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US 4553899 A

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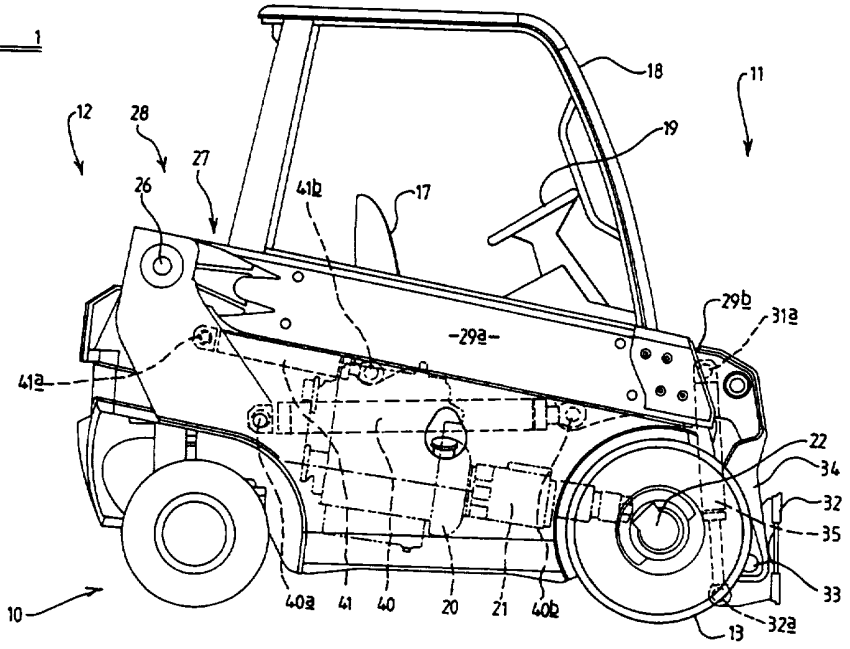
INT CL^6 B66F 9/065

(54) Abstract Title
Hydraulic crowd mechanisms

(57) A crowd means on a load handling lift truck comprises a crowd ram 35 connected in fluid circuit with a compensation ram 41 to cause automatic tilting of the load handling implement 32 relative to the boom 29 to maintain the implement in a constant orientation relative to a horizontal plane as the boom is raised or lowered. The crowd means further comprises a tilt means connected in fluid circuit with an operator control for supply of fluid thereto to cause tilting movement of the implement relative to the boom. Preferably the tilt means comprises a second ram (70, Fig 20) independent of the first ram, alternatively the tilt means comprises a dosing pot i.e. a cylinder with a floating piston. The dosing pot (407, Fig 21) is connected in fluid circuit with the crowd ram to allow operator control of the crowd ram. Preferably the crowd ram comprises first and second cylinders disposed co-axially end to end (35, Fig 9). Preferably the crowd means permits a larger arc of movement of the implement than the tilt means.

FIG 1



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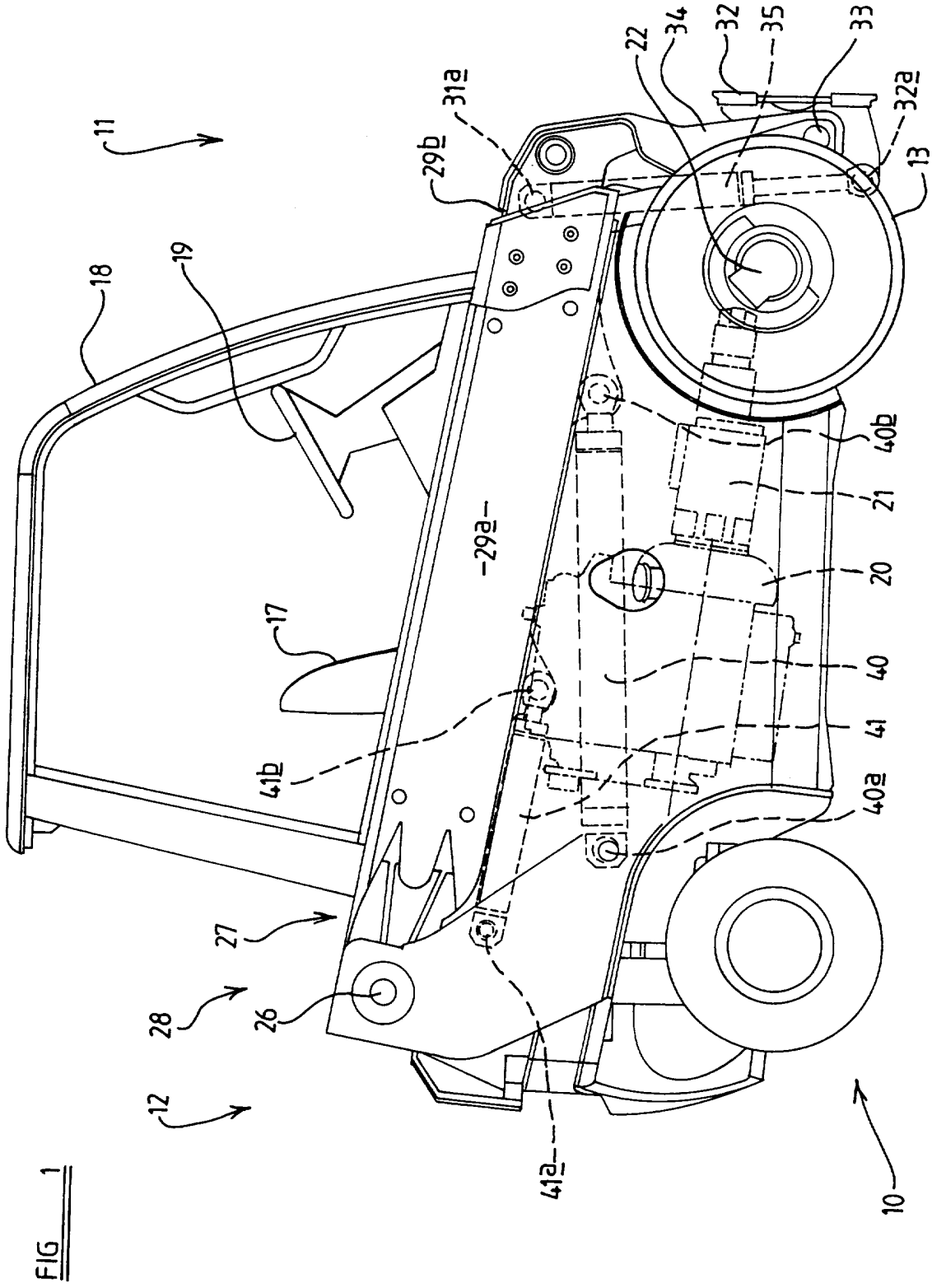
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35
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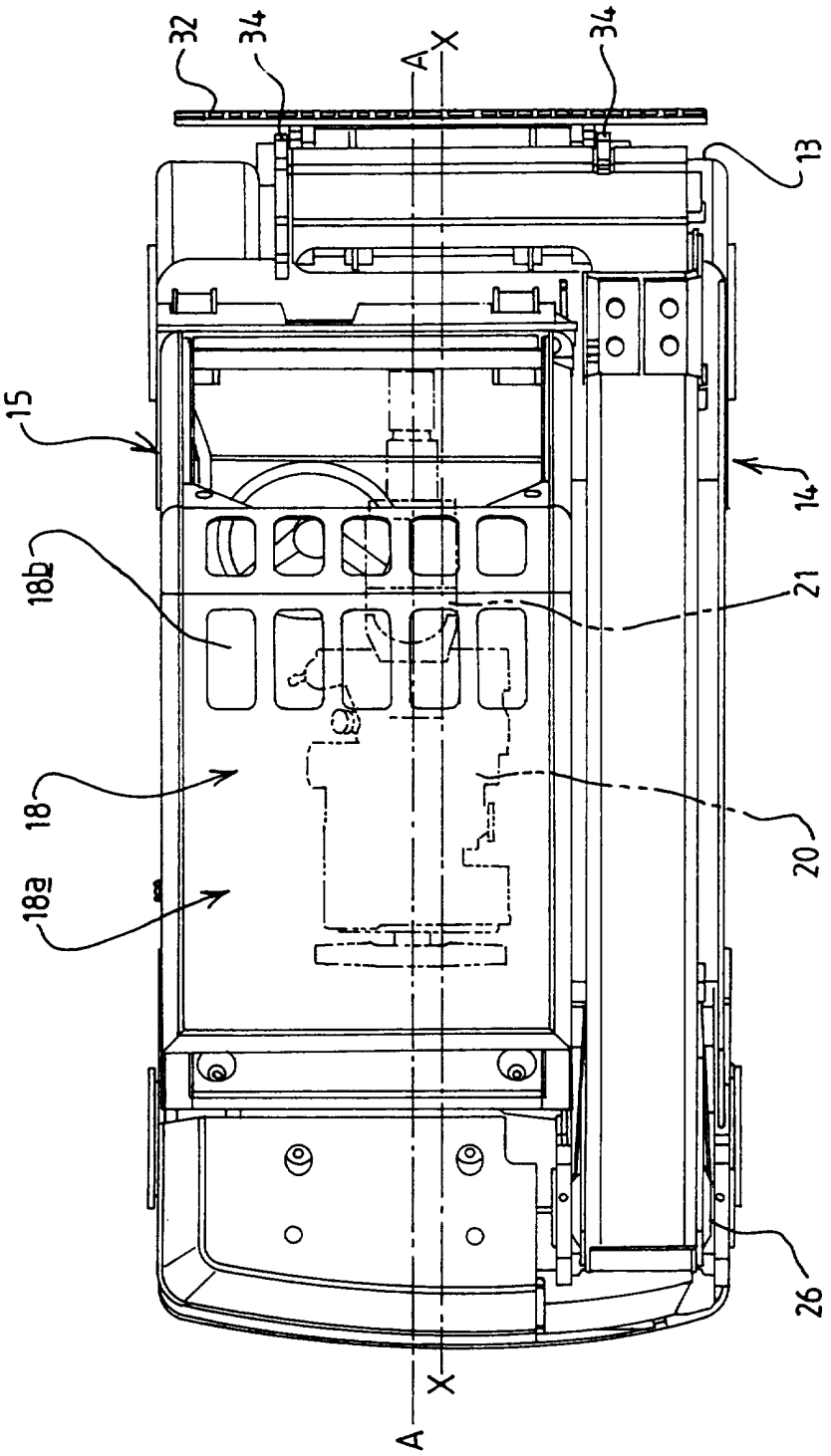
17
41b
27
28
26
12
41a
10

FIG 1



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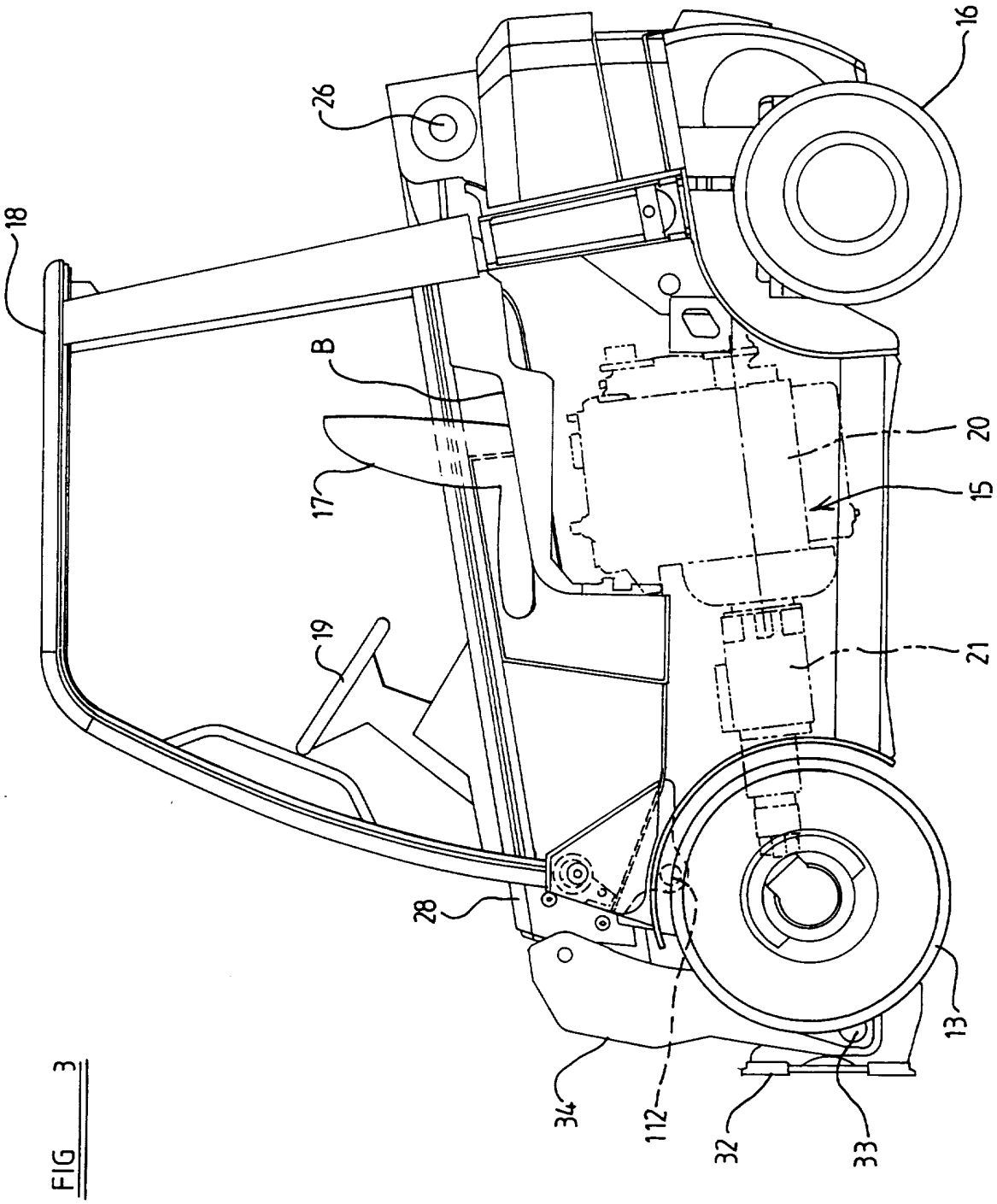

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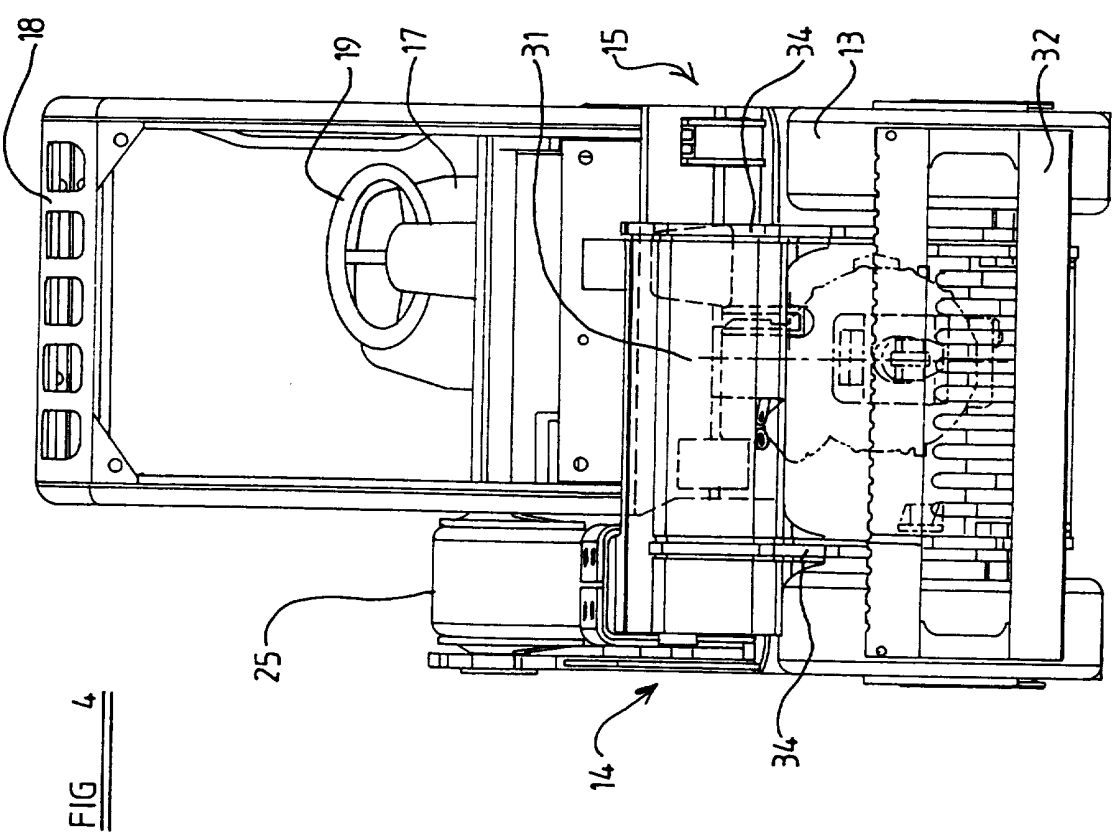

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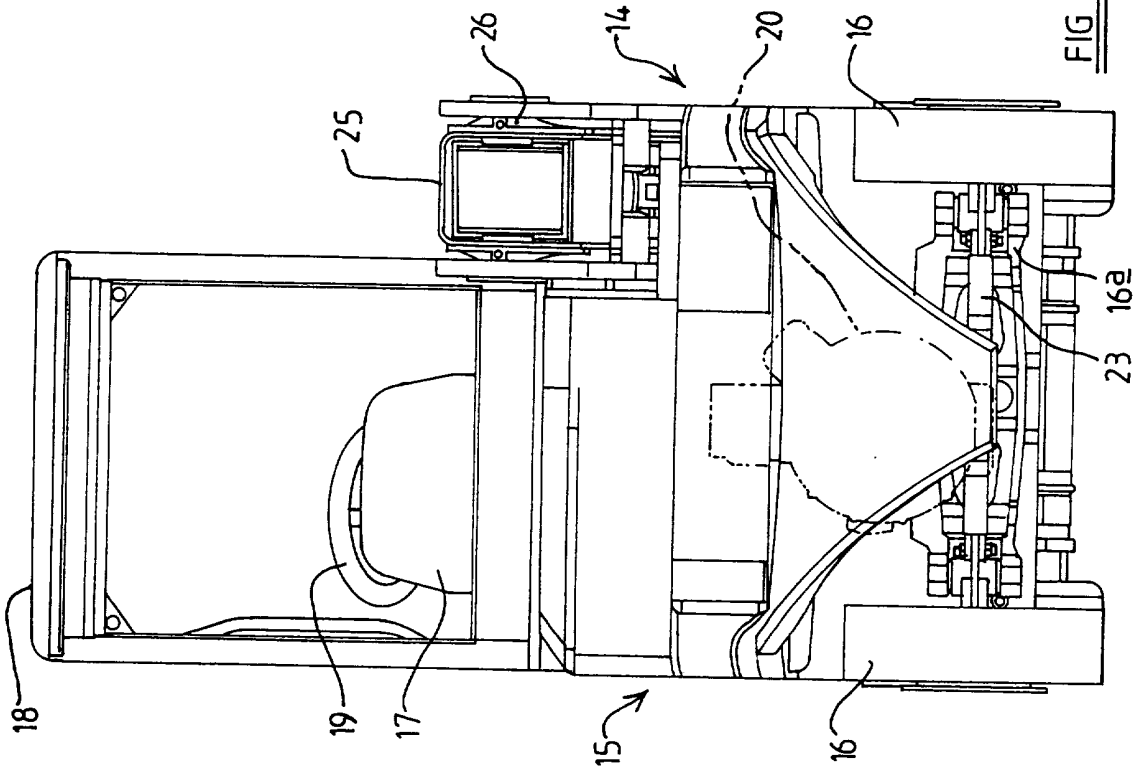

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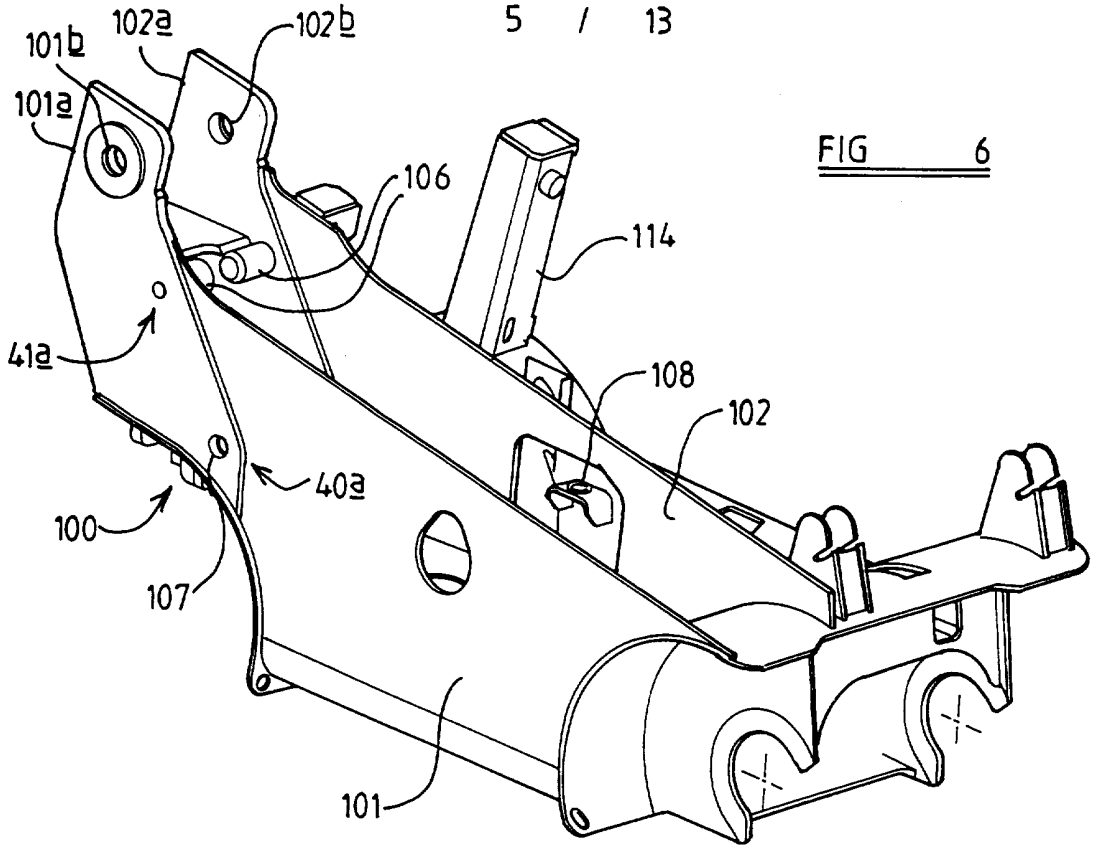
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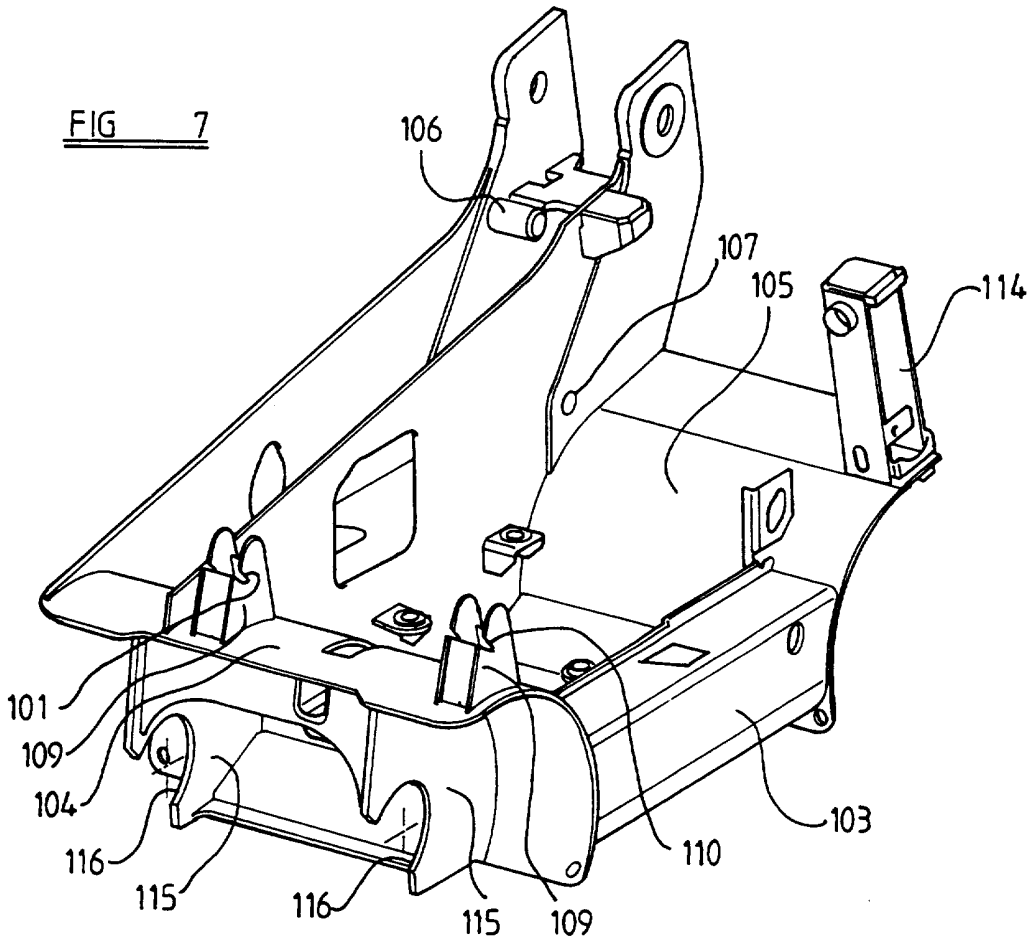
102a
102b
101a
106
114
41a
108
102
40a
100
107
101

FIG 6

FIG 7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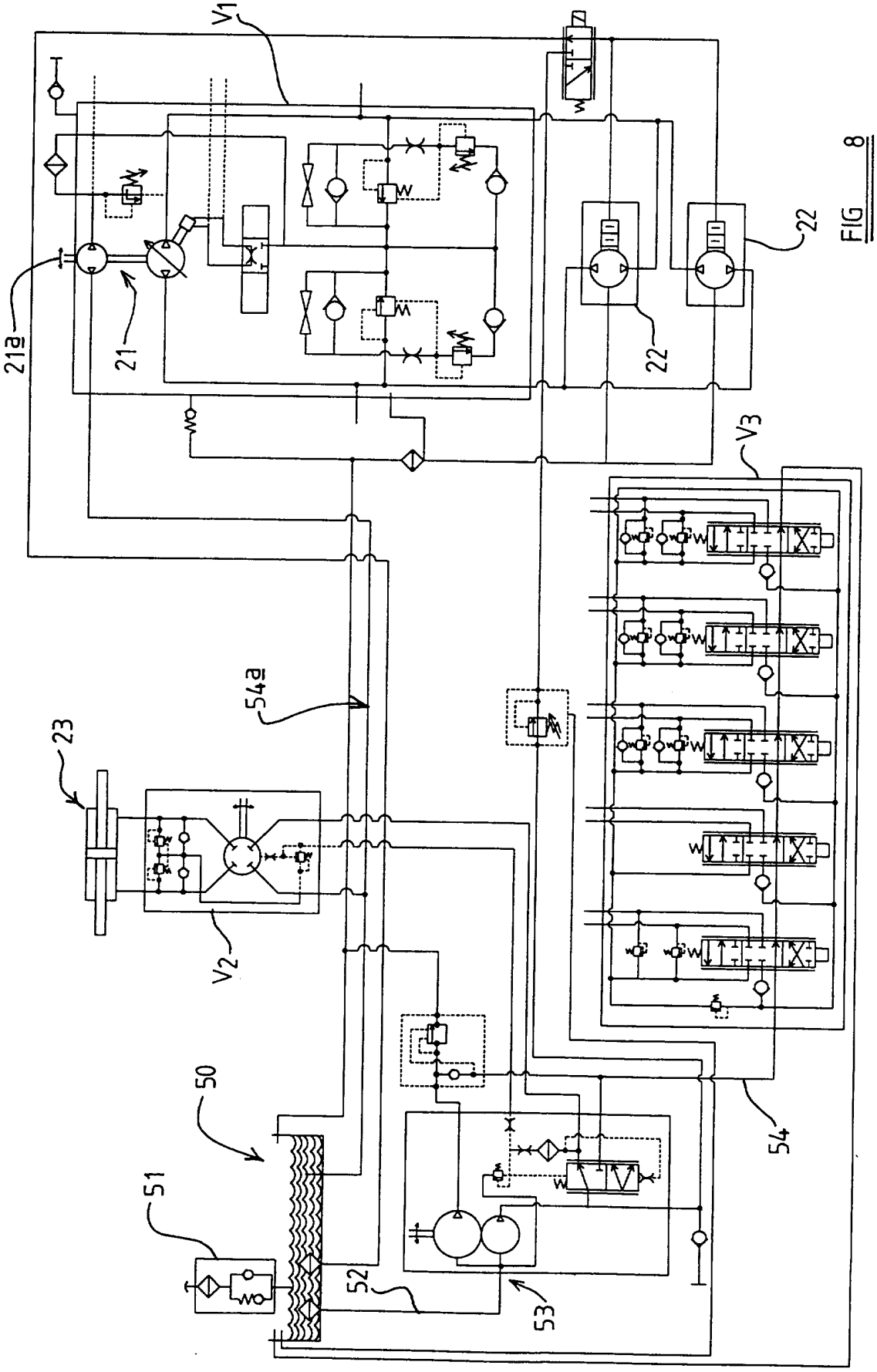

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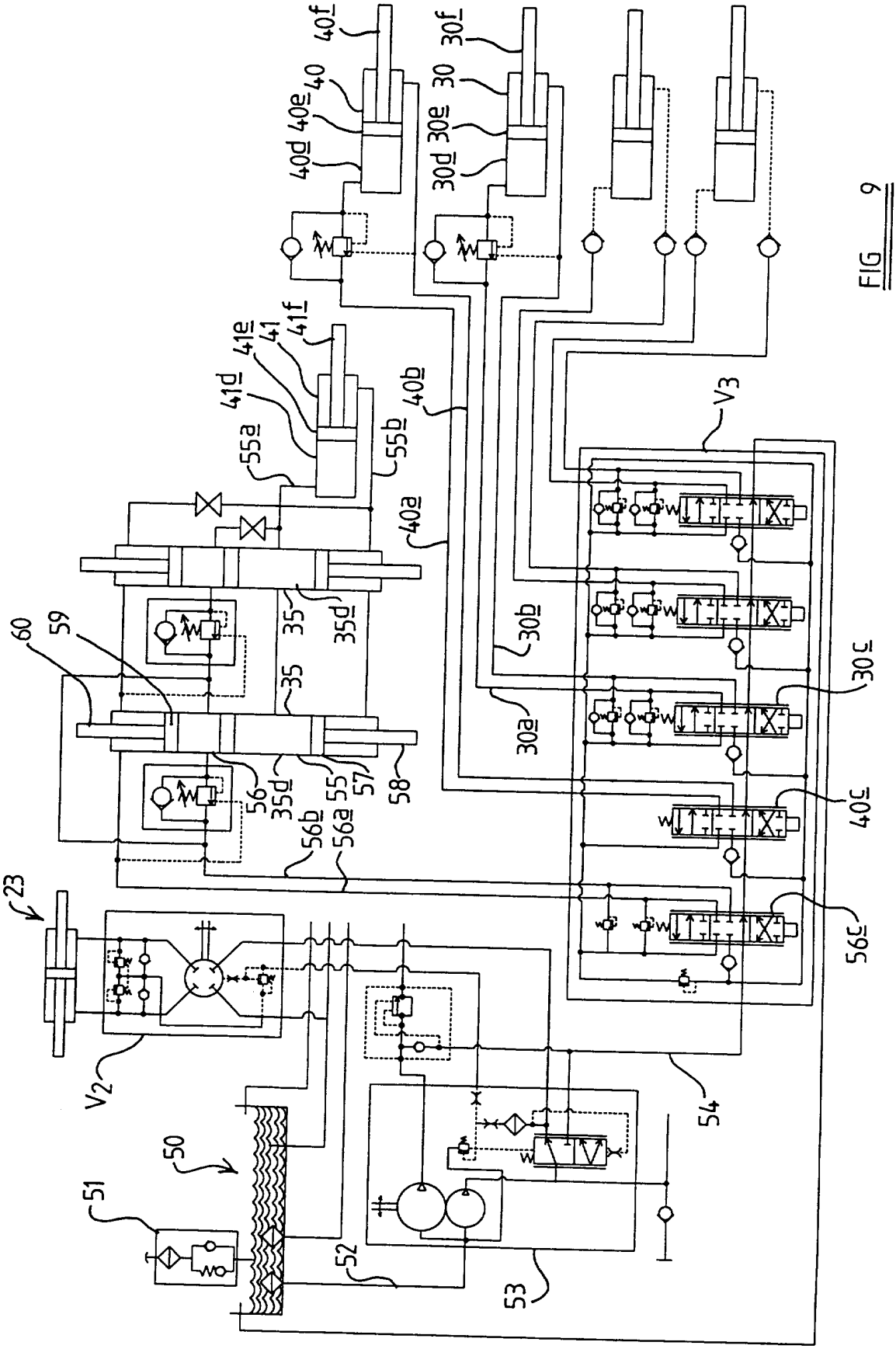
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41f
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V3
30b
30a
30c
40c
56c
60
59
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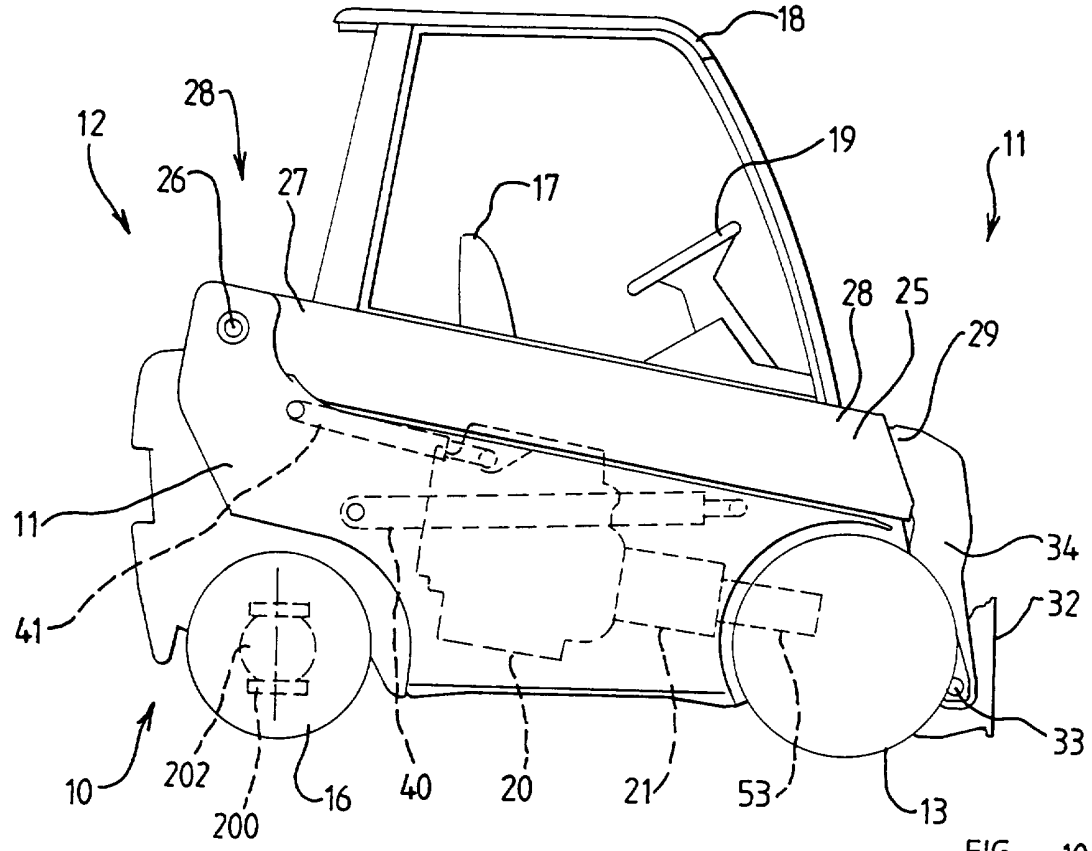
35d
56
56b
56a
55
57
58
23
V2
50
51
52
53
54

FIG 9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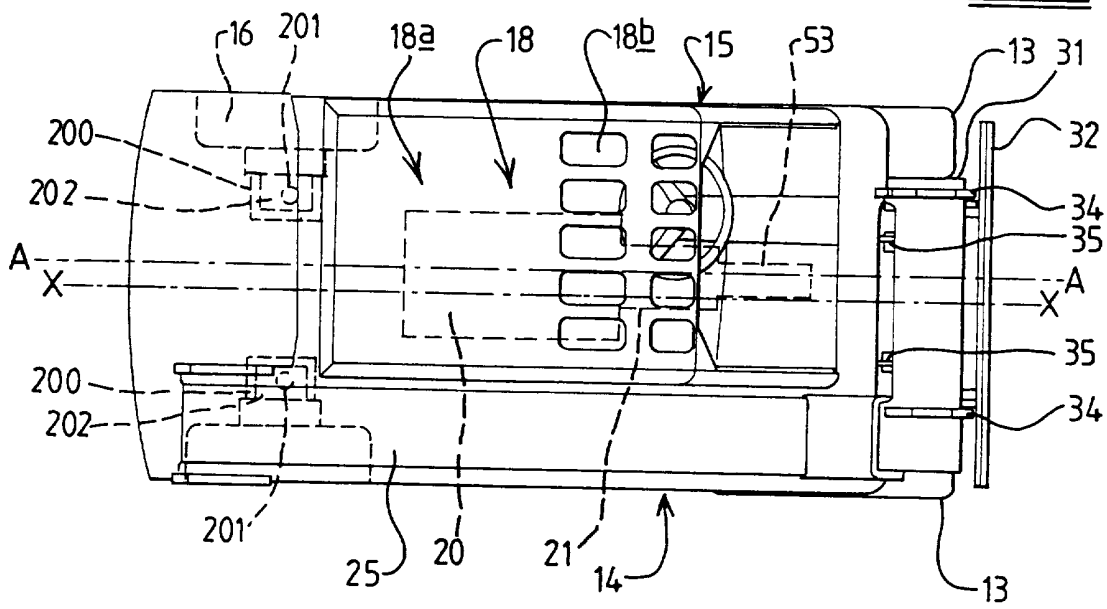
200

FIG 10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18a
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18b
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13
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32
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X
A
X
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202
34
201
25
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14
13

FIG 11

FIG 12

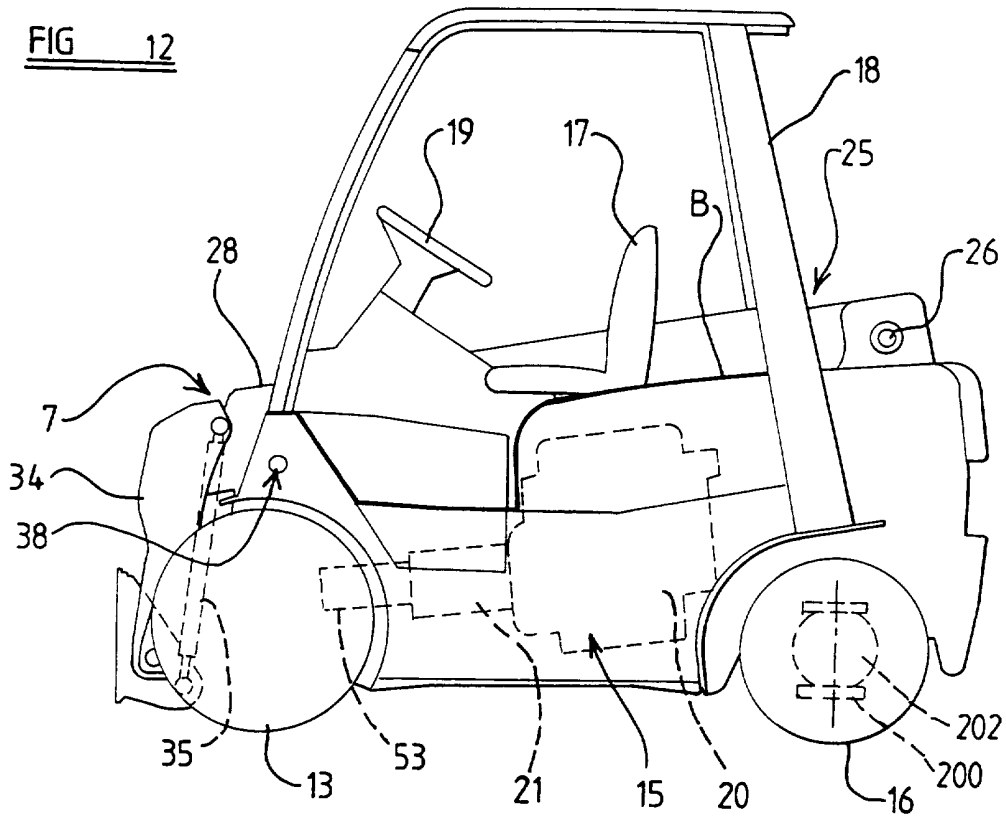


FIG 13

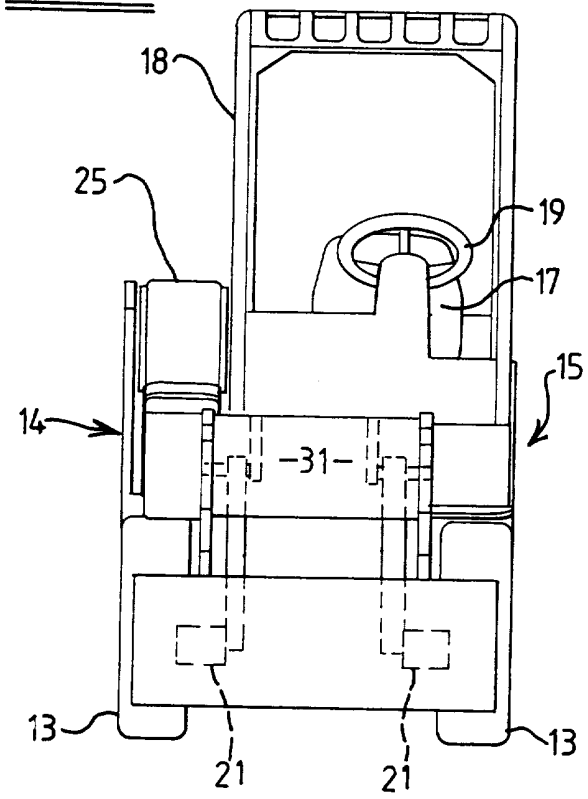
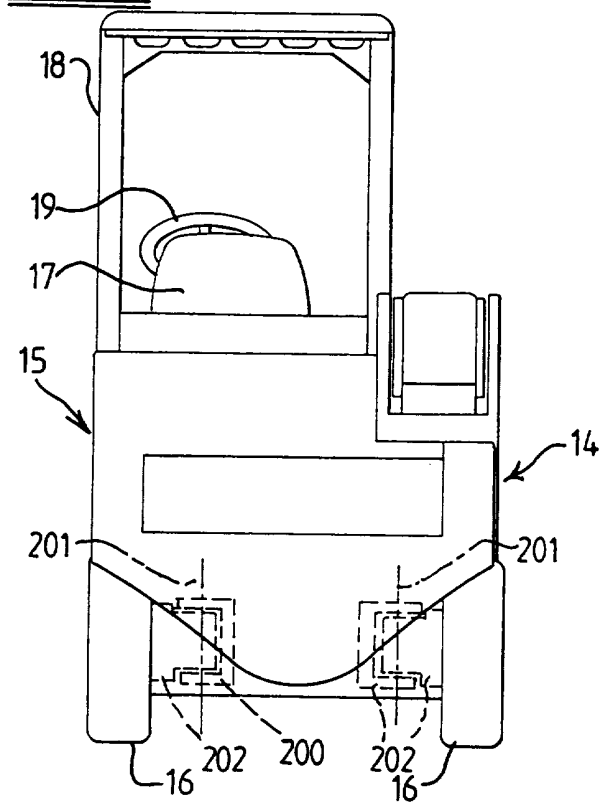
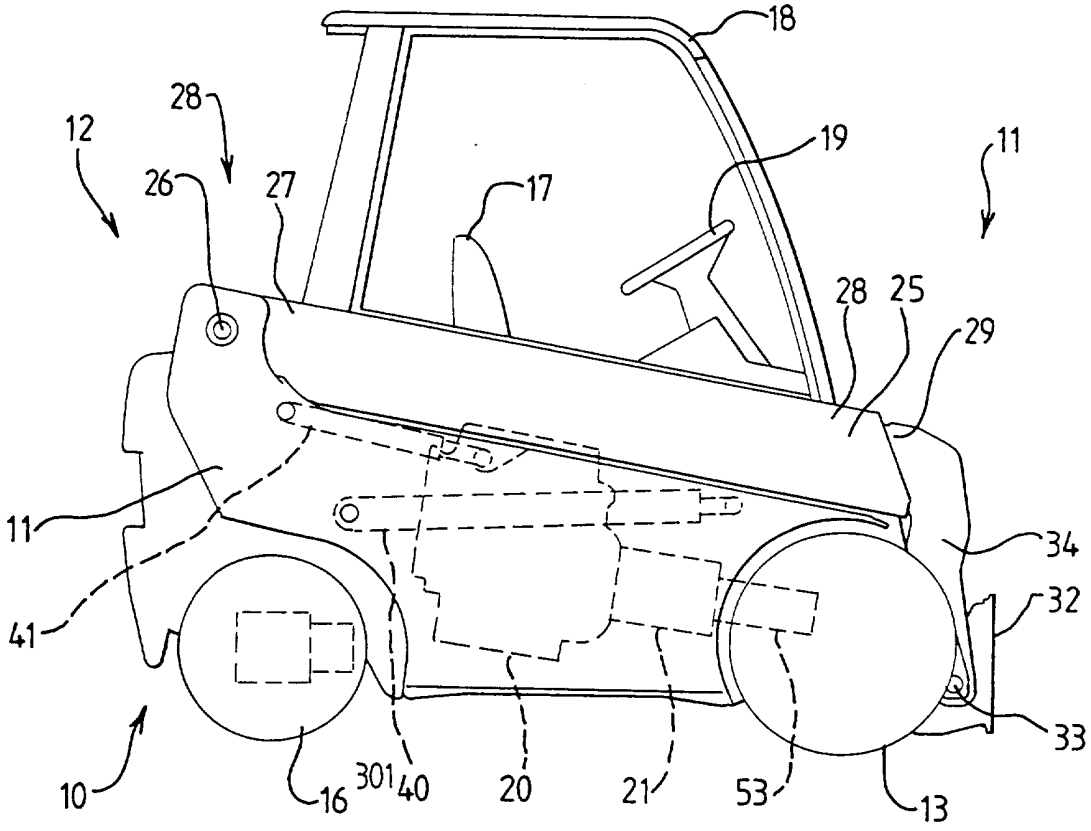


FIG 14

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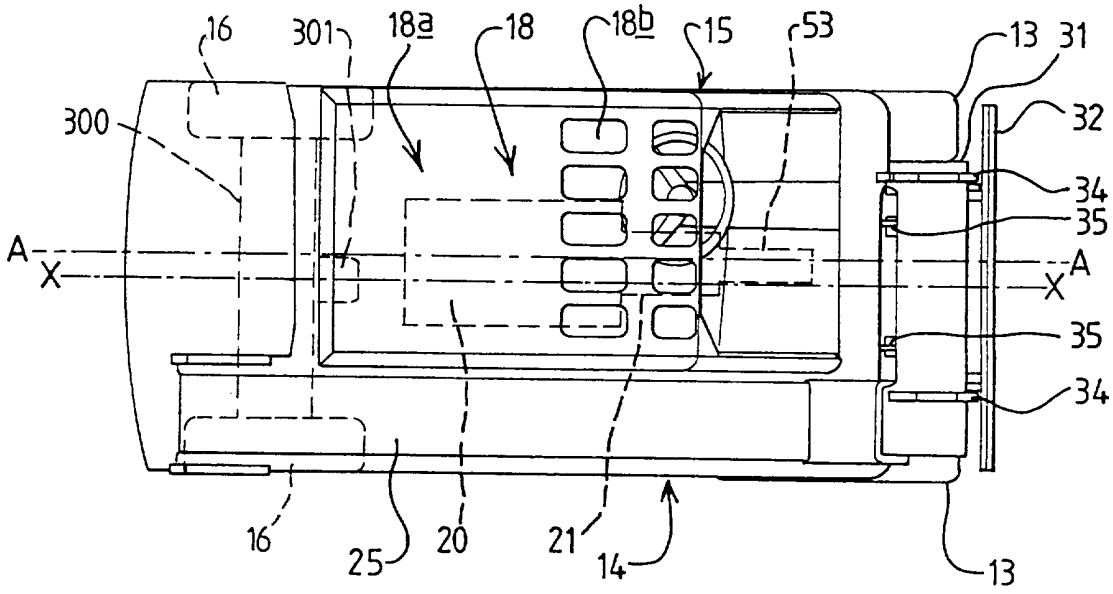
53
13

FIG 15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301
18a
18
18b
15
53
13
31
300
32
34
A
X
35
A
X
35
34
16
25
20
21
14
13

FIG 16

FIG 17

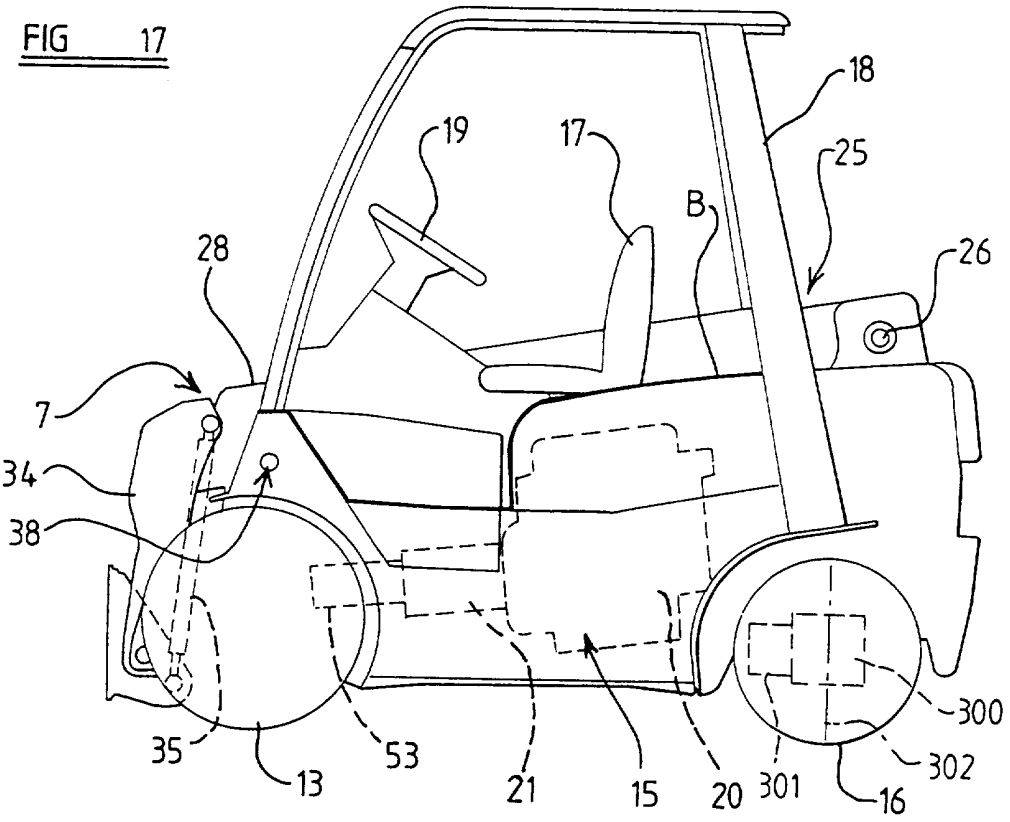


FIG 18

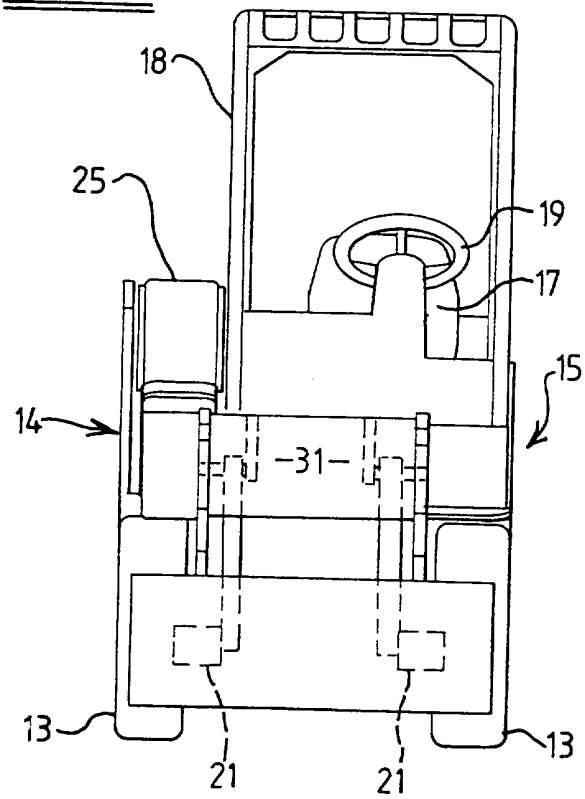
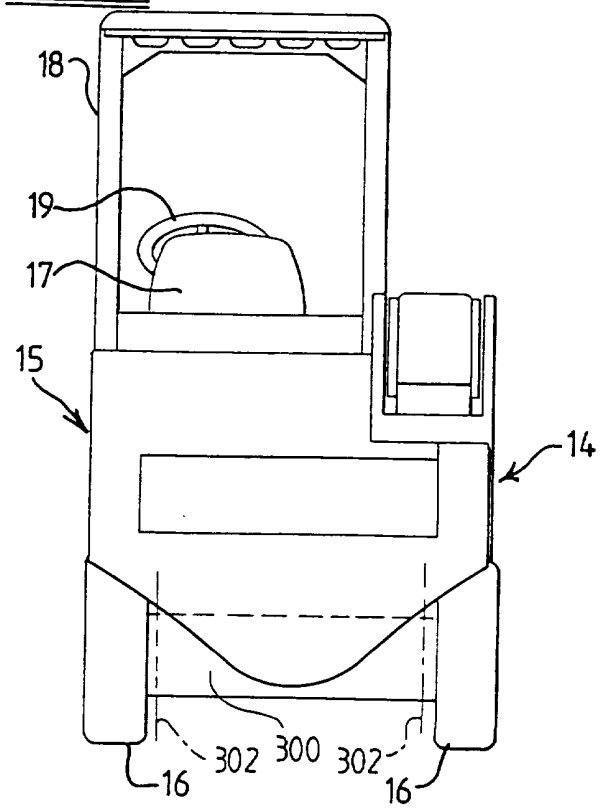


FIG 19



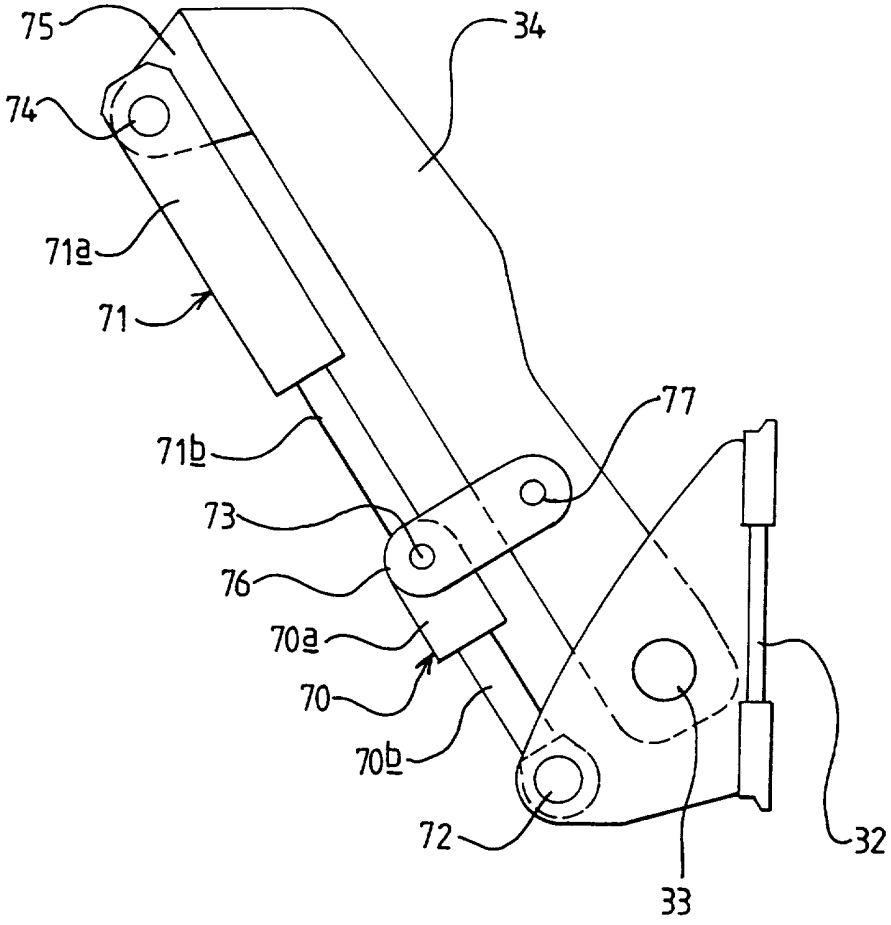
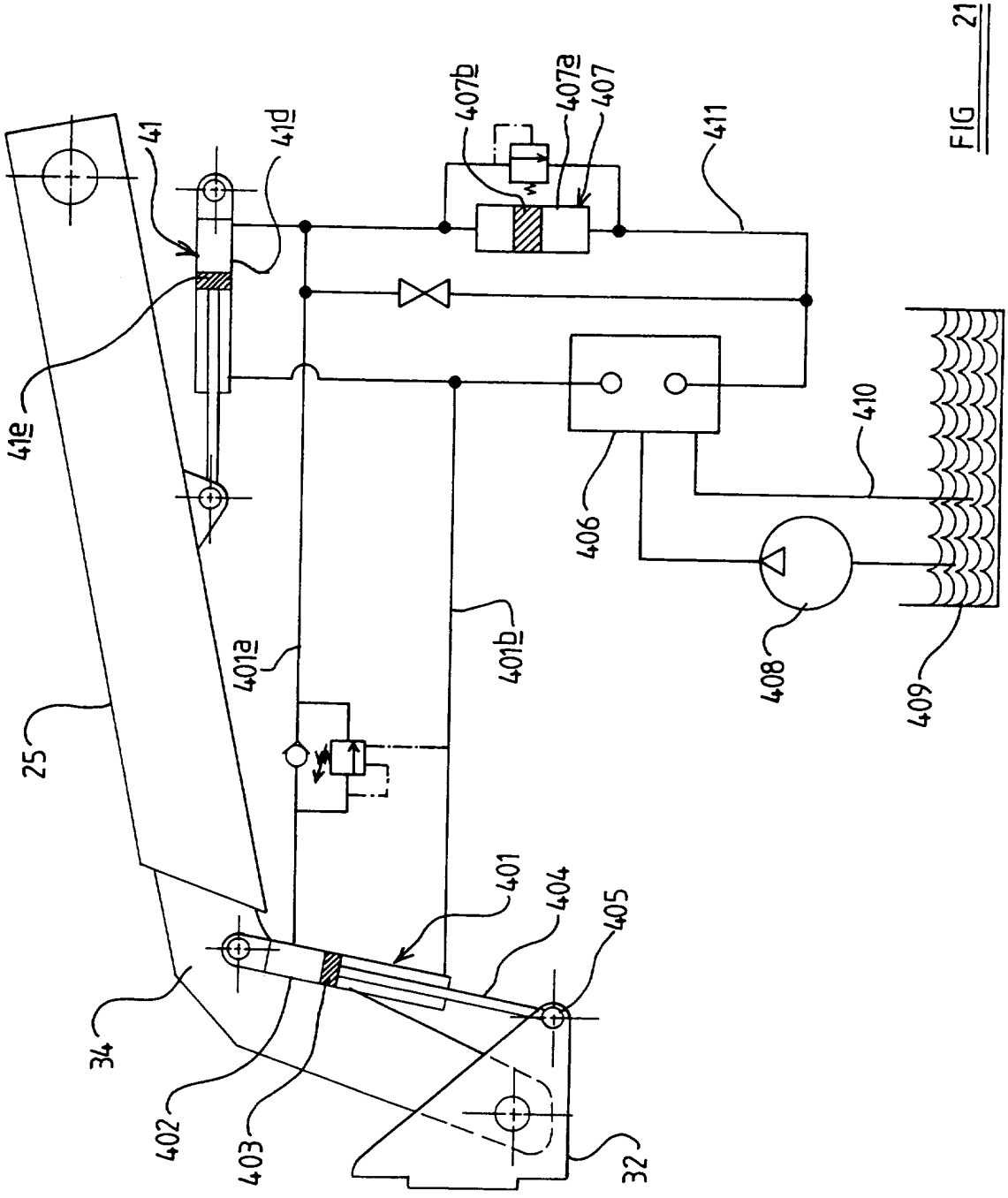


FIG 20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41d
407b
407a
407
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41e
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401a
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FIG 21

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PATENTS ACT 1977

JNL/A9138GB/11B

Title: Load Handling Vehicle

Description of Invention

This invention relates to a load handling lift truck, hereinafter referred to as being of the kind specified, comprising a structure, a boom pivotally mounted to the structure at one end region of the boom for up and down swinging movement by a lift ram means and having a load carrying implement mounted on the boom at an opposite end region thereof for pivotal movement relative thereto by crowd ram means.

It is desirable for the load carrying implement to be mounted so as to maintain a constant orientation relative to a horizontal plane as the boom is swung up or down and it is known, for this purpose, to provide a compensation ram means which varies in length as the boom is raised or lowered to displace hydraulic fluid between the compensation ram means and the crowd ram means.

The ram must have sufficient extension capability to permit maintenance of the orientation of the load carrying implement constant relative to a horizontal plane over an arc through which the boom may swing as well as permitting manual crowding, to enable the load carrying implement to be tilted up or down from a generally horizontal position.

The provision of both these facilities can lead to excess manual crowding movement which is undesirable in a fork lift truck environment. The extension of the ram for crowding is limited only by the maximum possible extension of the ram. Thus crowd movement over a relatively large arc can occur which can lead to dropping of a load in front of the truck or tumbling of a load rearwardly on to the top of the truck.

An object of the invention is to provide a load handling lift truck of the kind specified whereby the above mentioned problem is overcome is or is reduced.

According to one aspect of the invention we provide a load handling lift truck of the kind specified wherein the crowd ram means comprises a first ram, said ram comprising a double acting ram connected in fluid circuit with a compensation ram

to cause tilting movement of the implement relative to the boom to maintain the load handling implement in a constant orientation relative to a horizontal plane as the boom is raised or lowered, said crowd ram means further comprising a tilt means connected in fluid circuit with an operator control for supply of fluid thereto to cause tilting movement of the implement relative to the boom under operator control.

The tilting movement of the implement relative to the boom may comprise components due to operation of at least one of said first ram and said tilt means.

The tilt means may comprise a second ram, said second ram comprising a double acting ram.

Accordingly, the second ram may be operated to cause crowd movement of the load handling implement independently of the first ram.

Alternatively, the tilt means may comprise a dosing pot.

The dosing pot may be connected in fluid circuit with the first ram to restrict the supply of fluid under operator control to said first ram.

In either of the preceding alternatives, the first ram may permit of, for example, a relatively large arc of movement of the boom whilst the tilt means may permit of a second, smaller arc of movement of the implement relative to the boom.

The first arc of movement may lie in the range 65° to 75° and the second range of movement may lie in the range -5° to + 12° from the horizontal.

The crowd ram means may comprise first and second cylinders, a first piston rod extending in a first direction from a piston disposed in the first cylinder and a second piston rod extending in a second, opposite direction, from a piston disposed in the second cylinder.

The first and second cylinders may be disposed end to end.

The cylinders may be disposed end to end in co-axial relationship.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings wherein:

Figure 1 is a side view of a load handling vehicle embodying the invention,

Figure 2 is a plan view of the vehicle of Figure 1,

Figure 3 is an opposite side view of Figure 1,

Figure 4 is a front view of the vehicle of Figure 1,

Figure 5 is a rear view of the vehicle of Figure 1,

Figure 6 is a fragmentary perspective view, from one side, of a chassis of the vehicle of Figure 1.

Figure 7 is another fragmentary perspective view from the other side of the chassis of Figure 6.

Figure 8 is a partial circuit diagram of the hydraulic circuit of the vehicle of Figures 1 to 7.

Figure 9 is a further partial circuit diagram of the vehicle of Figures 1 to 7.

Figure 10 is a side view of a modified load handling vehicle embodying the invention,

Figure 11 is a plan view of the vehicle of Figure 10,

Figure 12 is an opposite side view of Figure 10,

Figure 13 is a front view of the vehicle of Figure 10,

Figure 14 is a rear view of the vehicle of Figure 10,

Figure 15 is a side view of another modified load handling vehicle embodying the invention,

Figure 16 is a plan view of the vehicle of Figure 15,

Figure 17 is an opposite side view of Figure 15,

Figure 18 is a front view of the vehicle of Figure 15 and,

Figure 19 is a rear view of the vehicle of Figure 15.

Figure 20 is a side view of an alternative embodiment of the crowd ram means.

Figure 21 is a schematic view and partial circuit diagram of a boom arm according to a further embodiment of the invention.

Referring to Figures 1 to 7 of the drawings a load handling vehicle of the telescopic lift truck type is indicated generally at 10. The vehicle 10 has a front end 11 and a rear end 12. Disposed in a front end region are a pair of front ground engageable wheels 13 which are spaced apart width-wise of the vehicle so as to be disposed one at each side 14, 15 of the vehicle. In a rear end region of the vehicle are provided a pair of rear ground engageable wheels 16 again disposed width-wise of the vehicle so that the wheels are disposed one at each side, 14, 15 of the vehicle.

An operator's seat 17 is disposed within an operator's compartment 18 in which is disposed a steering wheel 19 and a conventional foot and hand controls of the vehicle.

The operator's compartment 18 is provided with a top 18a having a plurality of openings 18b which may be glazed as desired. Of course the pattern of openings and whether or not they are glazed may be modified as necessary. The operator's compartment 18 is provided so as to be of adequate strength to satisfy necessary safety requirements in conventional manner.

Disposed beneath the operator's seat 17 is an engine 20 connected in conventional manner to a variable angle swash plate pump 21 which provides fluid via suitable conduits to motors 22 drivingly connected to the front wheels 13 which are mounted on the vehicle in conventional manner and which are not steerable. The hydraulic fluid is transmitted, in conventional manner to the motors 22 from a manually operable speed control 21, see Figure 8, utilising the hydraulic sub-circuit indicated generally at V1 in Figure 8 in conventional manner.

The rear wheels 16 are mounted by conventional suspension means 16a and are undriven but are steerable by means of steering ram 23, see Figures 5,8 and 9. The steering ram 23 is supplied with fluid by a steering valve indicated generally at V2 in Figures 8 and 9.

The front and rear wheels together with the motors 22 which drive the front wheels only comprise a ground engagable propulsion means of the vehicle.

The vehicle is provided with a single telescopic boom 25 which extends in a forward direction of the truck parallel to and off-set width-wise from, a central plane

X-X of the vehicle. The boom 25 is mounted on the structure for up and down swinging movement by a pivot means 26 disposed in a rear end region 27 of the boom and also disposed in a rear end region 28 of the vehicle. The pivot means 26 is disposed rearwardly of the axis of rotation of the rear wheels 16 but longitudinally within their circumference so that in a present example a vertical line through the axis of pivot means 26 lies at a position which is about 30% of the diameter of the rear wheels 16 rearwardly of their axis of rotation. The overall boom length is 95% of the total machine length.

The boom 25 is off-set from the central plane X-X so as generally to overlie the front and rear wheels 13, 16 at one side 14 of the vehicle and to provide a space for the operator's compartment 18 between the boom 25 and the opposite side 15 of the vehicle.

The engine 20 is positioned so as to be offset from the centre line X-X of the vehicle, by approximately 100mm in the illustrated example, in a direction away from a boom 25, thereby allowing the space below the boom to be unobstructed by the engine.

Thus, if desired, the boom, when lowered, may be at least partly alongside part of the engine. That is to say, a lower part of the boom and/or a component connected to the boom and depending downwardly therefrom may be below an upper part of the engine

The boom 25 comprises a rearward portion 29a and a forward portion 29b telescopically received within the rearward portion 29a in conventional manner. An extension ram is provided between the boom parts 28 and 29 within the boom part 28 and is indicated generally in Figure 7 at 30.

The forward boom part 29a is provided with a width wise extending portion 31 which extends from the boom part 29a towards the opposite side 15 of the vehicle and which carries an implement carrying means 32. The implement carrying means 32 may be provided with any desired load handling implement such as a pair of forks or a platform or any other desired load handling implement.

The implement carrying means 32 is connected to the transversely extending part 31 by a pair of pivot means 33 for pivotable crowd movement about a generally horizontal axis. The pivot means 33 are each carried on a limb 34 which extends downwardly from the transversely extending member 31.

The implement carrying means 32 is connected to the limbs 34 for pivotal movement under the control of a crowd ram means comprising a pair of crowd rams 35 which are pivotally connected to the implement carrying means 32 at 32a and to the transversely extending member 31 at 31a. The arrangement of the hydraulic circuit of the crowd rams 35 will be described hereinafter.

The boom 25 is caused to swing up and down by a lift ram 40 connected at 40a, b to a lug of the boom part 29a and to the structure 11 to extend operatively therebetween.

A compensation ram 41 is also pivotally connected at 41a, b to a lug of the boom part 29a and to the structure 11 to extend operatively therebetween.

The cab maybe arranged to pivot forwardly relative to the remainder of the structure about an axis provided by a pivot means 38 so that the operator's compartment may be tilted upwardly and forwardly along with the seat, steering column and controls in conventional manner along a "split-line" B to provide access to the engine 20 and pump 21.

The operator's compartment 18 may be glazed on one or more sides. If glazed on all sides it is provided with an access door, not shown.

Referring now to Figures 6 and 7 the vehicle has a chassis 100 made as a welded fabrication. The chassis 100 comprises a pair of generally planar side frame members 101, 102 disposed on one side of the vehicle and a box section side frame member 103 disposed on the opposite side of the vehicle. The frame members 101, 102 and 103 are connected together by transversely extending front and rear portions 104, 105 of the chassis which are of curved configuration and essentially provide wheel arches for the front and rear wheels 13, 16 of the vehicle. The side frame members 101, 102 have, at their end, a upwardly extending part 101a, 102a respectively provided with an aperture 101b, for the pivot means 26.

The frame members 101, 102 also have stub members 106 whereby the compensation ram 41 is connected to the structure 11 at the position 41a.

The side frame members 101, 102 are also provided with a lift ram pivot means 107 whereby the lift ram 40 is connected to the structure at the position 40a.

Four vibration/damping absorbing mounts 108 are provided on the inner frame member 102 and the opposite side frame member 103 for mounting the engine/pump assembly 20, 21 thereon.

The front transverse member 104 is provided with a pair of upstanding brackets 109 which provide a pair of slots 110 for the pivot means 38.

The chassis 110 is also provided with an upright 114, on said other side of the chassis, to provides a location for the operator's compartment 18

In addition, the chassis at the front end, is provided with a pair of forwardly projecting parts 115, provided with part circular apertures 116, which receive the front motors 22.

In the present example the ratio of the width of the operator's compartment to the overall width of the vehicle is 1:0.72 and the above mentioned ratio may lie, if desired, in the range 1:0.5 to 1:0.8.

In the present example the vehicle has an overall width of 1180mm if desired, the width may be other than that specifically described with reference to the example and is generally less than 1200mm.

The boom 25 is disposed so that when the boom is in a lowered position, as illustrated, an operator may see laterally as well as forwardly and rearwardly over the top of the boom and the load carrying implement. Even when the boom is being raised or lowered the operator view is relatively unobstructed as his vision is only obstructed when the implement and any load carrier thereon is in his line of sight. This is in contrast with a conventional fork lift truck in that the operator's view forwardly is not obstructed by any permanently present mast.

In the present example the axis of pivot 26 of the boom 25 is disposed at a position which is less than about 30% of the rear wheel diameter behind the axis of

rotation of the rear wheel but may be positioned at any desired position within the range 0% to 50% of the rear wheel diameter being said axis of rotation of the rear wheels.

The axis of rotation 26 is, in the present example, positioned 55% of the overall vehicle height above ground on which the wheels of the vehicle are disposed but may be disposed in any desired position in the range 40% to 70%

Referring now to Figure 6, a reservoir for hydraulic fluid of the vehicle is indicated generally at 50 and is filled with fluid by filler/breather arrangement 51.

Fluid is fed from the reservoir 50 on line 52 to a engine driven pump arrangement indicated generally at 53 in conventional manner and fluid under pressure is supplied by the pump arrangement 53 to the steering valve arrangement V2 and, on line 54, to a boom control valve block V3. Fluid is supplied via line 54a to charge pump 21a which in turn supplies fluid under pressure to variable swash plate pump 21. Fluid under pressure is supplied to motors 22 its direction and flow being controlled by V1 which is controlled by the operator in conventional manner.

Appropriate returns are provided to the reservoir 50 from the valve means V1-V3.

Referring now particularly to Figure 9, the extension ram 30 is connected by lines 30a, 30b to a extension control valve 30c within the valve block V3 so that manual operation of the valve 30c can supply fluid under pressure to the cylinder 30. The lift ram 40 is connected by lines 40a, 40b to a manually operable valve 40c of the valve lock V3 so as to permit supply of fluid under pressure to the cylinder 40d on opposite sides of a piston 40e housed there within so as to cause extension or retraction of a piston rod 40f associated with the piston 40e and consequent to lifting or lowering swinging movement of the boom 25.

Each crowd ram 35 differs from rams provided for the lift ram and the extension ram by virtue of comprising a pair of separate cylinders 55, 56 which are hydraulically separate but are mechanically connected, in the present example, by being disposed coaxially end to end. The cylinder 55 houses a piston 57 connected by a piston rod 58 to the implement carrier 32. The cylinder 56 houses a piston 59 which is connected by a piston rod 60 to the associated limb 34. The cylinder 55 and its piston

57 comprise a first ram, and the cylinder 56 and piston 59 comprise a second ram hereinafter referred to as a tilt means.

The cylinders 56 are connected by lines 56a, 56b to a tilt valve 56c of the valve block V3 whilst the cylinders 55 are connected by lines 55a, 55b to opposite sides of a cylinder 41d of the compensation ram 41 in which is housed a piston 41e connected by a piston rod 41f to the boom 25 whilst the cylinder 41 is connected at the opposite end of the ram to the structure 11.

Accordingly, as the boom 25 is raised or lowered a corresponding pivotal movement of the implement carrier is caused to take place by the fluid displaced from the relevant side of the compensation ram 41 in to the cylinders 55.

When it is desired to perform crowd movement, the manually operable tilt valve 56c is operated to cause fluid to be fed to the relevant side of pistons 59 in the cylinders 56.

As a result, the tilting movement of the implement relative to the boom caused by the crowd ram means as a whole may comprise a component due to operation of the first rams to maintain the implement in a desired orientation relative to a horizontal plane or a component due to operation of the tilt means comprising the second rams for tilting movement of the implement relative to the boom under manual control or may comprise both components due to operation of both of the first and second rams. In short, the first and second rams are arranged so that the outputs of the two rams are connected "in series". Thus operation of either the first or the second rams causes tilting movement of the implement relative to the boom but operation of both rams causes a resultant movement of the implement relative to the boom which is effectively an algebraic sum of the component movements.

In accordance with the present invention the cylinders for compensation movement and tilting movement are independent and the respective cylinders may be of appropriate size to enable achievement of a desired pivotal movement for compensation and for tilting movement. In the present example the boom 25 may be swung up and down over an arc of about 70° whilst tilting movement may be provided over a range of -5° from the horizontal to +12° from the horizontal.

If desired, the mechanical configuration of the crowd rams 35 may be provided as desired. For example, instead of providing a pair of cylinders disposed end to end in co-axial relationship each crowd ram 35 may comprise two separate cylinders facing in opposite directions but arranged, for example, side-by-side or in any other suitable configuration in which the tilt and compensation cylinders are arranged to operate independently.

An alternative mechanical configuration of the crowd ram means is shown in Figure 20, wherein the same reference numerals have been used to refer to corresponding parts of the crowd ram means as shown in the embodiments of the vehicle as described with reference to Figures to 1 to 19. The implement carrying means 32 is connected to the limbs 34 for pivotal movement about pivot means 33, and is controlled for pivotal movement by a first ram 71, comprising a single double-acting ram and a second ram comprising a single double acting ram 70 providing a tilt means. The second ram 70 comprises a cylinder 70a housing a piston (not shown) connected by a piston rod 70b to the implement carrying means 32 via a pivot 72. The first ram 71 similarly comprises a cylinder 71a housing a piston (not shown) connected by a piston rod 71b to the second ram 70 by pivot 73. The first ram 71 is connected at its other end to the limb 34 by pivot means 74 provided on an ear 75 of limb 34. To constrain movement of the first and second rams, a link 76 is pivotally attached to cylinder 70a and rod 71b by pivot 73 and is pivotally attached to limb 34 by pivot 77. The first ram 71 is connected in fluid circuit with a compensation ram (not shown) as described in the embodiments described hereinbefore, to maintain the load handling implement in a constant orientation, relative to a horizontal plane as the boom is raised or lowered. The second ram is connected in fluid circuit with an operator control (not shown) as described in the foregoing embodiments, for supply of fluid thereto to cause tilting movement of the implement relative to the boom under operator control.

The rams for compensation movement and tilting movement are thus independent, and may be operated by a suitably modified hydraulic circuit of the kind shown in Figure 9. The respective rams may be of an appropriate size to enable achievement of a desired pivotal movement for compensation and tilting movement as before.

Figures 10 to 14 show a modification of the vehicle described hereinbefore with reference to Figures 1 to 9. In these figures the arrangement of the vehicle is illustrated diagrammatically. as details of the vehicle are the same as described in connection with Figures 1 to 9 except as hereinafter to be stated and the same reference numerals have been used to refer to corresponding parts.

In this example the rear wheels 16 besides being steerable are also driven. As best shown in Figure 14, rear wheels 16 are carried on bracket members 200, fixed to the chassis 100, for rotation about a vertical axis 201 and each wheel 16 is driven by a hydro-static motor 202 which is pivotable with the wheel. The hydro-static motors 202 are driven from the pump 21 by flexible conduit means in conventional manner.

Referring now to Figures 15 to 19, again the vehicle is as described hereinbefore with reference to Figures 1 to 9 and as in the first mentioned modification the rear wheels 16 are steerable and driveable. In this example the rear wheels 16 are carried on opposite ends of an axle assembly 300 which is provided with a hydro-static motor 301 which drives the wheels 16 through an appropriate differential drive mechanism within the axle 300. The hydro-static motor 301 is driven from the pump 21 in conventional manner and the wheels 16 are mounted on the axle 300 so as to be rotatable about upright steering axe 302.

Referring now to Figure 21, an alternative embodiment of the crowd ram means is shown. The crowd ram means may be applied to a vehicle as described hereinbefore with reference to Figures 1 to 19, the same reference numerals referring to corresponding parts. As before, the vehicle comprises a single telescopic boom 25 to which is attached a compensation ram 41. A first ram 401 is provided comprising a double acting ram, attached to the implement carrying means 32 and the limb 34. Said first ram 401 comprises a cylinder 402 housing a piston 403 connected by a piston rod 404 to the implement carrier 32 by a pivot 405. The cylinder 402 is connected at opposite sides of the piston 403 to each side of a piston 41e housed within a cylinder 41d of the compensation ram 41. The cylinder is further connected by line 401b to a control valve 406 of the type shown at Figure 56c in Figures 7 and 8. A tilt means is provided comprising a dosing pot 407, the dosing pot 407 comprising a cylinder 407a

housing a piston 407b. The cylinder 402 is connected on line 401a to one side of the dosing pot 407, the other side of said dosing pot 407 being connected by line 411 to the control valve 406. Pressurised fluid is supplied to the control valve 406 by a pump 408 drawing fluid from a reservoir 409 while a return line 410 leads from the control valve 406 to the reservoir 409. It will be clear that such an arrangement could be included in a circuit of the type shown in Figures 7 and 8.

As before, when the boom 25 is raised or lowered, a corresponding pivotal movement of the implement carrier 32 is caused to take place by the fluid displaced from the relevant side of the compensation ram 41 into the cylinder 402.

To cause downward pivoting of the implement carrier 32 under operator control the control valve 406 is moved to a first position wherein line 401b is connected to the pump 408 and line 411 is connected to the return line 410 to the reservoir 409. As viewed in Figure 21, fluid pressure is supplied to the lower side of the ram 403, forcing it to move upwardly, and so tilting the implement carrier 32 downwards. The pressure is thus increased on line 401a which acts upon the piston 407b of the dosing pot 407, causing it to move downwardly. Conversely, when it is desired to tilt the implement carrier 32 upwards, the control valve is moved to a second position wherein line 411 is connected to the pump 408 and line 401b is connected to line 410. Fluid pressure is supplied to the lower side of the dosing pot piston 407b which is forced upwards, increasing the pressure in line 401a and hence in the upper part of the cylinder 402, forcing the piston 403 and ram 404 downwards and tilting the implement carrier 32 downwards.

The maximum range of movement of the piston 403 in response to operation of the control valve 406 is constrained by the range of movement of the dosing pot piston 407b in the cylinder 407a. When the control valve 406 is operated to supply fluid to the first ram 401 to tilt the implement carrier 32 downwards, a corresponding volume of fluid is displaced by the first ram 401 which accordingly forces the 407b of the dosing pot 407 to move downwardly. If further fluid is supplied to the first ram 401, eventually the piston 407b will reach the lower end of the dosing pot cylinder 407a as shown in Figure 21 and will be unable to move any further. No

more fluid can be displaced from the ram 401 on line 401a and hence the piston 403 and piston rod 404 can move no further, and the implement carrier 32 has reached the limit of the range of downwards tilting movement which can be effected by the operator. Conversely, when it is desired to tilt the implement carrier 32 upwardly and fluid is supplied to the lower side of the dosing pot piston 407b, once the piston 407 has reached the upper limit of its range of movement in the dosing pot cylinder 407a, no further fluid can be displaced from the dosing pot cylinder 407b to the first ram 401, and hence the implement carrier 32 is at the limit of its range of upward tilting movement which can be effected by the operator.

The supply of fluid to the first ram 401 of course has no actuating effect on the compensation ram 41 but merely serves to alter the inclination of the material handling implement 32. In the event of the boom being operated, the compensation ram 41 will cause movement of the piston 403 of the first ram 401 as described in the foregoing embodiments. This embodiment removes the need for a second, separate ram as used in the foregoing embodiments.

The ground engageable propulsion means in all embodiments comprises a pair of front and a pair of rear ground engageable wheels and a drive motor to drive at least one of said pairs of wheels.

Besides the drive arrangements described hereinbefore, if desired, the drive motor may drive only the rear, steerable, wheels. As a generality, if desired, the front wheels may be steerable as well as or instead of, the rear wheels and the front wheels and/or the rear wheels may be driven by suitable adaption of the suspension, steering and drive means described hereinbefore. Further, although hydro-static drive means have been described hereinbefore, if desired, in any version the drive means may be provided wholly or partly by a mechanical transmission from the engine to the wheels.

If desired the vehicle described hereinbefore may be provided without the crowd ram facility described hereinbefore with reference to Figures 8, 9, 20 or 21 or, alternatively, the crowd ram facility described with reference to Figures 8, 9, 20 or 21 may be provided in a vehicle of different configuration to that described hereinbefore with reference to the other figures.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A load handling lift truck of the kind specified wherein the crowd ram means comprises a first ram, said ram comprising a double acting ram connected in fluid circuit with a compensation ram to cause tilting movement of the implement relative to the boom to maintain the load handling implement in a constant orientation relative to a horizontal plane as the boom is raised or lowered, said crowd ram means further comprising a tilt means connected in fluid circuit with an operator control for supply of fluid thereto to cause tilting movement of the implement relative to the boom under operator control.

2. A truck according to claim 1 wherein tilting movement of the implement relative to the boom caused by the crowd ram means may comprise components due to operation of at least one of said first ram and said tilt means.

3. A truck according to claim 1 or claim 2 wherein said tilt means comprises a second ram, said second ram comprising a double acting ram.

4. A truck according to claim 3 wherein the second ram is operable to cause crowd movement of the load handling implement independently of the first ram.

5. A truck according to claim 1 or claim 2 wherein said tilt means comprises a dosing pot.

6. A truck according to claim 5 wherein said dosing pot is connected in fluid circuit with said first ram to restrict the supply of fluid under operator control to the first ram.

7. A truck according to any one of the preceding claims wherein the first ram means permits a relatively large arc of movement of the boom whilst the tilt means permits a second, smaller, arc of movement of the implement relative to the boom.

8. A truck according to claim 7 wherein the first arc of movement lies in the range 65° to 75° and the second range of movement lies in the range -5° to +12° from the horizontal.

9. A truck according to any one of the preceding claims wherein the crowd ram means comprises first and second cylinders, a first piston rod extending in a first direction from a piston disposed in the first cylinder and a second piston rod extending in a second, opposite, direction from a piston disposed in the second cylinder.

10. A truck according to claim 9 wherein the first and second cylinders are disposed end to end.

11. A truck according to claim 10 wherein the cylinders are disposed end to end in co-axial relationship.

12. A truck substantially as hereinbefore described with reference to the accompany drawings.

13. Any novel feature or combination of features described herein and/or in the accompanying drawings.

The Patent Office

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Application No:	GB 9805985.0	**Examiner:**	Andrew Glanfield
Claims searched:	1-13	**Date of search:**	30 September 1998

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B8H (HCJ, HCN, HPA)

Int Cl (Ed.6): B66F9 (9/065)

Other: -

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1535284	(CASE) see compensating ram 14 and crowd and tilt ram 18 in figure 1, also page 1, lines 60 to 80.	1-2
X	GB 1513328	(HAMMARSTRAND) see compensating ram 5 and crowd and tilt ram 10 in figure 2, also page 2 line 129 to page 3 line 35.	1-2
X	GB 821746	(CLARK) see compensating ram 47 and tilt and crowd ram 43 in figure 4, also page 3 lines 39 to 50 and page 4, lines 83 to 109.	1-2
X	US 4553899	(MAGNI) see compensating ram 8 and crowd and tilt means 23 in figure 1, also column 4 lines 46 to 62.	1-2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.