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Agricultural distributor

Description

The invention relates to an agricultural distributor according to the preamble of Patent Claim 1.

Such an agricultural distributor is known from DE 10 2007 025 751 A1. In this distributor, the distributor boom is to be kept in a position which is as steady as possible by way of suitable actuators by compensating for the transmission of the frame movements to the distributor boom, wherein sensors detect the movement of the frame and transmit them to an electronic closed-loop control device, which then actuates the actuators. In this case, however, accelerations induced by cornering, which have an influence on the boom movement, are not taken into consideration. During cornering, the boom has the disadvantageous tendency to incline downward, generally toward the inner side of the curve.

The invention is based on the object of being able to ascertain data in a simple manner, to avoid disadvantageous deflection of the distributor boom during cornering or during the turning process.

This object is achieved according to the invention in that the sensor determining operating data is embodied as a rotational speed sensor, in that the damping element and/or the actuator for influencing the position of the distributor boom can be actuated and/or adjusted on the basis of the measurement data determined by the rotational speed sensor, specifically in such a way that forces acting on the distributor boom during cornering and/or a turning process are counteracted.

As a result of these measures, the centrifugal acceleration may be determined by means of the rotational speed sensor during cornering or during a turning process. This is performed in that the centrifugal acceleration is calculated on the basis of the rotational velocity determined by the rotational speed sensor and the actual travel velocity. An adaptation of the boom closed-loop control is performed on the basis of the determined centrifugal acceleration. This is performed before the boom is deflected from the target position by the centrifugal acceleration.

With the aid of the data of the rotational speed sensor and the travel velocity of the vehicle, the centrifugal acceleration acting on the vehicle is determined and the forces acting on the distributor boom during cornering are calculated on the basis of this acceleration. These calculated data are used as the foundation for actuating the actuators, to keep the distributor boom in the desired position.

Because of the detection according to the invention of the centrifugal acceleration and the adjustment data derived therefrom via the closed-loop control device, the damping element and/or the actuator for influencing the position of the distributor boom can be actuated by the closed-loop control device in accordance with these stored data, in such a way that a boom position of the distributor boom which is as steady as possible can be achieved during cornering and/or a turning process.

Further details of the invention can be inferred from the exemplary description and the drawings. In the figures
Figure 1 shows an agricultural distributor, implemented as a towed field sprayer having distributor boom, in a schematic and perspective illustration,
Figure 2 shows the middle region of the distributor boom with the towing hitch of the distributor boom on the frame of the distributor in the view from the rear, in a schematic illustration and partial view,

Figure 3 shows the field sprayer, which is towed by a farm tractor, with distributor boom located in the operating position during cornering and the forces acting on the boom in a top view and in an outline illustration, and
Figure 4 shows the distributor boom in the situation according to Figure 3 in a rear view and with forces acting on the boom in an outline illustration.

The agricultural distributor, which is implemented as a towed field sprayer 1, is coupled via a towing hitch to a farm tractor 2. The field sprayer 1 has a distributor boom 3 on its rear side, which is arranged so it is adjustable in the vertical direction via a coupling device 4 on the rear end of the frame 5 of the field sprayer 1. The distributor boom 3 consists of a middle boom section 6 and multiple boom sections 7, 7', 8, 8', 9, 9', which are articulated with one another. The respective innermost boom section 7, 7' is articulated on the middle boom section 6. Motorized adjustment elements 10, which are implemented here as double-action hydraulic cylinders, are arranged between the individual boom sections 7, 7', 8, 8', 9, 9', which can be folded in relation to one another, and between the respective innermost boom section 7, 7' and the middle boom section 6, to move the boom sections 7, 7', 8, 8', 9, 9' into a first folded position, which corresponds to the working position shown in Figure 1, and into a second folded position, in which the boom sections which can be folded in in relation to one another are arranged in a collapsed manner, which corresponds to the transport position (not shown). The individual boom sections 7, 7', 8, 8', 9, 9' adjoining one another are connected to one another via joints 11.

The middle boom section 6 is fastened via the boom mount 12 by means of a joint pin 13 to the frame 5 of the field sprayer 1 in a pivotable manner about the pivot axis 14 extending in the travel direction. Furthermore, an intermediate element 15 is also fastened in a pivotable manner on the joint pin 13. An adjustment element implemented as a double-action hydraulic cylinder 16 is fastened between the lower end of the intermediate element 15 and the middle boom section 6. The intermediate element 15 and the distributor boom 3 are fixedly connected to one another by means of the hydraulic cylinder 16.

The actuators 17 or damping elements for influencing the position of the distributor boom 3 and the spring elements implemented as tension springs 18 are arranged between the frame 5 and the intermediate element 15, and therefore the distributor boom 3.

A rotational speed sensor 19 is associated with the agricultural distributor 1. This rotational speed sensor can be arranged on the farm tractor 2, which pulls or supports the distributor. The rotational speed sensor 19 transmits the data measured thereby to the electronic closed-loop control device 20. An open-loop control and/or evaluation program is stored in the memory of the electronic closed-loop control device 20. The data which the rotational speed sensor 19 determines are supplied to this open-loop control and/or evaluation program. On the foundation of the measured data determined by the rotational speed sensor 19, in accordance with the adjustment data determined by the open-loop control and/or evaluation program, the damping element and/or the actuator 17 is actuated and adjusted to influence the position of the distributor boom 3. This is performed such that the forces acting on the distributor boom 3 during cornering and/or the turning process are counteracted. In accordance with the stored data, the damping element and/or the actuator 17 for influencing the position of the distributor boom 3 can be actuated by the control device 20, specifically in such a way that a position of the distributor boom 3 which is as steady and stable as possible is achieved during cornering and/or the turning process.

The actuation of the damping elements and/or the actuator 17 on the basis of the data determined by the rotational speed sensor 19, by the open loop control and/or evaluation program stored in the memory of the onboard computer 20, is performed essentially as follows, as explained in greater detail on the basis of Figures 3 and 4:

During cornering, the boom 3 of a plant protection sprayer 1 inclines because of the centrifugal acceleration, so that the side of the boom 3 on the inside of the curve is inclined downwards. The centrifugal acceleration during the cornering of the farm tractor 2 with the plant protection sprayer 1 is determined using a rotational speed sensor 20 and an adaptation of the boom closed-loop control device is performed on the basis of this variable, specifically before the boom 3 is deflected by the centrifugal acceleration out of the target position. An inclination of the boom during cornering is therefore suppressed by a corresponding adaptation of dampers or an inclination adjustment of the boom 3 by actuators 17.

The calculation of the travelled circle radius (r) on the basis of the rotational speed (Ω) and the travel velocity (v) measured by a velocity sensor is performed according to the mathematical equation:

$$r[m] = \frac{1}{\Omega[rad/s] : v[m/s]} = \frac{v[m/s]}{\Omega[rad/s]}$$

The calculation of the centrifugal acceleration (az) on the basis of the rotational speed (Q) measured by the rotational speed sensor and the circle radius (r) is performed according to the equation:

$$a_z[m/s^2] = \Omega^2[rad/s]^2 * r[m]$$

The centrifugal acceleration aZ acts on the centre of gravity SG of the boom 3 during cornering. This acceleration generates a resulting force Faz, which is opposite in its action direction to the acceleration. Because of the distance x between the centre of gravity SG of the boom 3 and the point of rotation 21, the force Faz generates a resulting torque Maz. This torque generates a deflection of the boom 3 during cornering.

With the aid of a rotational speed sensor 19, the centrifugal acceleration during cornering of the farm tractor 2 with the plant protection sprayer 1 is determined. If the mass of the boom 3 and the distance between the boom centre of gravity SG and the point of rotation 14 of the boom 3 are known, the dimension of the resulting torque Maz is thus calculated therefrom by the open-loop control and evaluation program stored in the onboard computer 20. This information can be used for an open-loop control and/or closed-loop control, to adapt the boom parameters such that the resulting torque Maz is compensated for, without a deflection of the boom 3. It is therefore possible to separate influences of cornering from the movement of the boom 3. The position of the boom 3 in relation to the ground surface is determined by distance sensors 22, which are arranged on the two end regions 21 of the distributor boom 3 in a known manner, and which also transmit their measurement data to the onboard computer 20.

Patentkrav

1. Landbrugsspredemaskine omfattende en fordelerbom (3) og en ramme (5) båret på jorden af et understel og mindst en opbevaringsbeholder, hvori fordelebommen (3) er ophængt på rammen ved hjælp af en ophængsindretning på sådan måde, at den kan bevæge sig omkring mindst en svingakse (14), der forløber i køreretningen, hvori fordelerbommen (3) strækker sig på tværs i forhold til køreretningen over flere gange spredemaskinens transportbredde, hvori ophængsindretningen har mindst et dæmpningselement arrangeret under rammen mellem fordelerbommen (3) og/eller mindst en aktuator (17) til at påvirke fordelerbommens position, hvilket dæmpningselement kan aktiveres med en elektronisk styringsindretning i henhold til et styrings- og/eller evalueringsprogram, som er lagret i styringsindretningens hukommelse, og til hvilket føres data fra mindst en føler, der bestemmer spredemaskinens driftsdata, **kendetegnet ved, at** føleren, der bestemmer driftsdata, er udført som en omdrejningshastighedsføler (19), at dæmpningselementet og/eller aktuatoren (17) for påvirkning af fordelerbommens (3) position kan aktiveres og/eller justeres på basis af måledataene bestemt af omdrejningshastighedsføleren (19), især på sådan måde, at kræfter, der virker på fordelerbommen (3) under kurvekørsel og/eller vending, modvirkes.

2. Landbrugsspredemaskine ifølge krav 1, **kendetegnet ved, at** for påvirkning af fordelerbommens (3) position kan dæmpningselementet og/eller aktuatoren (17) aktiveres af styringsindretningen (20) i henhold til de lagrede data på sådan måde, at en så vidt mulig rolig stilling af fordelerbommen (3) kan opnås under kurvekørsel og eller vending.

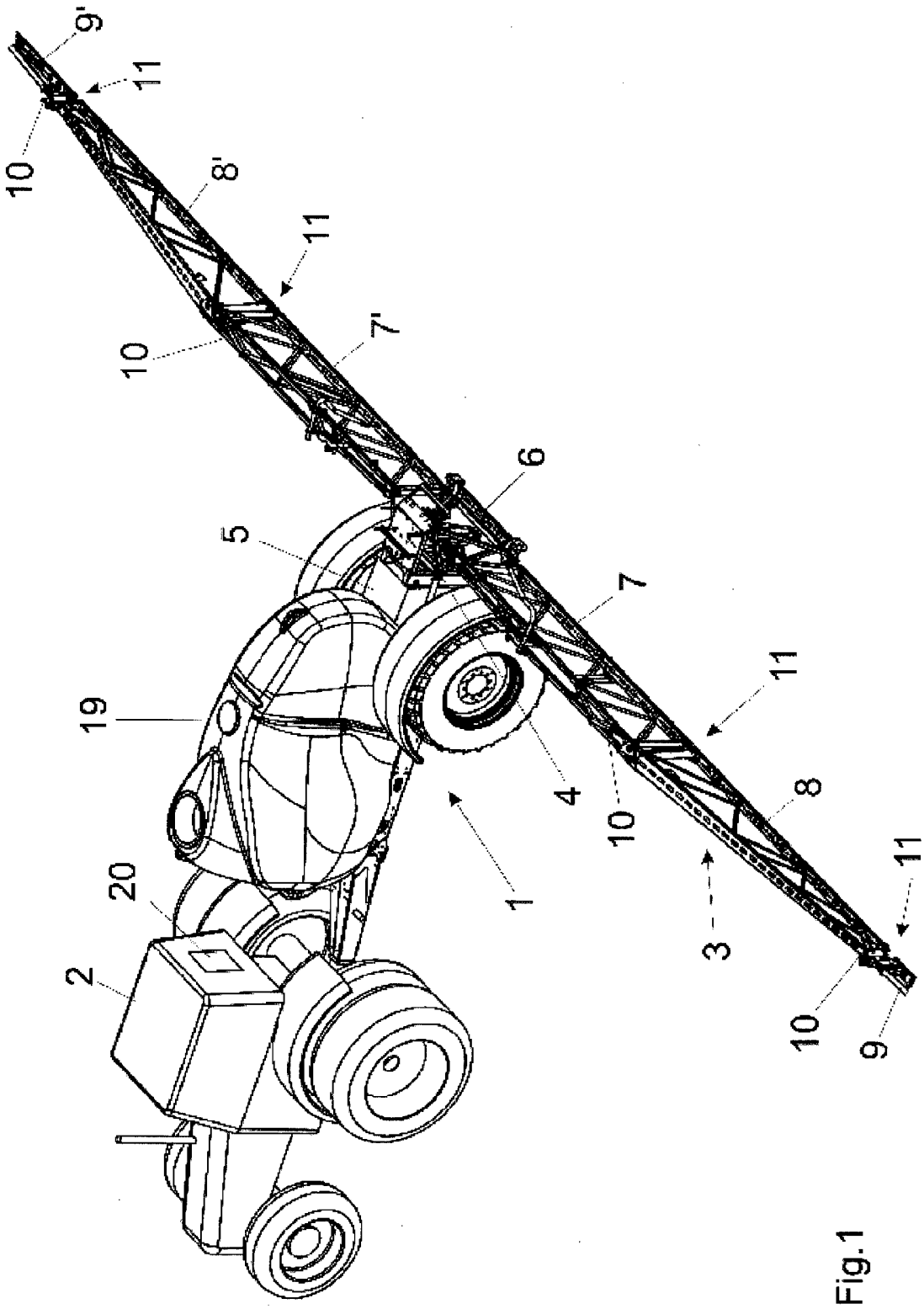

Fig.1

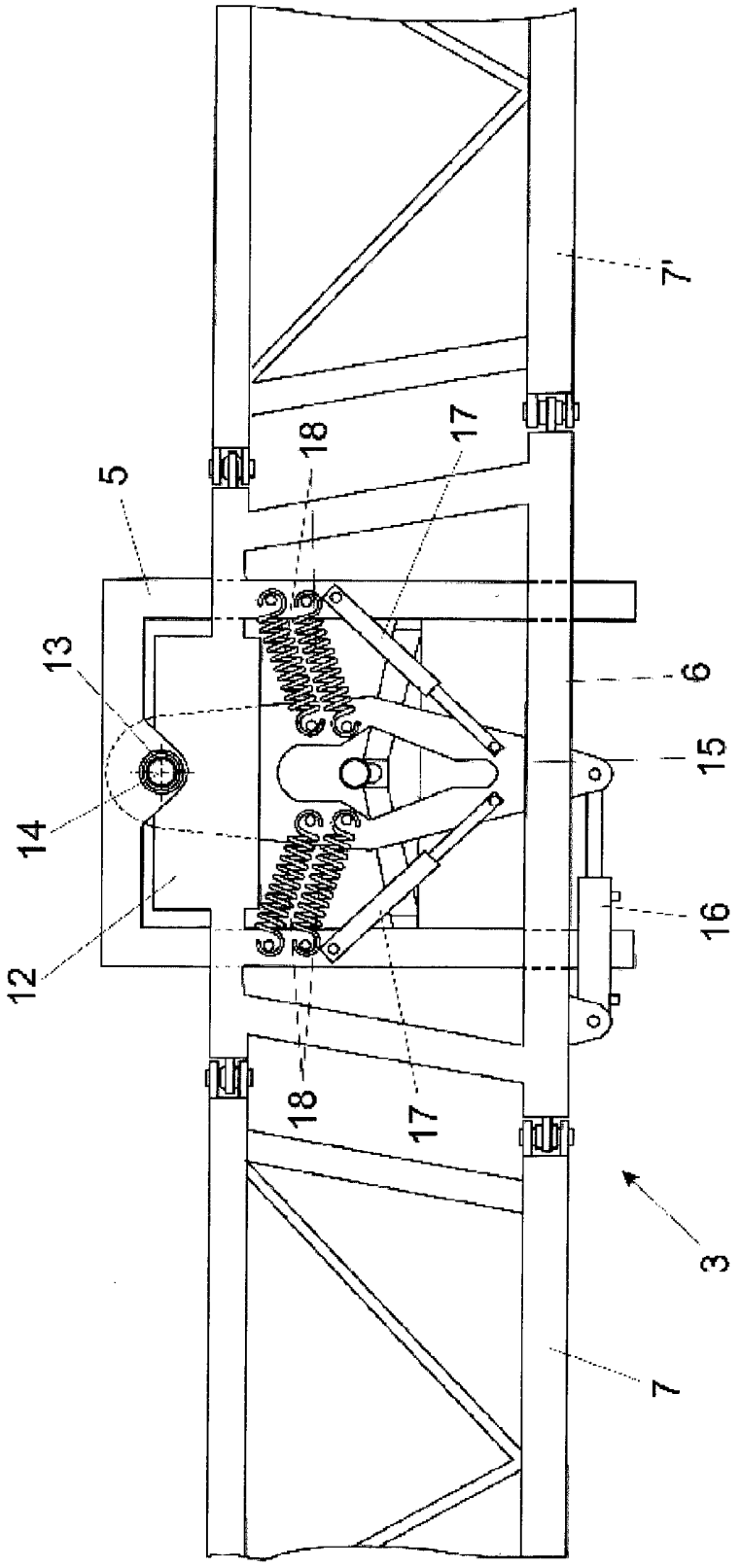

Fig. 2

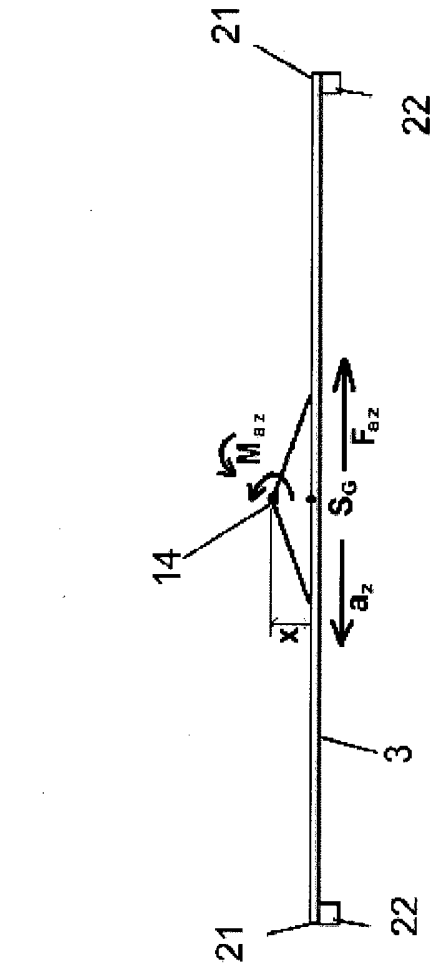

Fig. 4

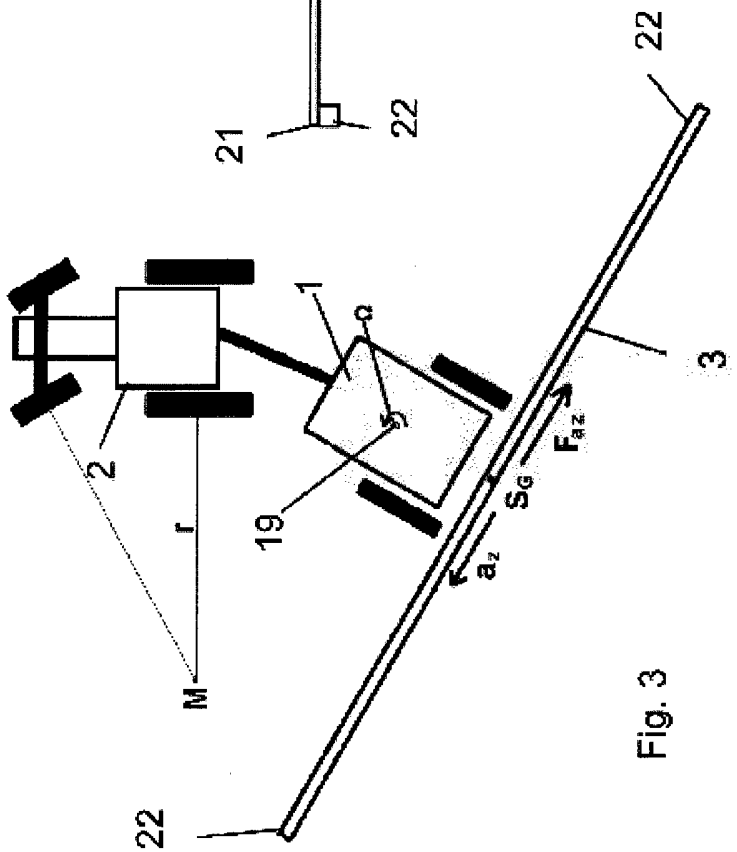

Fig. 3