the header 1, crops are transported into the main body 5 of the combine by a feeder 8. The feeder 8 is inclined upwards from the header 1 towards the main body 5 and comprises moving belts 9 inside a housing 11. The belts transport the crops upwards, from an inlet section 12 of the feeder to an outlet section 13. At the front, the feeder comprises a cradle frame 20, onto which the header 1 is mounted and secured.

10 The cradle frame 20 may be fixedly attached to the feeder 8, or it may be movable, for example for allowing the header 1 to undergo a tilting movement and/or a sideways floatation relative to the feeder 8. The rotation of the reel 3 and the auger 4 is driven by a driveline on the header which is itself coupled to the driveline of the combine as described in the introductory portion.

15 Figure 2 shows a detail of the left-hand side of the feeder housing 11, in a combine harvester according to a preferred embodiment of the invention. The cradle frame 20 is visible in the drawing. Also the header frame 14 is visible, which is the part of the header that is directly attached to the feeder. An interlocking beam 15 of the header frame is supported by a cradle 21 at the top of the cradle frame 20. A jackshaft 22 protrudes laterally from the feeder housing

20 11. The jackshaft 22 is part of a driveline which may comprise multiple drive axles interconnected by universal joints or other connection means and which is driven by a power source of the combine. These axles are generally oriented in the forward direction of the combine. In the vicinity of the feeder's inlet section 12, the driveline may then further comprise a transverse gearbox (not shown) or any

25 equivalent means to transfer the rotation of the forwardly oriented driveline elements into the rotation of the transversely oriented jackshaft 22. The components described so far are known in the art and need not therefore be described in more detail.

30 Also visible in Figure 2 is a drive shaft 23, which is part of the header driveline. The drive shaft 23 is extendable in length, and mounted between a first and second universal joint 24 and 25 (the second joint is only partially shown). Connected to the first universal joint 24 is the automatic coupling mechanism

according to an embodiment of the invention. The various parts of the coupling mechanism will now be described with reference both to Figure 2 and to the section view in Figure 3.

A bearing hub 30 is provided, comprising a cylindrical housing 31 and an
5 axle portion 32 arranged within the housing. The axle portion 32 is rotatable relative to the housing 31 about its central axis 33 via suitable bearings 34, preferably roller bearings. The housing 31 of the bearing hub is pivotably connected at one end of a pendulum arm 36. At its opposite end, the pendulum arm 36 is pivotably connected to a support 35 (not shown in Figure 2) that is
10 fixedly attached to the backside of the header frame 14. The pendulum arm 36 is pivotable about a first fixed pivot axis 37 oriented transversely, preferably perpendicularly, with respect to the jackshaft 22. A 'fixed pivot axis' is to be understood in the present context as an axis that is fixed with respect to the header 1. The pivot connection of the pendulum arm 36 to the support 35 is
15 preferably a flexible pivot connection, allowing a limited degree of movement of the pendulum arm 36 outside the plane perpendicular to the pivot axis 37. This may be achieved by mounting a resilient member between the pivot axle of the pendulum arm 36 and an opening in the support 35. At its opposite end, the pendulum arm 36 comprises a fork 38 having two legs between which the bearing
20 hub 30 is rotatably held, via pivot connections on the side of the hub 30, allowing pivoting of the hub relative to the fork about pivot axis 39, equally oriented transversely with respect to the jackshaft 22.

An actuator assembly is furthermore provided. According to the embodiment shown, this assembly comprises a variable length actuator 45, which
25 may be an electrical or a hydraulic actuator, comprising a base portion 45a and an extendable portion 45b (see Fig. 3). The base portion 45a is pivotably connected to the backside of the header frame 14, preferably via the same support 35 to which the pendulum arm 36 is connected. The actuator is thereby pivotable about a second fixed pivot axis 47 oriented transversely with respect to the jackshaft 22.
30 The distal end of the extendable portion 45b of the actuator 45 is pivotably connected to the midpoint 48 of a pair of foldable arms 49,50. The arms are foldable by pivoting relative to each other about axis 51, through the midpoint 48. This leaves the two outer ends 55 and 56 of the pair of foldable arms. At the first

outer end 55, the first foldable arm 49 is pivotably connected to a support 40 (not shown in Figure 2) that is fixedly attached to the backside of the header frame 14. The first foldable arm 49 is thereby pivotable about a third fixed pivot axis 58 oriented transversely with respect to the jackshaft 22. At the second outer end
5 56, the second foldable arm 50 is pivotably connected to the pendulum arm 36, at a location above the bearing hub 30. The second foldable arm 50 and the pendulum arm 36 are pivotable relative to each other about pivot axis 59. Preferably all the pivot axes 37,47,58,39,51 and 59 are substantially parallel to each other. Like the pivot connection of the pendulum arm 36 to the support 35,
10 the pivot connections of the actuator 45 and the first foldable arm 49 for rotation respectively about axes 47 and 58 are preferably flexible pivot connections as defined above, for example by providing a resilient member in these pivot connections.

The first end of the axle portion 32 within the bearing hub 30 is rotatably
15 connected to the universal joint 24. The opposite end of the axle portions 32 carries a spring-operated first part 60 of an axial clutch, preferably a jaw clutch. In the embodiment shown (see Figure 3), the spring-operation is achieved by rotatably connecting the first part 60 of the jaw clutch to the axle portion 32 mounted inside the bearing hub 30, while at the same time allowing axial motion
20 of the jaw clutch part 60 relative to said axle portion 32, for example by a spline connection. The axial movement of the jaw clutch part 60 is limited in one direction and actuatable in the opposite direction by an axial spring 61. The second part 62 of the clutch is mounted on the outer end of the jackshaft 22. The second part 62 of the jaw clutch is furthermore provided with a conical alignment
25 aid 63 in the middle of the jaw clutch part. This alignment aid is designed to fit into a central opening provided in the first clutch part 60.

The mechanism operates by driving the variable length actuator 45. Figure 3 shows the actuator 45 in the fully extended state. In this state, the clutch parts 60 and 62 are engaging and the header driveline is effectively coupled to the
30 jackshaft 22. For releasing the coupling, the extendable portion 45b of the actuator 45 is retracted upwards, as seen in Figure 2. The midpoint 48 of the pair of foldable arms 49,50 is pulled upwards, causing the foldable arms 49 and 50 to be folded together. As the outer end 55 of the first foldable arm 49 is fixed to the

header, this causes the second arm 50 to pull the pendulum arm 36 to the left, which results in a swinging motion of the pendulum arm 36 in the same direction and in the pulling away of the bearing hub 30 from the jackshaft 22. The clutch parts 60 and 62 are thereby released. The inverse movement is actuated by
5 pushing the extendable portion 45b of the variable length actuator 45 down, until it reaches the position shown in Figure 3. The pendulum arm 36 swings to the right, thereby pushing the bearing hub 30 towards the jackshaft 22. By the alignment aid 63 and by the action of the spring 61, the two clutch parts 60 and 62 are brought into alignment and the coupling is established. Preferably, the alignment
10 is further aided by a degree of flexibility of the pivoting movements about pivot axes 37, 47 and 58, afforded by the provision of resilient members in one or more of the respective pivot connections as described above. The mechanism thereby establishes the coupling automatically, without any manual intervention.

It is seen in the embodiment of Figure 3 that the actuator assembly is
15 designed so that when the clutch parts 60 and 62 are interlocked, the midpoint 48 of the pair of foldable arms 49,50 is at a lower location than the outer ends 55,56 of this pair of arms. This provides an anti-release security to the coupling, even if the power to the variable length actuator 45 is lost. The midpoint 48 can only be raised by activating the variable length actuator 45. The mechanism is thereby
20 protected from unwanted release of the coupling.

The invention is however not limited to the embodiment shown in the drawings. The actuator assembly could be replaced by any other assembly that performs the function of actuating the pivoting motion of the pendulum arm 36 about the first pivot axis 37. A variable length actuator could for example be
25 oriented horizontally or at a suitable oblique angle to the horizontal direction, between a pivot point on the header frame 14 and the pivot point 56 on the pendulum arm 36.

According to an embodiment, the pivot connection that connects the pendulum arm 36 to the header is fixed relative to the header during operation of
30 the coupling mechanism, but this pivot connection is displaceable between a variety of fixed positions, preferably in the vertical direction. In other words, the pivot axis 37 in Figure 3 can be placed higher or lower. This can be realized by any suitable mechanism, for example by providing multiple holes in the header

frame along a vertical line, in which holes a rotation axle through the top portion of the pendulum arm 36 can be inserted. This feature lends a degree of adaptability to the coupling mechanism, allowing it to adapt to different positions of the jackshaft 22 for example.

5 The coupling mechanism is preferably arranged above the header driveline and the jackshaft 22, as shown in the drawings, but the same mechanism could be installed below these components, by mirroring the mechanism about the longitudinal axis of the jackshaft 22. In the latter case, the midpoint of the foldable arms 49,50 would need to be pushed upward for closing the clutch, and
10 downward for opening it.

 The hub 30 could be connected to the pendulum arm 36 in another way instead of through a pivotable connection that allows the hub to pivot about pivot axis 39. The hub could be attached at the end of the pendulum arm through a resilient member, that allows the hub sufficient freedom of movement relative to
15 the pendulum arm 36, for enabling the hub to become aligned with the jackshaft 22. The hub could be substantially fixed to the pendulum arm 36, provided that the orientation of the jackshaft 22 is adapted for alignment with the hub when the pendulum arm 36 swings towards the closing position.

Claims

1. A combine harvester (10) comprising :

- 5 • a feeder (8) at the front of the harvester, the feeder comprising a housing (11), an input section (12) and an output section (13),
- a driveline rotatably coupled to a power source of the combine and comprising a jackshaft (22) in the vicinity of the input section of the feeder,
- a combine header (1) removably attached to a front portion of the feeder
- 10 (8), and comprising a header driveline that includes a header drive shaft (23) configured to be releasably coupled to the feeder jackshaft (22),
- characterised in that the combine harvester (10) comprises a mechanism for automatically coupling the header drive shaft (23) to the jackshaft (22), said mechanism comprising :
- 15 • a pendulum arm (36) pivotably connected to the header (1) at a first end, and arranged to pivot relative to the header (1), about a first pivot axis (37) oriented transversely with respect to the jackshaft (22),
- a bearing hub (30) connected to the pendulum arm (36) at the latter's opposite end, the hub (30) comprising a housing (31) and a rotatable axle
- 20 portion (32) inside the housing (31) and rotatable relative to the housing (31), , wherein one end of the axle portion (32) is rotatably connected to the header drive axle (23), and the opposite end of the axle portion (32) comprises a first part (60) of an axial clutch,
- an actuator (45) mounted on the header (1) and configured to actuate a
- 25 pivoting motion of the pendulum arm (36) about the first pivot axis (37),
- a second clutch part (62) configured to engage with the first clutch part (60), the second clutch part (62) being mounted at the outer end of the jackshaft (22).

- 30 2. The combine harvester according to claim 1, wherein the pivot connection between the pendulum arm (36) and the header (1) is a flexible pivot connection, configured to allow a limited lateral movement of the pendulum arm (36) with respect to a plane perpendicular to the first pivot axis (37).

3. The combine harvester according to claim 1 or 2, wherein:

- the actuator is a variable length actuator (45) comprising a base portion (45a) and an extendable portion (45b) that can be controlled to extend from or retract toward the base portion, wherein the base portion is pivotably connected to the header and arranged to pivot about a second pivot axis (47),
- the automatic coupling mechanism further comprises a pair of foldable arms (49,50), pivotably interconnected at a midpoint (48),
- the extendable portion (45b) of the actuator is pivotably coupled to the midpoint (48) of the pair of foldable arms (49,50),
- the first foldable arm (49) is pivotably connected to the header at its outer end (55) opposite to the midpoint (48), and arranged to pivot about a third pivot axis (58),
- the second foldable arm (50) is pivotably connected to the pendulum arm (36) at its outer end (56) opposite the midpoint (48),
- the actuator (45) is configured to drive the movement of the midpoint (48) between the foldable arms, so that said movement actuates the approach or retraction of the bearing hub (30) relative to the jackshaft (22).

4. The combine harvester according to claim 3, wherein the first to third pivot axes (37,47,58) are substantially parallel.

5. The combine harvester according to claim 3 or 4, wherein the pivot connections between the actuator (45) and the header (1) and between the first foldable arm (49) and the header (1) are flexible pivot connections.

6. The combine header according to any one of claims 3 to 5, wherein the mechanism is configured so that when the clutch parts (60,62) interlock, the midpoint (48) of the foldable arms (49,50) has moved beyond the position of the outer ends (55,56) of the foldable arms opposite the midpoint (48).

7. The combine harvester according to any one of the preceding claims, wherein the second clutch part (62) is provided with an alignment aid (63), configured to engage in an opening provided in the first clutch part (60).

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8. The combine harvester according to any one of the preceding claims, wherein the drive axle (23) of the combine header is connected to the axle portion (32) located in the bearing hub (30) through a universal joint (24).

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9. The combine harvester according to any one of the preceding claims, wherein the jackshaft (22) and the header drive axle (23) are oriented transversely to the forward driving direction of the combine harvester.

15

10. The combine harvester according to any one of the preceding claims, wherein the bearing hub (30) is pivotably connected to the pendulum arm (23).

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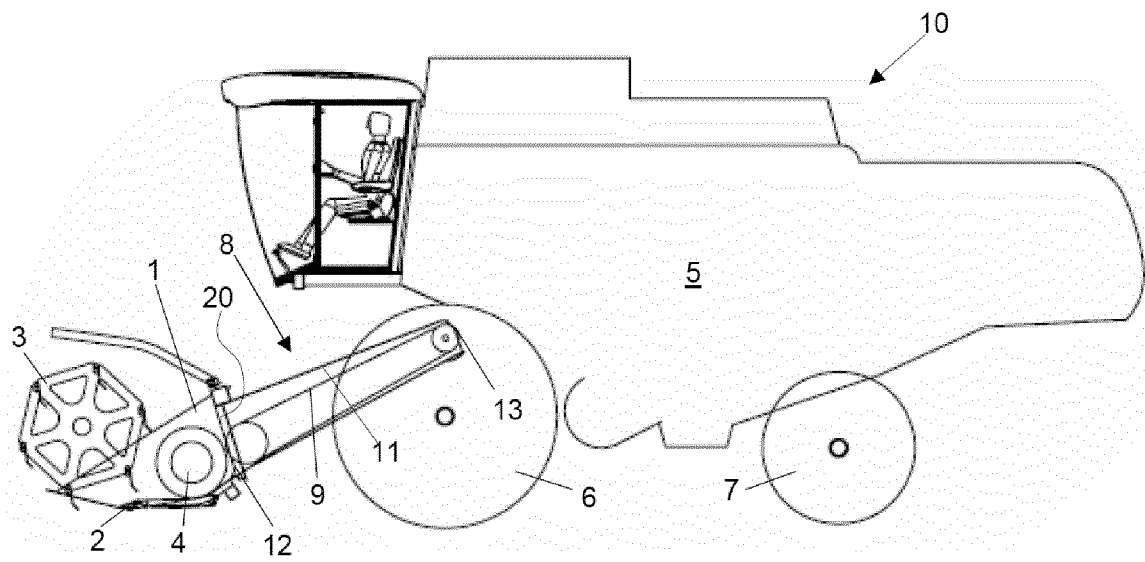


FIG. 1

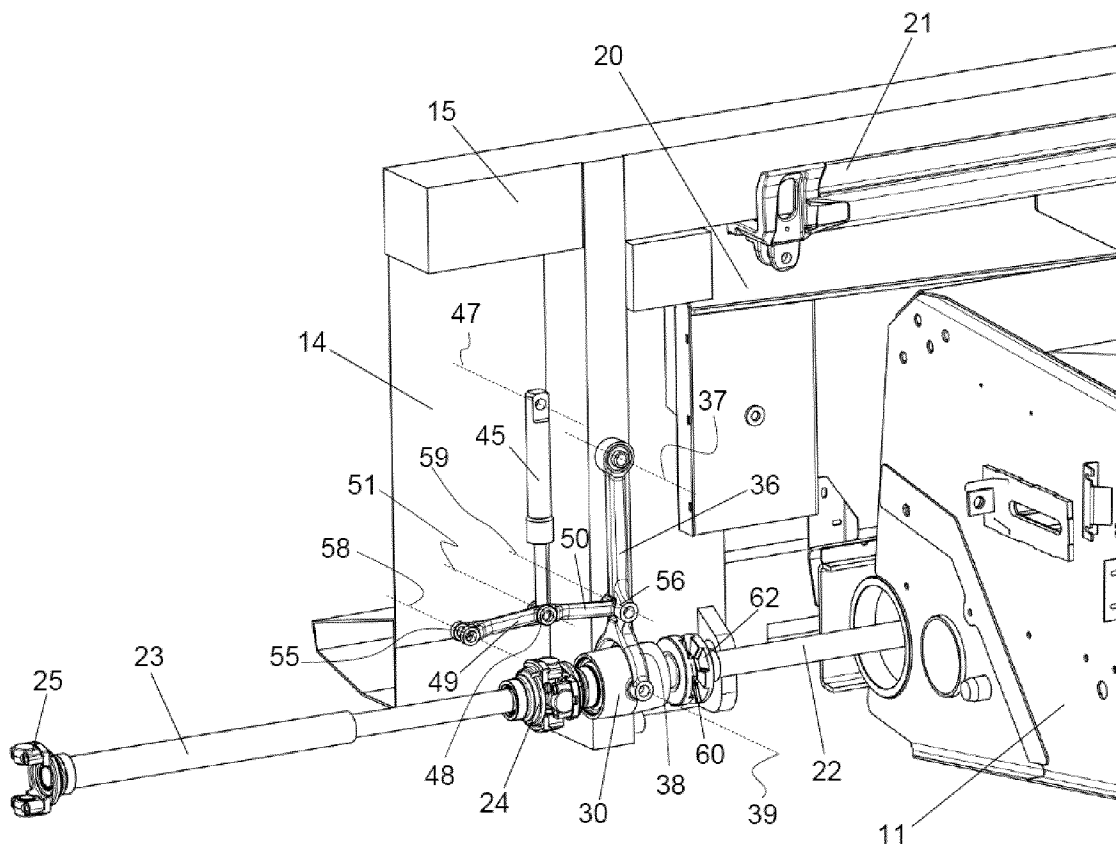


FIG. 2

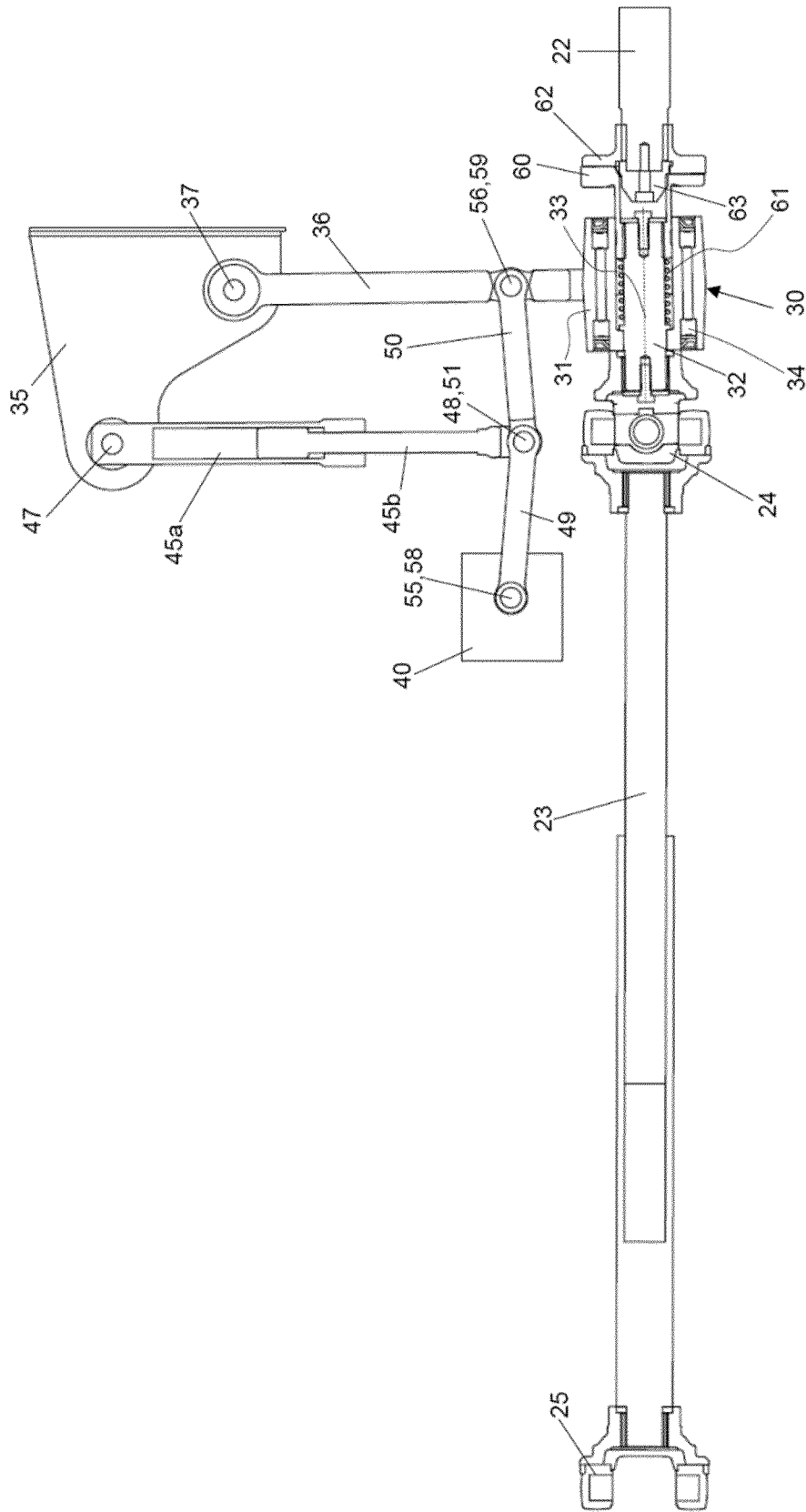


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
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According to International Patent Classification (IPC) or to both national classification and IPC		
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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.
A	AU 434 298 B2 (MASSEY FERGUSON LIMITED) 29 March 1973 (1973-03-29) the whole document figure 6 -----	1-10
A	US 3 324 637 A (ROBERT ASHTON ET AL) 13 June 1967 (1967-06-13) the whole document figure 6 -----	1-10
A	WO 2015/134055 A1 (AGCO CORP) 11 September 2015 (2015-09-11) the whole document figure 5 -----	1-10
A	DE 15 07 338 A1 (MASSEY FERGUSON IND LTD) 8 January 1970 (1970-01-08) the whole document -----	1-10
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 20 February 2020		Date of mailing of the international search report 20/03/2020
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 Wagner, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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