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(54) **Title**: SPRAY DEVICE FOR SPRAYING LIQUIDS ON CROPS

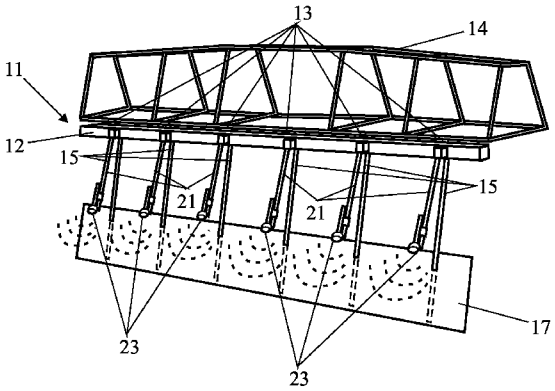

FIG. 2

(57) **Abstract**: A field crop spray apparatus 11 comprises a carrier 12 which is coupled to a carrier frame 14. A plurality of suspension elements 15 are attached to the carrier to which elements a blade 17 is attached. Carrier elements 21 are also attached to the carrier 12. Spays 19 which are positioned at a distance from the blade 17 are fixed to these carrier elements. The carrier elements are attached to the carrier independently of the suspension elements and the carrier frame has at least one stop that bounds the displacement of the carrier. As a result the sprays move along with the blade until further displacement of the carrier is impeded by the stop. When the blade is moved as a result of flexible displacement of the suspension elements, the position of the carrier elements with the sprays attached to them does not change so that the direction in which the sprays emit the spray fluid onto the vegetation thus remains the same.

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Field crop spray apparatus for spraying liquid on crops

DESCRIPTION

Field of the invention.

The invention relates to a field crop spray apparatus for spraying liquid on crops, the apparatus comprising a carrier frame, a carrier located parallel to the carrier frame and hingeably suspended from the carrier frame, a plurality of suspension elements attached to the carrier, a blade attached to the suspension elements and running parallel to the carrier, a plurality of carrier elements attached to the carrier, and sprays which are attached to the carrier elements and are located at a distance from the blade, which field crop spray apparatus is intended to be attached to an agricultural tractor with the carrier extending at right angles to the direction of movement of the agricultural tractor.

State of the art.

A spray apparatus of this kind is known from EP-A-2 098 117. In this known field crop spray apparatus the carrier elements and suspension elements form part of parallelogram structures which enable the sprays to be moved along with the blade in both height and direction when the apparatus is moved over the crop. These parallelogram structures are connected to a carrier which is hingeably suspended from a carrier frame. Owing to undulations of the ground the carrier moves up and down during the use of the field crop spray apparatus. During a downward movement of the carrier the blade meets with more resistance from the crop causing the position of the blade to change and the carrier to be displaced. As a result, the spray continues to maintain its distance from the crop, it is true, but the angle of distribution of the spray liquid over the crop is changed.

Summary of the invention.

It is an object of the invention to improve the known field crop spray

apparatus. To this end the field crop spray apparatus according to the invention is characterized in that the carrier elements are attached to the carrier independently of the suspension elements and on the carrier frame at least one stop is present that bounds the displacement of the carrier. As a result, the sprays move along with the blade until a further displacement of the carrier is impeded by the stop. When the blade is moved owing to flexible bending of the suspension elements, the position of the carrier elements with the sprays attached to them does not change. So the position of the sprays relative to the crop does not change during the moving over the crop, which is in contrast to the known field crop spray apparatus in which the sprays move along with the carrier. The direction in which the sprays emit the spray liquid onto the crop thus remains the same, irrespective of the position of the blade . In consequence, the spray liquid is always emitted onto the crop in the same direction, which direction is optimized.

It is observed that from US 4 659 017 a spray apparatus is known in which spray heads are directly connected to a carrier and the blade is hingeably suspended from the carrier. The carrier is attached to a slide which is moveable along a vertical guide. In this apparatus the spray heads as well as the blade are attached to the carrier independently of each other, but the carrier is not suspended hingeably.

An embodiment of the spray apparatus according to the invention is characterized in that dampers are positioned between the carrier and the carrier frame, which dampers deaden the movement of the carrier relative to the carrier frame. When the spray apparatus is moved over the crop, the blade will be dragged over the tops of the vegetation and then slowly move up and down owing to the difference in height of the crop and undulations of the ground on which the agricultural tractor is driving. When the agricultural tractor drives out of the crop, the spray apparatus immediately tends to hang down. This fast movement is deadened by the damper so that the spray apparatus will hang down slowly.

It should be observed that the dampers between the carrier frame and the carrier can also be applied to other spray apparatus than the field crop spray apparatus described hereinbefore, more particularly also to spray apparatus in which the sprays and the blade are not attached to the carrier independently of each other.

The dampers may be linear dampers as well as rotation dampers. In the case where the dampers are configured as rotation dampers, they preferably comprise two parts of which a first part is connected to the carrier and the other, second part is

connected to a coupling section which is connected to the carrier frame, as well as perforated plates of which a first group of plates is rigidly connected to the first part and a second group of plates is rigidly connected to the second part, while each plate of the second group is positioned between two plates of the first group and a viscous liquid is present between the plates. This rotation damper can be manufactured in a simple manner and is thus cost-effective and, in addition, robust and reliable in operation.

A further embodiment of the field crop spray apparatus according to the invention is characterized in that the suspension elements are made of a composite material. Applying a composite material yields a saving on weight, whereas the construction as such is nevertheless strong and flexible. The composite material is a combination of plastic and a tissue, for example carbon.

Brief description of the drawings.

The invention will be elucidated more fully below based on examples of embodiment of the field crop spray apparatus according to the invention while reference is made to the appended drawing figures, in which:

Fig. 1 gives a perspective view of the known field crop spray apparatus;

Fig. 2 gives a perspective view of an embodiment of the field crop spray apparatus according to the invention;

Fig. 3 gives a cross-sectional view of the field crop spray apparatus shown in Fig. 2;

Fig. 4 gives a cross-sectional view of the field crop spray apparatus during operation;

Fig. 5 shows the connection between the carrier and a coupling section in loose parts; and

Fig. 6 gives the sectional view of the connection shown in Fig. 5 in an assembled state.

Detailed description of the drawings.

Fig. 1 shows the known field crop spray apparatus 1. This field crop spray apparatus 1 comprises a carrier 2 which is connected by means of hinges 3 to a carrier frame 4 which can be coupled to an agricultural tractor and extends in essence

horizontally and at right angles to the direction of movement of the agricultural tractor. A plurality of elastic parallellogram-shaped suspension elements 5 are attached to the carrier 2 to which suspension elements is attached a blade 7 which drags over the crop during use and runs parallel to the carrier 2. Sprays 9 are attached to the suspension elements 5 between the blade 7 and the carrier 2.

Fig. 2 gives a perspective view of an embodiment of the field crop spray apparatus 11 according to the invention. This field crop spray apparatus 11 too comprises a carrier 12 which is connected to a frame 14 by means of hinges 13. Here too a plurality of suspension elements 15 to which a blade 17 is attached are connected to the carrier 12. The suspension elements 15, however, are not formed by flexible parallelogram constructions but by arms of carbon tissue. The field crop spray apparatus 11 also has sprays 19, but they are attached to the carrier 12 by means of carrier elements 21 independently of the blade 17. Between the carrier frame 14 and the carrier 12 are positioned a plurality of linear dampers 25 which deaden the movement of the carrier 12. Each of these dampers 25 is formed by a cylinder in which a piston moves. The dampers may be arranged as hydraulic or pneumatic dampers.

The sprays 23 are positioned at a distance above the blade 17, see Fig. 3. During the spraying of the crops, see Fig. 4, the blade 17 will come into contact with the crops as a result of which the field crop spray apparatus 11 turns around hinges 13 until it contacts the stop 23 which is attached to the carrier frame 14. During the spraying of the crop the blade 17 will bend the suspension elements 15 (indicated by broken lines) while the position of the carrier elements 21 with sprays 19 attached thereto does not change relative to the carrier frame 14. The sprays 19 are thus attached to the carrier frame 14 independently of the blade 17, so that the position of the sprays does not change when the position of the blade is changed as a result of the bending of the suspension elements 15 when the spray apparatus is moved over the crop.

In lieu of a linear damper such as the one indicated in Figs. 3 and 4, the carrier 12 may also be connected to the carrier frame 14 by means of a rotation damper. Fig. 5 shows loose parts of the construction of one of the hinges 13 provided with a rotation damper 31. The hinge construction is formed here by a sleeve 33 which is attached to the carrier 12 by means of a bolt 35 mounted on this sleeve 33. A bolt 37 projecting through the sleeve is connected by means of the rotation damper 31 to a coupling member 39 that is mounted on the carrier frame 14.

Fig. 6 gives a sectional view of the hinge 13 in an assembled state. The

rotation damper 31 comprises two parts 43 and 45, of which a first part 43 is connected to the carrier 12 and the other, second part 45 is connected to the coupling member 39. The rotation damper 32 further includes a plurality of perforated plates 47 and 49, of which a first group of plates 47 is rigidly connected to the first part 43 and a second group of plates 49 is rigidly connected to the second part 45. This rigid connection is obtained by arranging the first part 43 as a square-section shaft and the second part 45 as a housing with a chamber having a square cross section and providing the first group of plates 47 with a square opening and the second group of plates 47 with a square outer circumference. Each of the plates 49 of the second group is then positioned between two plates 47 of the first group and a viscous fluid, for example grease, is present between the plates 47 and 49.

Albeit the invention has been described in the foregoing with reference to the drawings, it should be pointed out that the invention is not by any manner or means restricted to the embodiments shown in the drawings. The invention also extends over any embodiment deviating from the embodiment shown in the drawing figures within the spirit and scope defined by the claims.

CLAIMS:

1. A field crop spray apparatus (1) for spraying liquid on crops, the apparatus comprising a carrier frame (14), a carrier (12) located parallel to the carrier frame and hingeably suspended from the carrier frame, a plurality of suspension elements (15) attached to the carrier, a blade (17) attached to the suspension elements and running parallel to the carrier, a plurality of carrier elements (21) attached to the carrier, and sprays (19) which are attached to the carrier elements and are located at a distance from the blade, which field crop spray apparatus is intended to be attached to an agricultural tractor with the carrier extending at right angles to the direction of movement of the agricultural tractor, characterized in that the carrier elements (21) are attached to the carrier (12) independently of the suspension elements (15) and on the carrier frame (14) at least one stop (23) is present that bounds the displacement of the carrier (12).

2. A field crop spray apparatus as claimed in claim 1, characterized in that dampers (25; 31) are positioned between the carrier (12) and the carrier frame (14), which dampers deaden the movement of the carrier relative to the carrier frame.

3. A field crop spray apparatus (11) as claimed in claim 2, characterized in that the dampers are configured as rotation dampers (31).

4. A field crop spray apparatus (11) as claimed in claim 3, characterized in that the rotation dampers (31) comprise two parts (43, 45), of which a first part (43) is connected to the carrier (12) and the other, second part (45) is connected to the coupling member (39) which is connected to the carrier frame (14), as well as perforated plates (47, 49), of which a first group of plates (47) is rigidly connected to the first part (43) and a second group of plates (49) is rigidly connected to the second part (45), each plate (49) of the second group being positioned between two plates (47) of the first group and a viscous fluid being present between the plates.

5. A field crop spray apparatus (11) as claimed in any one of the preceding claims, characterized in that the suspension elements (15) are made of a composite material.

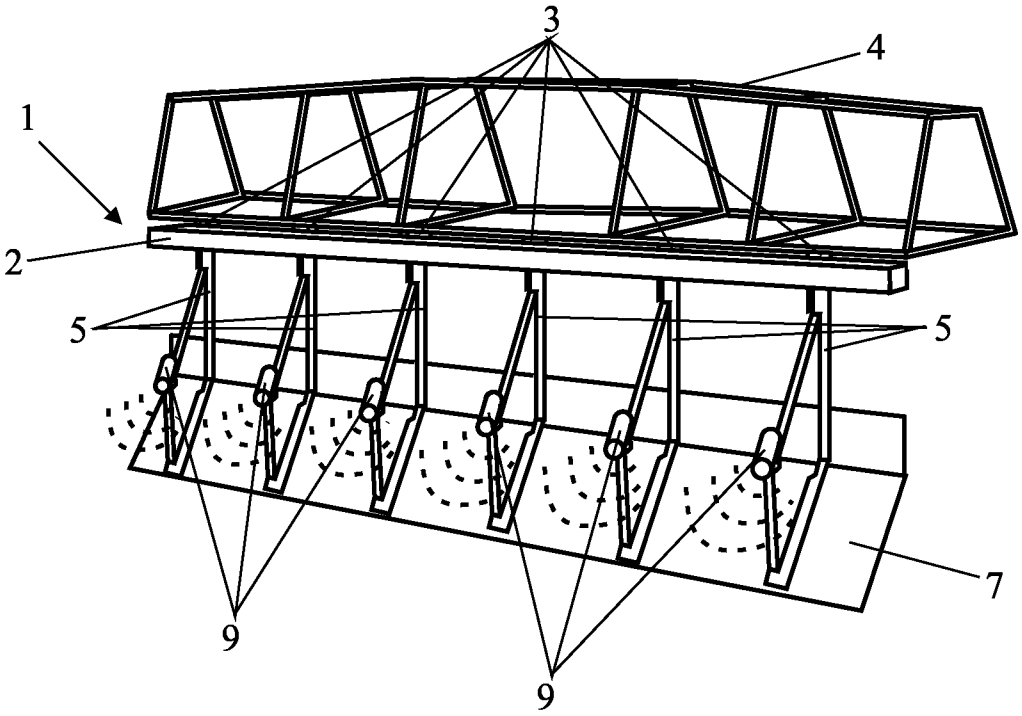

FIG. 1

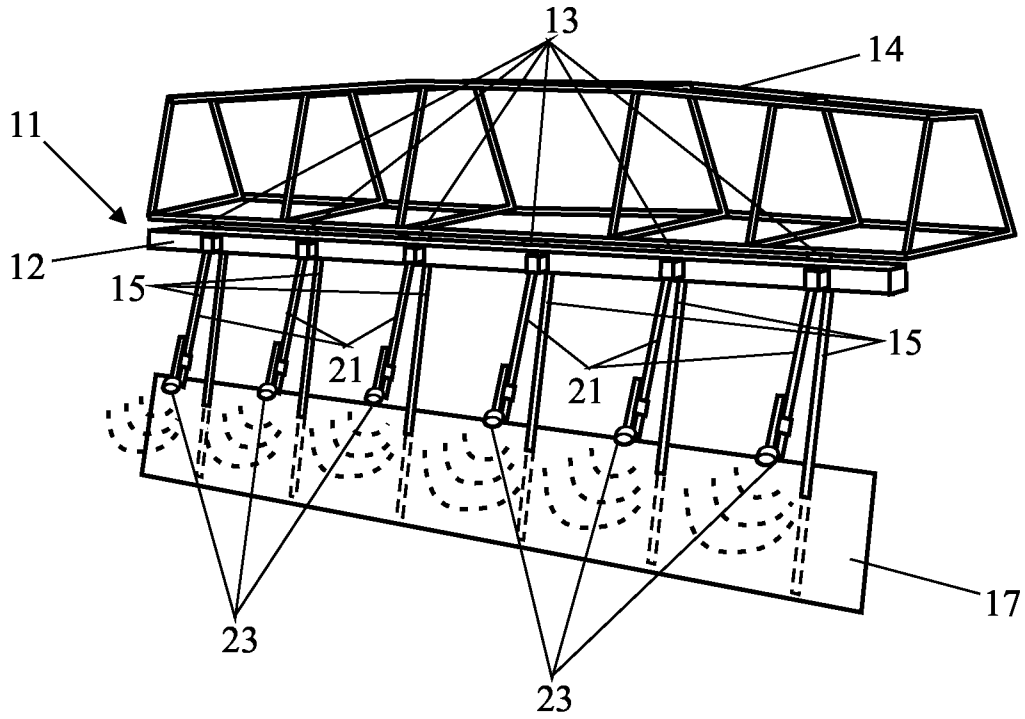

FIG. 2

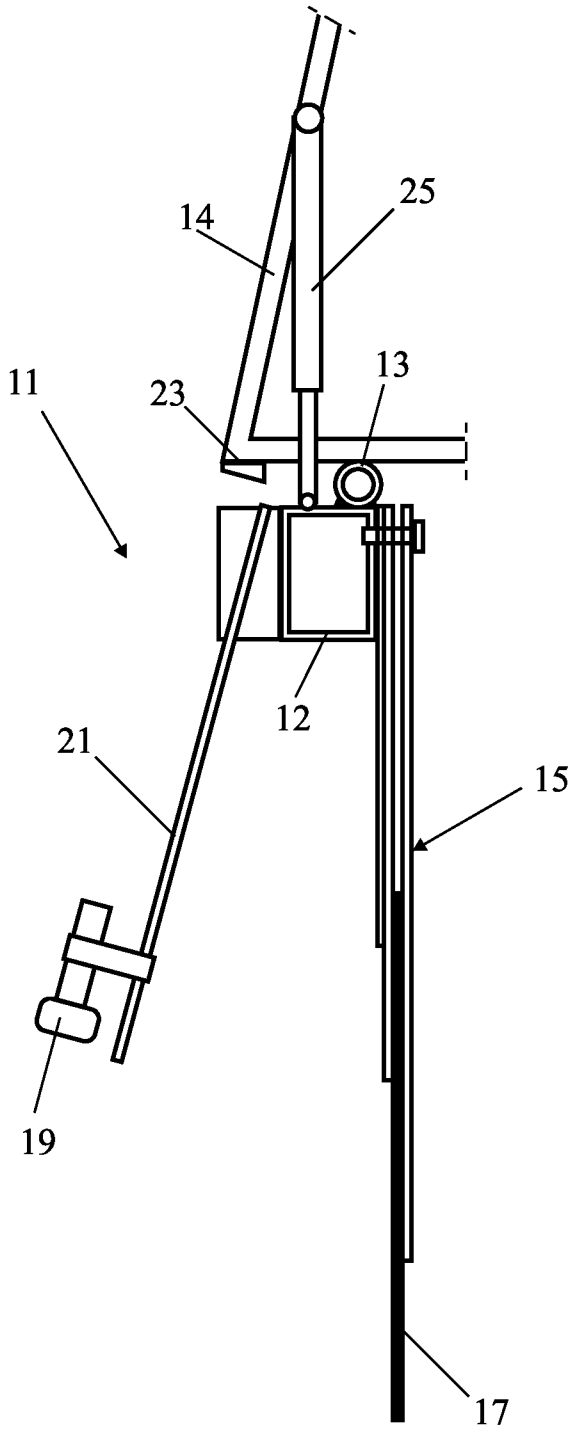

FIG. 3

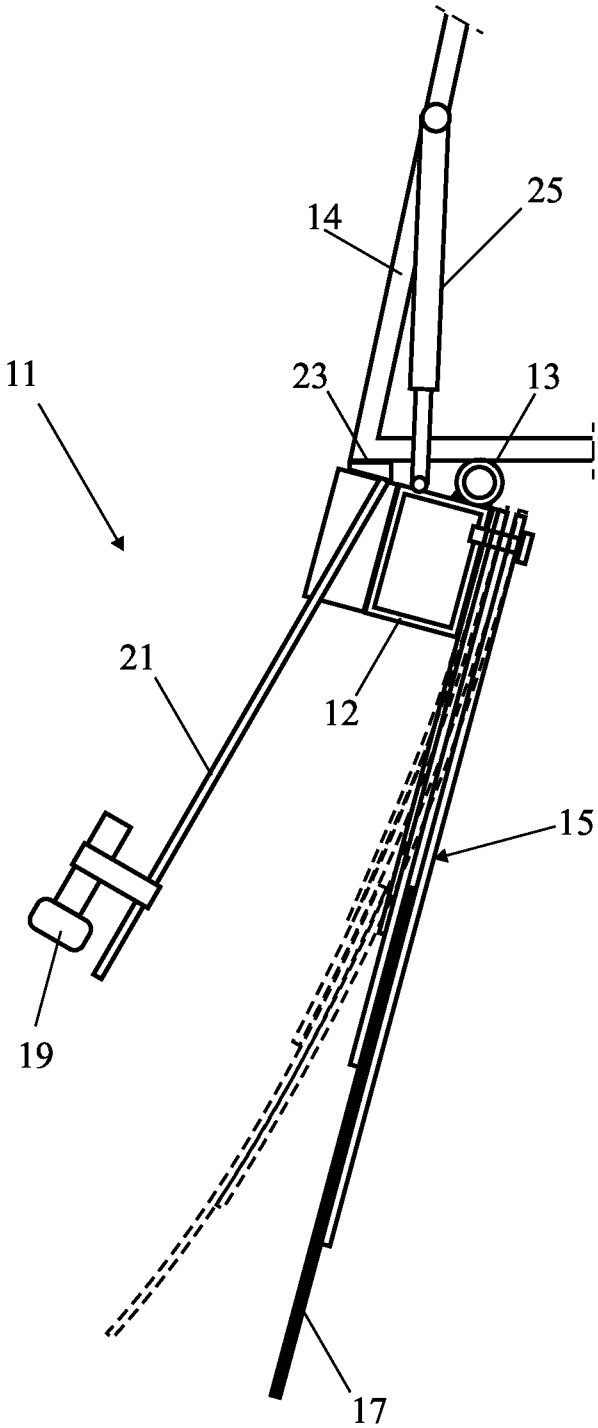

FIG. 4

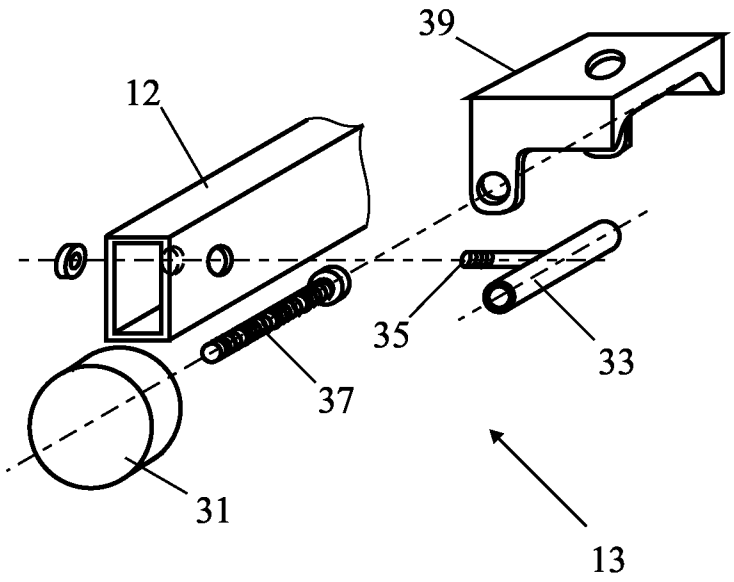

FIG. 5

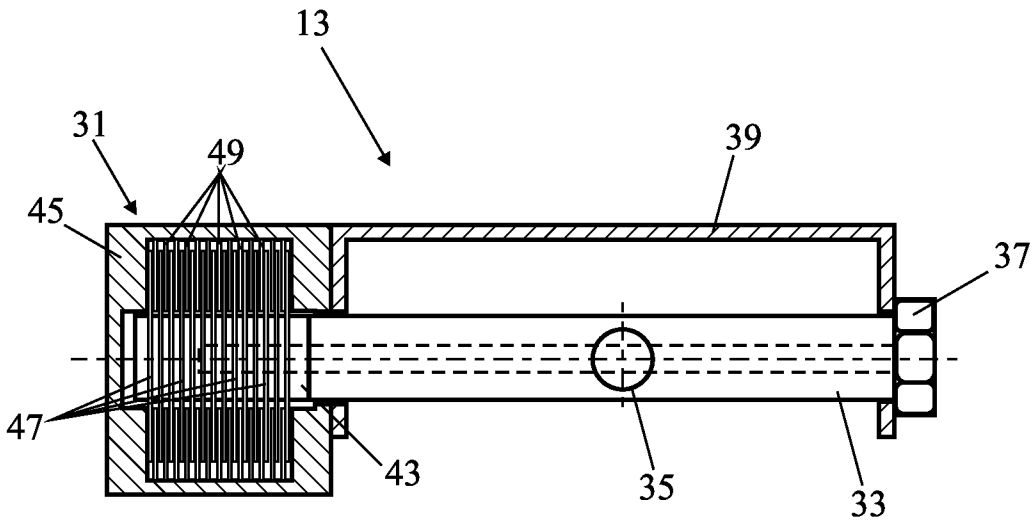

FIG. 6