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Display of the support frame height at an operator terminal

The present invention relates to an attachment for attaching to an agricultural and/or forestry machine, in particular to a tractor or hauler, wherein the attachment has a height adjustable support frame at which attachment at least one work assembly such as a mower, a rotary rake, or the like is adjustably suspended between a work position and a transport position.

Various agricultural attachments for attaching to a hauler are known whose work assemblies such as a mower unit, a rotary rake, a conditioner, or a soil cultivation device having grubber tines, coulter disks, or packer wheels are adjustably suspended at a height adjustable support frame such that the work assembly that carries out the main agricultural and/or forestry functions of the device can be moved between a lowered work position and a raised transport position. The work assemblies can, for example, be suspended by means of support arms that can be pivoted about horizontal pivot axes so that the work assemblies project above the ground in a roughly speaking horizontal work position and project upwardly in an upright transport position. Machines can hereby be implemented with large working widths that nevertheless observe the permitted road transport width in that the work assemblies are upwardly pivoted for transport.

In this process, however, it occurs due to working widths that always become bigger and bigger that the maximum permitted transport height is sometimes no longer observed since the work assemblies project more than four meters upwardly. To combat this and/or to be able to observe the permitted transport height, the support frame is therefore typically lowered as far as possible, optionally below the work height customary or optimum for the work position. In the work position, the support frame should be traveled in a specific desired height range to enable upward and downward movements of the work assembly for the purpose of ground adaptation,

to move a weight relief in a favorable desired region, and/or to avoid excessive kink angles of universal shafts or other drivetrain elements. If the support frame is traveled in a too greatly deviating "incorrect" support frame height in the work position, it may occur that suspension elements travel onto abutments during the ground adaptation and can no longer carry out the required ground adaptation or that a counterweight device such as tension springs are no longer moved in a range providing the relief force in accordance with the intended purpose and/or the universal shafts kink too much, energy supply hoses such as hydraulic hoses are bent over too much, or similar functional impairments or wear potential arise.

It is naturally known in the prior art to monitor the work height of the work assemblies in that the height position of the work assemblies is detected by different sensors and is then displayed on a display unit on the hauler, c.f., for example, the documents EP 1 300 061 A1, EP 2 158 799 A1, US 2012/186503 A1, US 6,076.611 A, US 2012/227992 A1, US 6,085,846 A, WO 2012/167258 A1, US 2013/081830 A1, and US 5,339,906 A.

Starting from this, it is the underlying object of the present invention to provide an improved attachment of the named type which avoids the disadvantages of the prior art and further develops the latter in an advantageous manner. An operation of the attachment at incorrect height positions of the support frame should in particular be avoided.

Said object is achieved in accordance with the invention by an attachment in accordance with claim 1. Preferred aspects of the invention form the subject of the dependent claims.

It is therefore proposed to detect the height position of the support frame and to display it in the field of view of the machine operator, in particular such that the detected actual height is displayed in comparison with a desired range for the support frame height so that the machine operator can easily recognize whether the support frame of the attachment is located in the region of the desired height or outside it. In accordance with the invention, at least one detection means for detecting the height

position of the support frame and a display terminal for displaying the detected height position of the support frame are provided, with said display terminal being positionable at the driver's cabin of the agricultural and/or forestry machine in the field of view of the machine operator. It can be avoided by the proposed detection and display of the height position of the support frame that the machine operator forgets to correct the support frame height, for example after the lowering of the work assemblies from the transport position into the work position, when the support frame height has previously been specifically lowered for road transport. The same applies in a similar manner when the support frame height had been specifically lowered, for example in difficult field accesses over berms or terrain crests, to have enough clearance and the machine operator then forgets to lower the support frame again.

Said display terminal can here be a hauler display that is fixedly arranged at the hauler and that is used to display the detected height position of the support frame of the attachment. Said hauler display can here be controlled from the attachment, for example from a job processor provided thereon. Alternatively or additionally, the control of the hauler display can also take place by a display control or a control device at the hauler side to which the height position signal of the detection means is supplied.

Alternatively or additionally to a hauler display not specific to such an attachment, the display terminal can, however, also have a unit display that is specific to the attachment and at which the detected height position of the support frame can be displayed. Said unit display can likewise be controlled from the attachment, for example its job processor, and/or also by a control unit at the hauler side, with said unit display advantageously likewise being positionable in the driver's cabin of the hauler, for example by a holder provided there.

Said display terminal can generally be configured as mobile and can have a mobile display, for example in the form of a tablet. Alternatively, however, a fixedly installable display is also possible. The display can, for example, be a computer-like monitor.

Said display terminal can here be connected to the control device at the unit side and/or at the hauler side by means of a signal supply line and/or a power supply line. Alternatively, a wireless communication is also possible between the detection means for detecting the height position of the support frame or the corresponding control device, on the one hand, and the display terminal, on the other hand.

In accordance with the invention, the display terminal has a range display for displaying a desired range of the support frame height and an actual display for displaying the detected actual height position of the support frame relative to said desired range of the support frame height to make it easily detectable whether the actual height is outside or inside the desired range. Said desired range display can, for example, comprise a bar chart representation with which an indicator representation of the actual display can be associated. A green bar can, for example, advantageously display the desired range; for example with adjacent marginal regions that are yellow and/or red and that display height positions disposed outside the optimum height region, with the actual display being able to move the aforesaid indicator in the region of the green bar and also outside. It is, however, also understood that different configurations of the display units are possible, for example traffic light displays or similar. Acoustic displays are also possible.

In accordance with the invention, the display terminal here comprises at least two range displays of which a first range display indicates the desired range of the carrier arm height for the work position of the work assembly and a second range display indicates the desired range of the support frame height for the transport position of the work display.

The suspension or linkage or support of the at least one work assembly at the support frame can generally be configured differently and can be adapted to the respective machine category. The at least one detection means for detecting the height position can accordingly be configured differently and can comprise one or more sensors that can in turn be configured differently.

In accordance with the invention, the at least one work assembly is suspended by means of at least one pivotable support arm that can be pivoted about an at least approximately horizontal support arm pivot axis between a lowered work position and a raised transport position. On such a configuration of the attachment, the detection means for detecting the height position of the support frame can advantageously have at least one angle sensor by means of which the pivot position of said support arm can be determined. Two or more angle sensors can also be sensible depending on the specific configuration of the support frame and/or of the suspension of the work assembly. in a further development of the invention, the work assembly can, for example, be connected in an articulated manner to a bearing arm that is in turn pivotably connected to the aforesaid support arm in an articulated manner, for example about a pivot axis that is in turn aligned horizontally and that can extend approximately in parallel with the aforesaid support arm pivot axis. On such a configuration, it can be sensible to provide two angle sensors of which one detects the angle position of the support arm with respect to the horizontal and/or vertical and/or with respect to a base part of the support frame and another angle sensor determines the angle position of the bearing arm with respect to the horizontal or vertical and/or with respect to the support arm.

Alternatively or additionally to such an angle sensor, the at least one detection means can also comprise a height sensor that can, for example, directly measure the distance of a height relevant structural part of the support frame from the ground and/or the height position relative to the hauler. A sensor can, for example, measure the distance of a central base support from the ground, preferably contactlessly, with said base support being able to height adjustably support the at least one work assembly and/or can itself be height adjustably suspended at the hauler, for example by means of a three-point hitch.

Alternatively or additionally, the at least one detection means for detecting the height position can also have at least one sensor that can detect an extended state or a position and/or a distance of an adjustment actuator, in particular of a servo control cylinder, with said sensor advantageously being a linear sensor and/or being able to be integrated in said adjustment actuator. Such a sensor can, for example, be

associated with the lifting cylinder by means of which the support arm supporting the work assembly can be lifted out. Alternatively or additionally, such a sensor can also be associated with an adjustment cylinder of the three-point hitch of the central base support to be able to determine the height position of the base support relative to the hauler.

Alternatively or additionally, the at least one detections means can also comprise a distance measurement cylinder by means of which the respective covered distance of a height relevant component can be measured.

The aforesaid display terminal can advantageously have a pivot position desired range display that displays a desired angle range for the pivot position of the support arm and/or for the pivot position of the bearing arm, with the display terminal furthermore being able to comprise a pivot position actual display that can display the actual pivot position of the support arm and/or of the bearing arm relative to the respective associated desired range.

Alternatively or additionally to such a direct display of the pivot positions, an evaluation device can also be provided by means of which the detected pivot position of the support arm and/or of the support arm and/or of further suspension arms is/are evaluated to determine the height position of the support frame from it/them so that the height position of the support frame can be displayed in the previously described manner, in particular relative to a desired range.

In a further development of the invention, a control device for controlling a height adjustment device is provided by means of which the height position of the support frame of the attachment can be set.

Said control device can here comprise a manual control mode that makes it possible for the machine operator to perform the height setting of the support frame manually, with the machine operator here being able to proceed with reference to the actual value and/or desired value of the height position displayed on the display terminal.

To further facilitate the height setting, said control device can also be configured as working semiautomatically or fully automatically, in particular such that a height position that is within the desired range of the height position is traveled to semiautomatically or fully automatically. If, for example, the display terminal indicates that the actual height position is outside the desired region for it, the control device can initiate the adjustment of the support frame, optionally after a release by the machine operator or after an input of a corresponding start command by the machine operator, can, for example, control a corresponding actuator to reach the desired height position. With a fully automatic configuration of the control device, the desired height position can also be traveled to automatically, for example whenever the work assembly is lowered from the transport position into the work position or vice versa is raised from the work position into the transport position.

If the detection device for the detection of the actual height position of the support frame works in the aforesaid manner with at least one angle sensor, said control device can also be configured in the manner of a regulating device and can adjust the height position of a support frame part at which the aforesaid support arm is pivotally connected until the emitted pivot position angle of the bearing arm is in a desired region provided for this purpose and/or the pivot position angle of the aforesaid bearing arm comes to lie in a desired region provided for this purpose when the working device is in its work position or is operated in working operation.

Alternatively or additionally, said control device can also comprise a control and/or regulation module that lowers the height position of the support frame on the moving of the work assembly into the transport position so far until the permitted transport height of - currently 4 m, for example - is reached or fallen below or is observed.

The measurement sensors can here generally be configured and arranged differently, for example be angle measurement sensors provided at the boom or at the attachment or at a rocker of the attachment. The sensors can be connected to a control or to a processor in which, for example, the length and/or width of the attachment and/or of the respective projecting work assembly is/are stored. The vertical extent or the height of the attachment can thus be determined without any

additional investment of components from the measured angle of incidence of the attachment and/or work assembly and its known length and/or width. Only the control has to be set accordingly for this purpose and no additional components are required.

It is conceivable in a preferred embodiment that the attachment is a plow, a grubber, a mower, a harrow, a seedbed combination, a seeder, a hay tedder, a chaff cutter, and/or another agricultural and/or forestry attachment. The invention thus in particular relates generally to attachments that in their work positions have a comparatively large width with respect to the corresponding machine and that can adopt correspondingly large heights in the transport state pivoted vertically upwardly.

It is conceivable in a further preferred embodiment that the attachment is arranged substantially horizontally in the work position and/or substantially vertically in the transport position. The attachment can thus be pivoted by approximately 90° between the two position, with the exact angle being immaterial here. The attachment can thus also be pivoted by 60° to 120° between the two positions or by an angle differing therefrom without deviating from the idea of the invention.

The invention is also directed to the combination of an agricultural and/or forestry machine, in particular a tractor having at least one attachment of the above described type.

The invention will be explained in more detail in the following with respect to a preferred embodiment and to associated drawings. There are shown in the drawings:

Fig. 1: a schematic plan view of an attachment in the form of a mowing machine that is attached to a hauler and that shows two laterally projecting attachments that are in the work position;

Fig. 2: a schematic representation of the support of the work assemblies on the support frame of the attachment of Fig. 1;

Fig. 3: a schematic representation of the display of the support frame height, and

Fig. 4: a schematic rear view of the attachment, with one work assembly being shown in the lowered work position and one work assembly being shown in the raised transport position.

As Figs. 1 and 2 show, the attachment 1 can have a support frame 2 that can be attached to a hauler 3.. Depending on the configuration of the attachment 1, the support frame 2 can be attached to the hauler 3 by means of an attachment block and a three-point hitch and can be height adjustable via said three-point hitch. Alternatively, the support frame 2 can also be supported on the ground by means of a chassis on the configuration of the attachment 1 as a fifth wheel device and can be connected to the hauler 3 in a pivotable manner via a towing bar, with the support frame 2 being able to be height adjustable, for example, by a height adjustable configuration of the chassis and/or by a kinked towing bar and/or by other height adjustment means.

Mixed forms are also possible in which the support frame 2 is supported on the ground by means of a contact chassis in the working position and can be raised for transport.

As Fig. 2 shows in more detail, a plurality of work assemblies 4 can be connected in an articulated manner to or suspended at the support frame 2 and can be configured as mowing units in the case of the mowing machine shown. The work assemblies 4 can here advantageously be connected in an articulated manner to the base support 6 of the support frame 2, with said support arms 5 being able to be pivotably supported about horizontal support arm pivot axes 7 that can face in the direction of travel so that the support arms 5 can be moved from the lowered work position shown in Fig. 2 with an approximately horizontal support arm alignment into a raised transport position with an approximately upright support arm alignment. A suitable lifting actuator, for example in the form of a pressure medium cylinder, can be

connected in an articulated manner to the base support 6, on the one hand, and to the respective support arm 5, on the other hand.

The work assemblies 4 can be directly or indirectly connected in an articulated manner to the support arms 5, for example by means of the bearing arms 8 that are further shown in Fig. 2 and that can in turn be pivotably suspended at the projecting ends of the support arms 5 about horizontal pivot axes 8 that can be aligned in parallel with the support arm pivot axes 7.

Said attachment 1 further comprises detection means 9 for detecting the height position of the support frame 2, with detection means 9 being able to comprise at least one sensor or different sensors. The at least one sensor can in this respect be differently configured, with a plurality of sensors also being able to be provided that can each be configured the same or can also be configured in different manners. A height sensor 10 that measures the distance of the base support from the ground can, for example, be associated with the central base support 6. Alternatively or additionally, the height of the central base support 6 can also be determined via the height position of the three-point hitch of the hauler 3.

Alternatively or additionally, angle sensors 11 that can determine the pivot position of the support arms 5 relative to the horizontal and/or vertical and/or relative to the base support 6 can be associated with the support arms 5. Further angle sensors 12 can furthermore be associated with the bearing arms 13 or with the joint between the support arms 5 and the bearing arms 13 to also be able to determine their angle position relative to the horizontal and/or vertical and/or relative to the support arms 5.

Alternatively or additionally to said angle sensors 11, the detection means 9 can also have at least one linear sensor 21 for detecting the position or the covered distance of the lifting cylinder by means of which the respective support arm 5 can be lifted out so that the position of the support arm 5 can be deduced from the position of this lifting cylinder. Alternatively or additionally, at least one sensor, preferably a linear sensor, can also be associated with the lifting cylinder of the three-point hitch by

means of which the central base support 6 of the support frame 2 is connected in an articulated manner to the hauler 3 to be able to calculate the height position of the base carrier 6 from the position of the three-point cylinder.

Alternatively or additionally, the at least one detection means 9 can also comprise a distance measurement cylinder 23 by means of which the covered distance of a height relevant structural component can be measured.

As schematically indicated in Fig. 1, the at least one detection means 9, in particular its sensors such as said various height and/or linear and/or angle sensors 10 to 12, can be connected to a control device 14 that comprises an evaluation unit 15 to determine the height position of the support frame 2 from the sensor signals.

The determined actual height position of the support frame 2 is displayed on a display terminal 16 that can be configured in the form of a display positionable at the driver's cabin of the hauler 3 and that can be controlled by said control device 14. Said display terminal 16 can here display in the initially described manner both the desired ranges 17, 18 for the height position of the support frame 2 in the work configuration and for the transport configuration of the attachment 1 and can indicate the actual value of the height position relative to the at least one desired height region as the actual height display 19, for example in the initially explained indicator bar diagram display, cf. Fig. 3.

Said control device 14 can advantageously also be used to control the height adjustment actuators for adjusting the height position of the support frame 2, and indeed advantageously in a semiautomatic or fully automatic manner, with the control device 14 advantageously being able to comprise different operating modes to be able to advantageously selectively set the height position of the support frame 2 manually, semiautomatically, and fully automatically, as was initially explained.

Measurement data of the measurement sensors or of the angle sensors can be detected at the individual components by a control, not shown, for determining the height of the work device 1. The vertical position or the vertical extent of the

attachment 1 can furthermore be determined from the determined data and from the known length of the attachment 1. Since the position of the attachment block 2 can also be determined via corresponding sensors and furthermore the position of the attachment block 2 relative to the subsurface of the machine can be known, the vertical extent of the attachment 1 from the ground up to its highest point can thus be measured and indicated.

It is also conceivable by means of the control to automatically move the attachment 1 into the transport position or to pivot it between the work and transport positions. An operator can start the corresponding pivot procedure via, for example, the control terminal for this purpose. To adopt the transport position, the respective support arm 5 can then, on the one hand, be pivoted upwardly and the attachment block 2 can be traveled downwardly to minimize the vertical extent of the attachment and to observe the maximum permitted travel height of, for example, 4 meters.

Patentkrav

1. Påhængsredskab til påsætning på en traktor (3), med en højdeindstillelig bæreramme (2), hvorpå mindst et arbejdsaggregat (4) såsom en slåmaskine, rotorrive, jordbearbejdningsindretning eller lignende er påhængt indstilleligt mellem en sænket arbejdsstilling og en hævet transportstilling ved hjælp af mindst en bærearm (5), der er monteret drejeligt omkring en liggende bærearmsdrejeakse (7) på den højdeindstillelige bæreramme (2), hvor der er tilvejebragt mindst et registreringsmiddel (9) til registrering af bærerammens (2) højdestilling og en visningsterminal (16) til visning af bærerammens (2) registrerede højdestilling, hvor den nævnte visningsterminal (16) kan positioneres på traktorens (3) førerhus i maskinførerens synsfelt, **kendetegnet ved, at** visningsterminalen (16) har en områdevisning (17, 18) til visning af et nominelt område af bærerammehøjden og en faktisk visning (19) til visning af den registrerede faktiske højdestilling af bærerammen (2) i forhold til det nævnte nominelle område, hvor visningsterminalen (16) omfatter en første områdevisning (17) til visning af et nominelt område af bærerammehøjden til påhængsredskabets arbejdsstilling (1), hvori bærearmen (5) er drejet nedad, og en anden områdevisning (18) til visning af et nominelt område af bærerammehøjden til påhængsredskabets (1) transportstilling, hvori bærearmen (5) er drejet opad.

2. Påhængsredskab ifølge det foregående krav, hvor visningsterminalen (16) omfatter et traktordisplay, der er tilvejebragt fast på traktoren (3), og/eller et apparatdisplay, der hører til påhængsredskabet (1).

3. Påhængsredskab ifølge et af de foregående krav, hvor det mindst ene registreringsmiddel (9) omfatter mindst en sensor (10, 11, 21, 22) til registrering af en placering og/eller en orientering og/eller en tilbagelagt vejstrækning og/eller en tilbagelagt drejevinkel af en højderelevant strukturkomponent af påhængsredskabet.

4. Påhængsredskab ifølge et af de foregående krav, hvor der er tilvejebragt mindst en vinkelsensor (11) til registrering af bærearmens (7) drejestilling, hvor

visningsterminalen (16) har en nominel områdevisning for drejestillingen til visning af et nominelt område for bærearmens drejestilling, og/eller der er tilvejebragt en analyseindretning til analyse af den registrerede drejestilling og bestemmelse af bærearmens (2) højdestilling ud fra den registrerede drejestilling.

5. Påhængsredskab ifølge et af de foregående krav, hvor det mindst en registreringsmiddel (9) omfatter en højdesensor (10) til registrering af afstanden mellem en central basisbæredel (6) af bærerammen (2) og underlaget.

6. Påhængsredskab ifølge et af de foregående krav, hvor det mindst ene registreringsmiddel (9) omfatter mindst en sensor (21, 22), især lineær sensor, til registrering af stillingen og/eller den tilbagelagte vejstrækning af en indstillingscylinder, der er tilvejebragt til indstilling af arbejdsaggregatet (4) og/eller bærerammen (2).

7. Påhængsredskab ifølge et af de foregående krav, hvor det mindst ene registreringsmiddel omfatter mindst en afstandsmålecylinder (23) til registrering af den tilbagelagte vej og/eller stillingen af en højderelevant strukturdel af påhængsredskabet.

8. Påhængsredskab ifølge et af de foregående krav, hvor en styreindretning (14) er tilvejebragt til styring af en højdeindstillingsindretning til indstilling af bærerammens (2) højde, hvor styreindretningen (14) omfatter en styrekomponent (20) til halv- eller fuldautomatisk indstilling af bærerammehøjden afhængigt af den registrerede bærerammehøjde.

9. Påhængsredskab ifølge det foregående krav i forbindelse med krav 5, hvor styreindretningen er udformet til afhængigt af bærearmens (5) registrerede drejestilling at indstille højdeindstillingsindretningen på en sådan måde, at bærearmens (5) registrerede drejestilling når et nominelt område.

10. Påhængsredskab ifølge et af de foregående krav, hvor styreindretningen (14) er udformet til ved eller efter arbejdsaggregatets (4) bevægelse til transportstillingen at indstille bærerammehøjden (2) på en sådan måde, at en maksimalt tilladt transporthøjde overholdes eller underskrides.

11. Påhængsredskab ifølge et af de foregående krav, hvor arbejdsaggregatet (4) i sin arbejdsstilling indtager en i det væsentlige liggende orientering og i sin transportstilling indtager en i det væsentlige opretstående orientering.

12. Påhængsredskab ifølge et af de foregående krav, hvor en bærerammehøjdeindstillingsindretning (21) til automatisk indstilling af bærerammens (2) bærerammehøjde ved flytning af arbejdsaggregatet (4) fra dens arbejdsstilling til dens transportstilling eller omvendt fra dens transportstilling til dens arbejdsstilling, hvor højdeindstillingsindretningen (21) er udformet til at sænke bærerammen (2) ved flytning af arbejdsaggregatet (4) til transportstillingen så langt, at en tilladt vejtransporthøjde overholdes, og ved flytning af arbejdsaggregatet (4) til dens arbejdsstilling at sænke bærerammen (2) automatisk til et nominelt højdeområde til arbejdsstillingen.

13. Påhængsredskab ifølge et af de foregående krav, hvor påhængsredskabet er en jordbearbejdningsindretning, især en plov, en kultivator, en harve, en såbedskombination, en såmaskine og/eller en græsmarksindretning, især en slåmaskine, en høbjergningsmaskine, en konditioneringsindretning, en flishugger og/eller et andet land- og/eller skovbrugspåhængsredskab.

14. Land- og/eller skovbrugsmaskine, især traktor (3), med mindst et påhængsredskab (1), der er udformet ifølge et af de foregående krav.

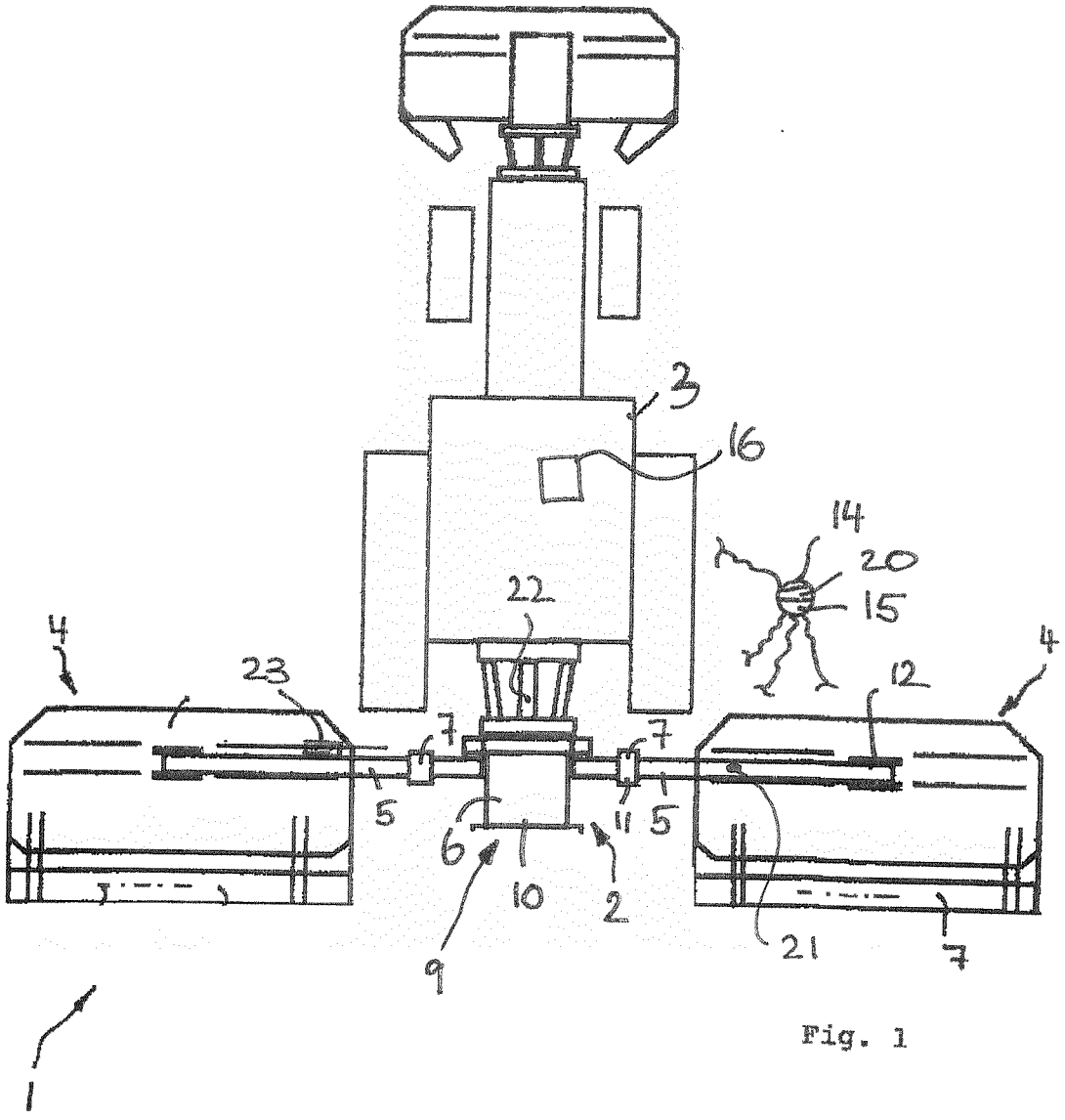

Fig. 1

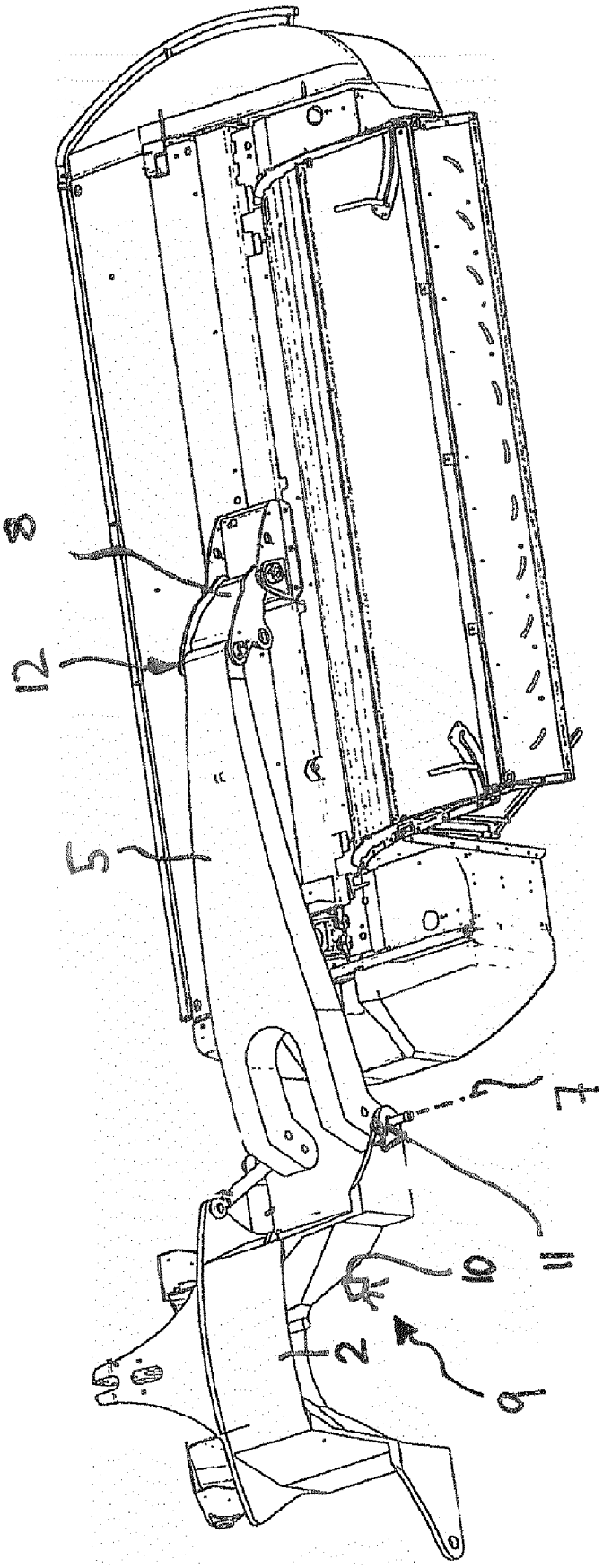

Fig. 2

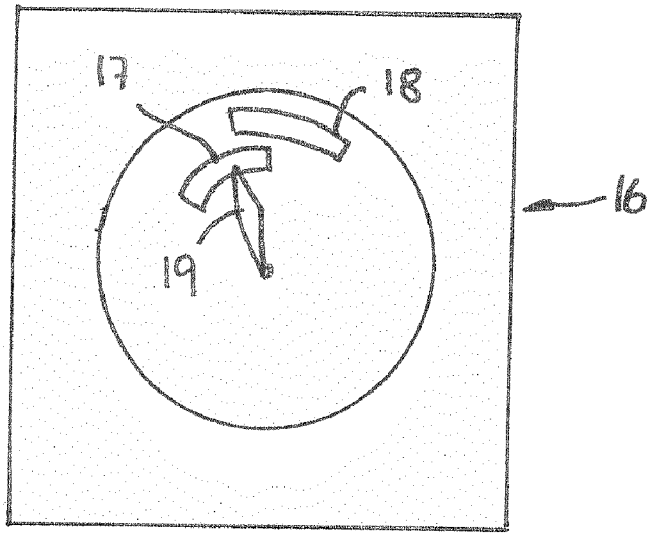

Fig. 3

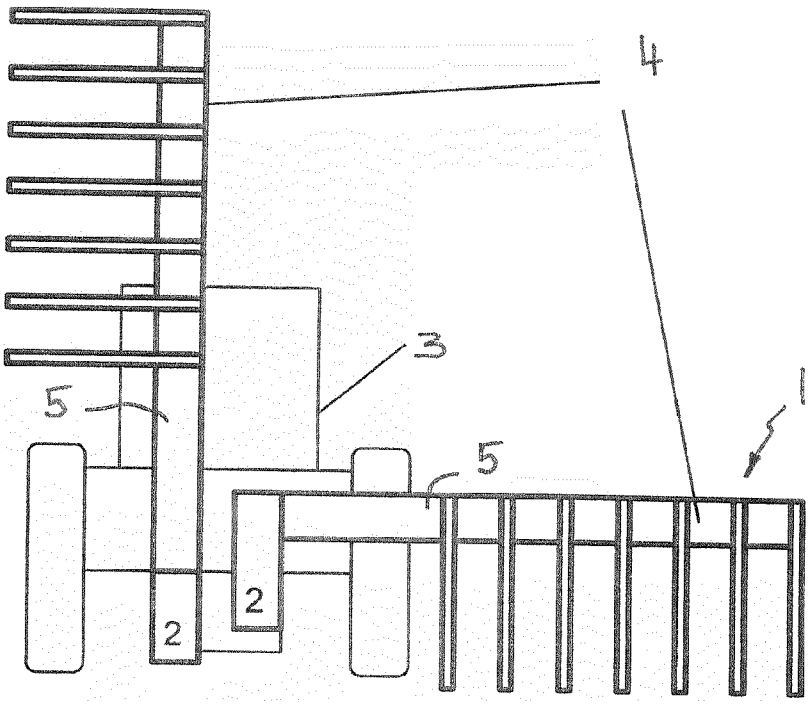

Fig. 4