

United States Patent

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[54] **FLOATING BOOM**
9 Claims, 4 Drawing Figs.

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239/175, 239/172, 239/169

[51] Int. Cl..... **B65d 5/74**

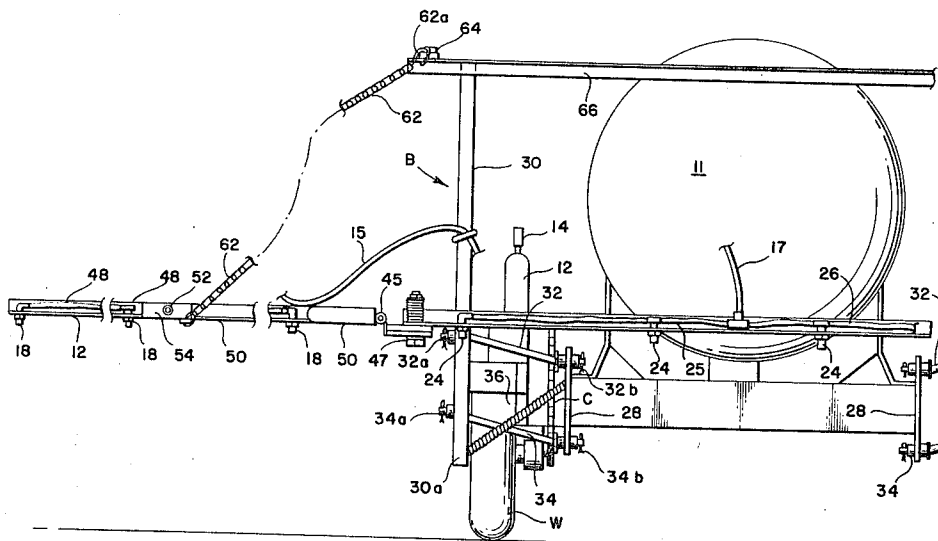
[50] Field of Search..... 239/164,
159, 166, 167, 168, 169, 172, 175, 176;
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ABSTRACT: An applicator tank-carrying spraying vehicle includes a nozzle-mounting elongate boom resiliently mounted on the vehicle through a pivotable parallel linkage arrangement and support springs. The outboard ends of the boom are pivotably connected to the sections of the boom inboard thereof and are chain-connected to upright sections of the boom structure at points inboard of these pivotable connections.



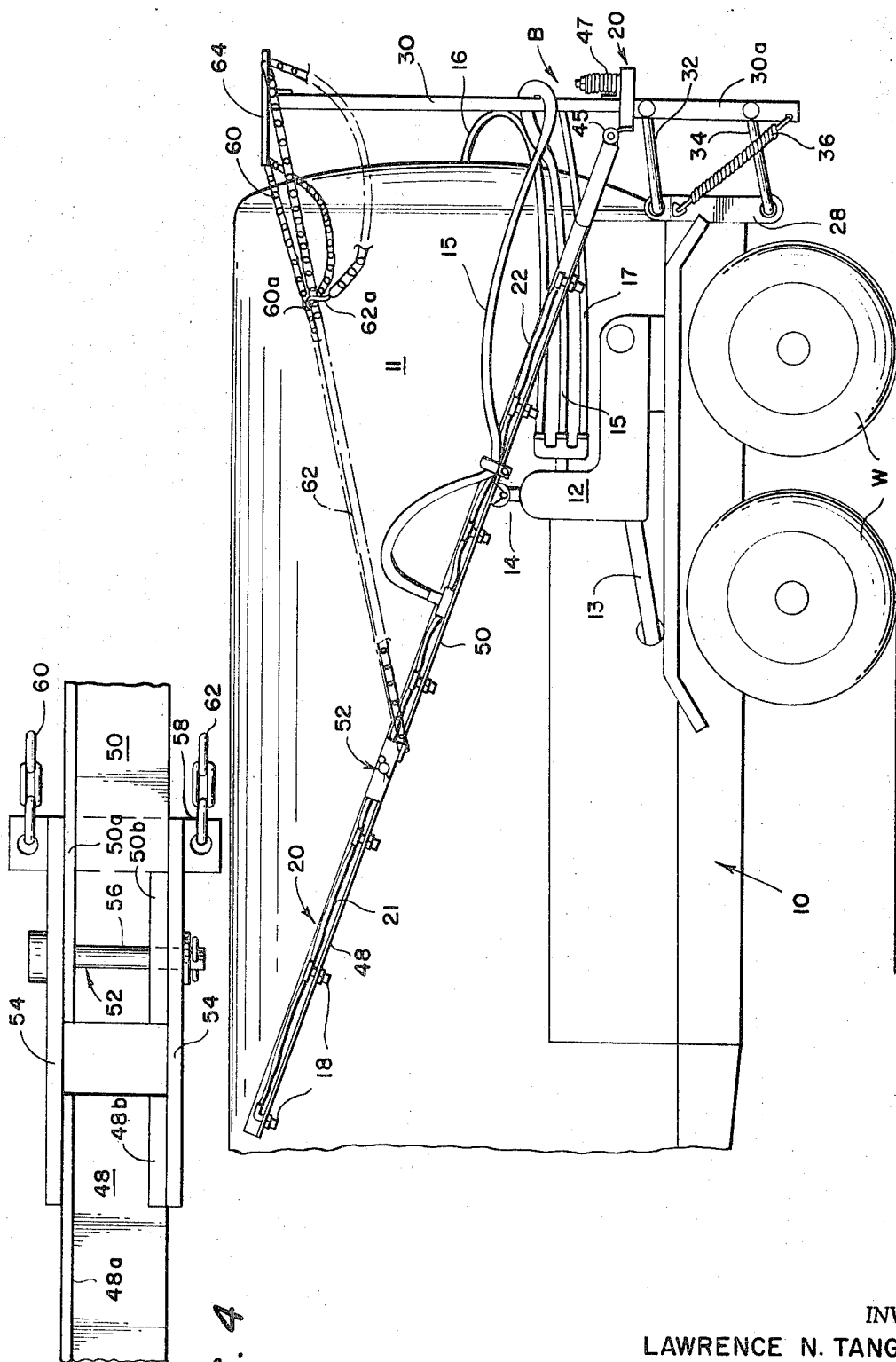


FIG. 1

FIG. 4

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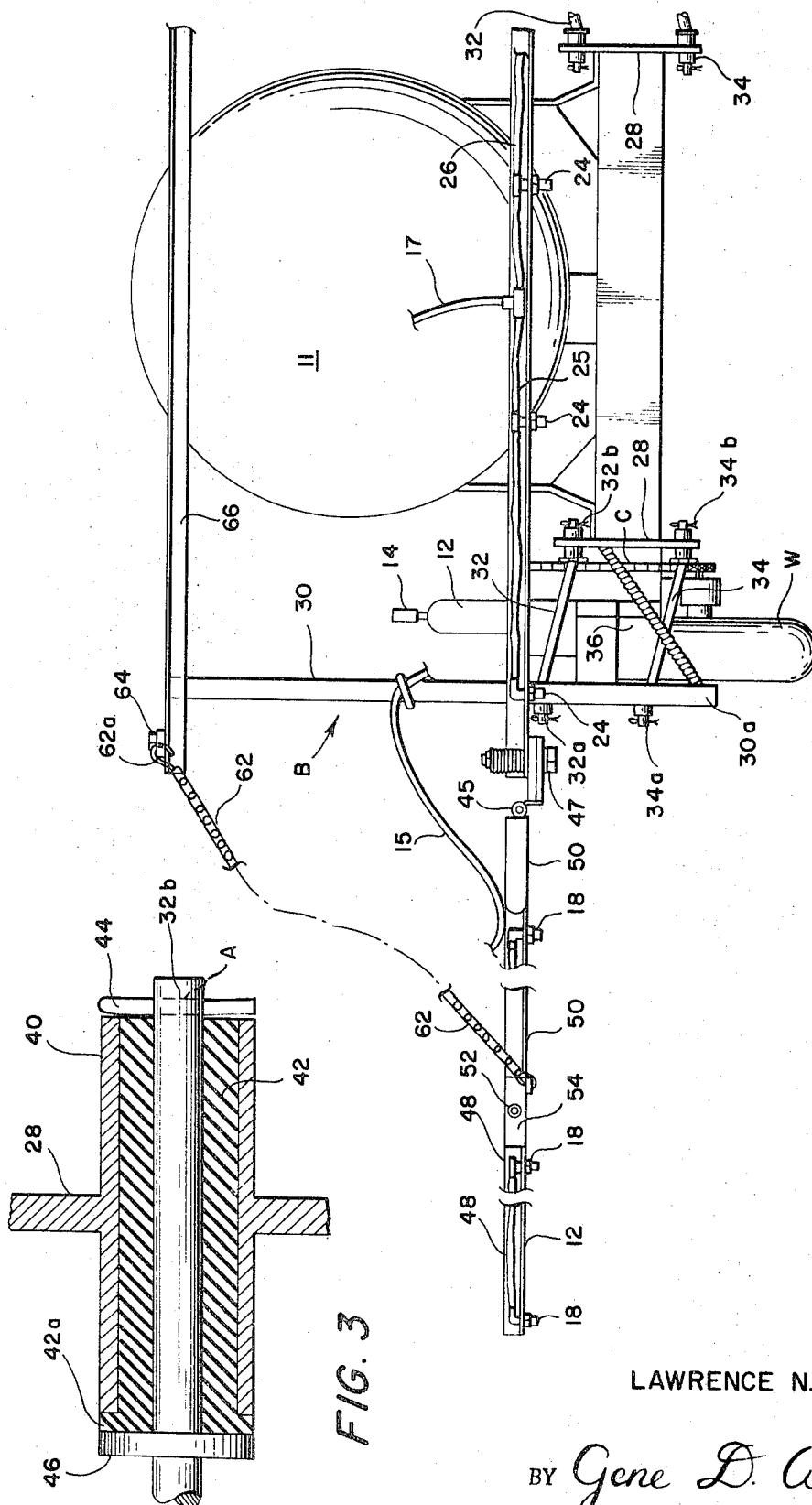


FIG. 2

FIG. 3

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FLOATING BOOM

FIELD OF THE INVENTION

This invention relates to spraying or fertilizing machines and more particularly to spraying vehicles employing elongate booms for mounting the spray elements.

BACKGROUND OF THE INVENTION AND THE PRIOR ART

In a popular spraying or fertilizing technique an applicator tank-carrying vehicle is provided with an elongate boom for mounting a number of spray nozzles in series relationship. These applicator tanks are in general quite large and may, for example, hold 1,000 1,000 gallons of liquid or more. It will be appreciated that the longer the boom used the more area covered in a single trip by the vehicle and the sooner the applicator tank can be emptied.

A number of problems surround the use of these booms when they are of any considerable length. A primary problem is that of instability of the outboard ends of the boom. The vehicles carrying the booms under normal operating conditions will encounter ruts, furrows, sharp terraces and the like causing uneven travel of the vehicle which is reflected in jarring and whipping of the boom. It often occurs that the natural frequency of the boom is close to or synchronous with the rolling or rocking motion of the vehicle and under these circumstances rather substantial vertical whipping of the boom takes place. Any substantial jarring or whipping experienced by the boom will, of course, disrupt the application rate of the liquid. Thus to avoid these effects it may become necessary to utilize shorter booms or to operate the tank-carrying vehicle at decreased speeds, both at the price of increased time required for completion of the spraying operation.

Attempts at solutions to the problems described hereinbefore include providing support chains connected to the outboard members of the booms at points beyond the boom joint and providing shock absorbers of various kinds for the booms. These approaches as well as other prior art approaches have met with only limited success particularly regarding the problem of controlling or damping whipping of the boom.

BRIEF SUMMARY OF THE INVENTION

In accordance with the present invention a spraying or fertilizing vehicle is provided with an elongate boom which is relatively unaffected by uneven travel of the applicator vehicle. Broadly, the present invention provides an arrangement where the motion of the boom is relatively independent of the motion of the vehicle, the boom generally acting as an energy absorber. According to one feature of a presently preferred embodiment of the invention the boom is resiliently supported with respect to the vehicle so that vertical motion of the boom may take place relatively free of the motion of the vehicle. A spring-supported, movable parallel linkage system is provided between an upright section of the boom and the vehicle. In accordance with a further feature both ends of each of the linkage members are mounted in rubber inserts such that much of the rotational movement of the boom is absorbed thereby. In accordance with another feature of the present invention outboard sections of the boom are provided with chain supports at the joint whereby when the outboard end of the boom moves upwardly a tensioning of the support chain is effected which tends to damp out any whipping action of the boom end.

Other features and advantages of the present invention will be apparent upon consideration of the following detailed description of the drawings, wherein:

FIG. 1 is a side view of a presently preferred embodiment of the invention with the boom shown in a retracted position;

FIG. 2 is an end view of the embodiment of FIG. 1 with the boom extended;

FIG. 3 is a detail section view of a support connection utilized in the embodiment of FIGS. 1 and 2; and

FIG. 4 is a detail top view of a joint between sections of the boom of FIGS. 1 and 2.

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Referring to FIG. 1 a carrier vehicle generally denoted 10 mounts an applicator tank 11 for the liquid to be distributed. Vehicle 10 which in operation is attached to a drive vehicle (not shown) through any suitable means (not shown) includes a control device denoted 12 which is connected through hose 13 to the applicator tank 11. The output of control device 12 is a function of the speed of rotation of the wheels W so that the rate of distribution of the liquid is a function of vehicle speed. An indication of wheel rotational speed is provided through means of a chain C (see FIG. 2) connected between the axle of one of the wheels W and control device 12. Applicator tank 11 may hold 1,000 gallons or more of the liquid fertilizer or similar liquid to be distributed. Control device 12 includes an indicator gauge 14 and a group of output hoses 15, 16 and 17.

Hose 15 feeds a series of spray nozzles 18 mounted in equally spaced relationship on an outboard section of an elongate boom 20 through a pair of oppositely extending feed hoses 21, 22. Elongate boom 20 is included in a boom arrangement generally denoted B and the construction thereof will be set forth in more detail hereinbelow. Hose 16 similarly feeds a series of corresponding nozzles (not shown) mounted on an oppositely located outboard section (not shown) of boom 20. Hose 17 feeds a series of nozzles 24 mounted in equally spaced relationship on an inboard section of boom 20 located between the outboard sections (see FIG. 2) through oppositely extending feed hoses 25, 26.

Boom 20 is located at the rear of carrier vehicle 10 and in the extended position thereof projects in a direction perpendicular to the direction of travel of vehicle 10. Boom-mounted spray nozzles (nozzles 18, 24 being shown) are thus capable of spraying an area substantially equal to the lateral extent of boom 20.

In accordance with the present invention boom 20 is resiliently mounted on the carrier vehicle 10 such that boom 20 is relatively movable in relationship thereto. Means for mounting boom 20 include a pair of spaced parallel elongate support members 28 (see FIG. 2) which are rigidly fixed to the vehicle 10. A pair of spaced parallel elongate upright support members 30 (one of which is shown in FIGS. 1 and 2) extend perpendicularly upward from boom 20 and are rigidly affixed thereto by any suitable means such as bolts.

The support means for boom 20 are symmetrical about the center of the boom 20 and thus the construction of only one-half of the boom arrangement B is discussed hereinafter. It will be understood that the elements described are duplicated for both halves of the boom arrangement B. A pair of parallel elongate linkage members 32, 34 connect the upright support member 30 to the vehicle support member 28. Linkage members 32, 34 are individually connected to the lower portion 30a of member 30 at positions located slightly above that at which the members 32, 34 are connected to member 28 (as can best be seen in FIG. 1). Member 28 is located inwardly of member 30 (see FIG. 2) so that linkage members 32, 34 extend outwardly and upwardly from their connections to member 28.

Boom 20 is further supported by a tensioning spring 36 which extends between a location on vehicle 10 just below the connection between linkage member 32 and support member 28 and a location below the connection between linkage member 34 and upright support member 30. Spring 34 is fixedly connected to vehicle 10 and upright member 30 at the locations described by suitable means such as through hooks formed at the opposite ends of the spring 36. The position of spring 36 coincides generally with a diagonal of the space parallelogram formed by members 28, 32, 30 and 34.

The connections between linkage members 32, 34 and support members 28, 30 are pivotable connections and thus the upright support member 30 is movable with respect to fixed member 28. A detail of a connection between linkage member 32 and support member 28 is shown in FIG. 3. The remaining connections between linkage members 32, 34 and the support members 28, 30 are similar to that shown in FIG. 3. Linkage members 32, 34 each include parallel end sections 32a, 32b

and 34a, 34b, respectively, located at opposite ends thereof (see FIG. 2). Considering linkage member 32 as an example, end sections 32a and 32b lie in different horizontal planes perpendicular to support members 28, 30. Referring to FIG. 3, support member 28 includes a connecting cylinder or tube 40 in which is located a tubular rubber insert 42. End section 32b of linkage member 32 is fitted into a bore in insert 42 and lies along the longitudinal axis of cylinder 40. End section 32b projects beyond the end of tube 40 and is fixed in relationship thereto by a cotter pin 44 inserted in a bore hole A through the projecting end and a circular flange 46 formed on the end of section 32b at a position adjacent the opposite end of cylinder 40. A circular flange 42a formed on insert 42 lies between flange 46 and the last mentioned end of tube 40. The arrangement described permits rotation of end section 32b together with insert 42 within cylinder 40. The rotational movement of the rubber insert 42 is such that a substantial amount of the rotational movement is taken up by the hysteresis in the rubber itself and in the frictional engagement between insert 42 and linkage end section 32b. Therefore, wear in these areas is kept at a minimum. Rubber inserts 42 also allow for a little torsional rotation of the boom system relative to the longitudinal center line of vehicle 10.

The pivotable connections described permit motion of boom 20 in a vertical direction independently of the motion of vehicle 10. Thus the jarring effects of uneven travel of the vehicle 10 are not transmitted to the boom 20 in a direct manner as would be the circumstance where there was a rigid connection between the boom and the vehicle. Boom 20 may be moved to a retracted position (FIG. 1) when not in use by pivoting and rotating boom 20 about pivot joint 45 and rotary joint 47.

In accordance with another feature of the present invention the upright members 30 are chain-connected to the boom 20 at a location inboard of the pivotable connections between the extreme outboard sections of boom 20 and the next section inboard thereto. Referring to FIG. 1, the section of boom 20 outboard of joints 45 and 47 comprises an extreme outboard section formed by angle-arm 48 and an intermediate outboard section formed by angle-arm 50. Arms 48 and 50 are connected together at a pivotable joint denoted 52. As can best be seen in FIG. 4 arm 48 further comprises a pair of parallel flanges 54 welded to upright angle member 48a and a similar upright member 48b mounted parallel to and located opposite member 48a at the end of outboard arm 48. Flanges 54 extend outwardly beyond the inboard end of member 48. A pivot pin 56 projects through bore holes located therein and through bore holes in upright angle member 50a and corresponding parallel upright member 50b of angle-arm 50. Thus angle-arm 50 and angle-arm 48 are pivotably connected and will rotate about pivot pin 56. It will be appreciated that other pivoting arrangements may be provided and that the arrangement described is merely illustrative of such arrangements.

A crossmember 58 welded to the underside edges of flanges 54 constitutes means for attaching chains 60, 62 to the angle-arm 48 inboard of pivot pin 56. Chains 60, 62 are fixedly secured to crossmember 58 through means of holes provided in opposite end portions of member 58 located outwardly of flanges 54.

Referring particularly to FIG. 1, the chains 60, 62 are supported at the other ends thereof by the outer ends of a crossbar 64 affixed to an upper boom support member 66. Support member 66 is fixedly secured to upright member 30 by suitable means such as bolting or welding and lies generally parallel to boom 20. Crossbar 64 may, for example, be bolted to member 66 and lies generally perpendicular thereto. With boom 20 retracted, chains 60, 62 are slidably supported in openings located in crossbar 64 and are looped back upon themselves with hook members 60a, 62a located on the ends thereof individually surrounding the chains bodies 60, 62, respectively, at intermediate locations as shown in FIG. 1. With boom 20 in the extended position thereof hook members 60a, 62a are inserted in the openings in crossbar 64 (see FIG. 2) so that chains 60, 62 are fixedly secured thereto.

This arrangement of chains 60, 62 and boom 20 serves to damp out whipping of the outboard sections 48. As was set forth hereinbefore, motion of the boom is most marked at the outboard ends of the boom, motion of the inboard sections being transmitted in an amplified manner to the outboard section. In accordance with the construction described, when outboard section 48 moves upwardly, pivoting about pivot pin 56, there is tensioning of chains 60, 62 caused by the downward movement of flanges 54 located inboard of the axis of rotation. This tensioning of chains 60, 62 tends to quickly dampen out any whipping motion of section 48 by providing an arresting force disrupting the natural frequency of vibration of this section and thereby considerably shortening the period of vibration.

Prior art arrangements wherein the chains are located outboard or below the axis of rotations of the sections cannot provide damping of the upward motion of the booms because such motion does not tension the support chains.

From the foregoing it would be appreciated that the present invention provides a boom arrangement wherein direct transmission of motion of the vehicle to the boom and from one section of the boom to another section is disrupted. Further, attendant amplification of vibratory or oscillatory motion occurring where there is overlap of synchronous frequencies of vibration between the boom and the vehicle is destroyed. With a boom arrangement constructed in accordance with the present invention, the boom 20 remains quite stable for vehicle travel over uneven ground even at relatively high speeds (8 to 10 m.p.h.).

It will be understood by those skilled in the art that the embodiment of the invention shown and described herein is subject to various modifications without departing from the scope and spirit of the invention. Accordingly it should be understood that the invention is not limited by the exemplary embodiments shown and described but rather only by the subjoined claims as construed in light of the foregoing specification and drawings.

Having thus described my invention in accordance with the Patent Statutes,

I claim:

1. A liquid distribution machine comprising a carrier vehicle, a plurality of spray elements adapted for connection to a liquid source, boom means including an elongate boom mounting said spray elements along the longitudinal extent thereof, and means resiliently mounting said boom on said carrier vehicle for movement of the entire boom or any part thereof in at least a vertical direction independent of the vehicle and torsional rotation relative to the longitudinal center line of the vehicle, whereby direct transmission of the vertical or rolling motion of said carrier to said elongate boom is disrupted.

2. A machine in accordance with claim 1 wherein said elongate boom extends perpendicularly outward of the direction of travel of said vehicle and said boom means further comprises vertical means perpendicular to said boom, said mounting means including support means fixed to said carrier vehicle and extending parallel to said vertical means, and movable linkage means for connecting said support means to said vertical means, said vertical means being fixed to said boom, and said vertical means and said boom being relatively movable with respect to said support means.

3. A machine in accordance with claim 2 wherein said mounting means further includes spring means connected between said carrier vehicle and said vertical means.

4. A machine in accordance with claim 3 wherein said vertical means comprises first and second parallel elongate upright members, said support means comprises first and second elongate parallel support members individually parallel to said first and second upright members, respectively, and said linkage means comprises two pairs of parallel linkage arms for connecting parallel support members and upright members, said spring means comprising a pair of springs individually connected between said carrier and said upright members generally across the diagonals of the parallelograms formed by

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an upright member, a support member, and a pair of said linkage arms.

5. A machine in accordance with claim 4 wherein the connections between said support members and said linkage members are pivotable and include resilient bushings located between and separating said support members and linkage members, and wherein the connections between said upright members and said linkage members are pivotable and include resilient bushings located between and separating said upright members and said linkage members, said elongate boom comprising a plurality of sections including two outboard sections, said outboard sections being pivotably connected to the sections of the boom inboard thereof, said boom means including chain means connected to said outboard sections at locations inboard of the pivotable connections between the outboard sections and said sections inboard thereof.

6. A machine in accordance with claim 2 wherein the connections between said support means and said linkage means are pivotable and include resilient means located between and separating said linkage means and said support means.

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7. A machine in accordance with claim 2 wherein the connections between said vertical means and said linkage means are pivotable and include resilient means located between and separating said vertical means and said linkage means.

8. A machine in accordance with claim 1 wherein said elongate boom comprises a plurality of sections including two outboard sections, said outboard sections being pivotably connected to the sections of the boom inboard thereof, said boom means including chain means connected to said outboard sections at locations inboard of the pivotable connections between said outboard sections and said sections inboard thereof.

9. A machine in accordance with claim 8 wherein said outboard sections each include a pair of parallel flanges extending inwardly beyond said pivotable connection and a crossmember lying perpendicular to and secured to said flanges, said chains means comprising first and second chains connected to opposite ends of said crossmember.

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