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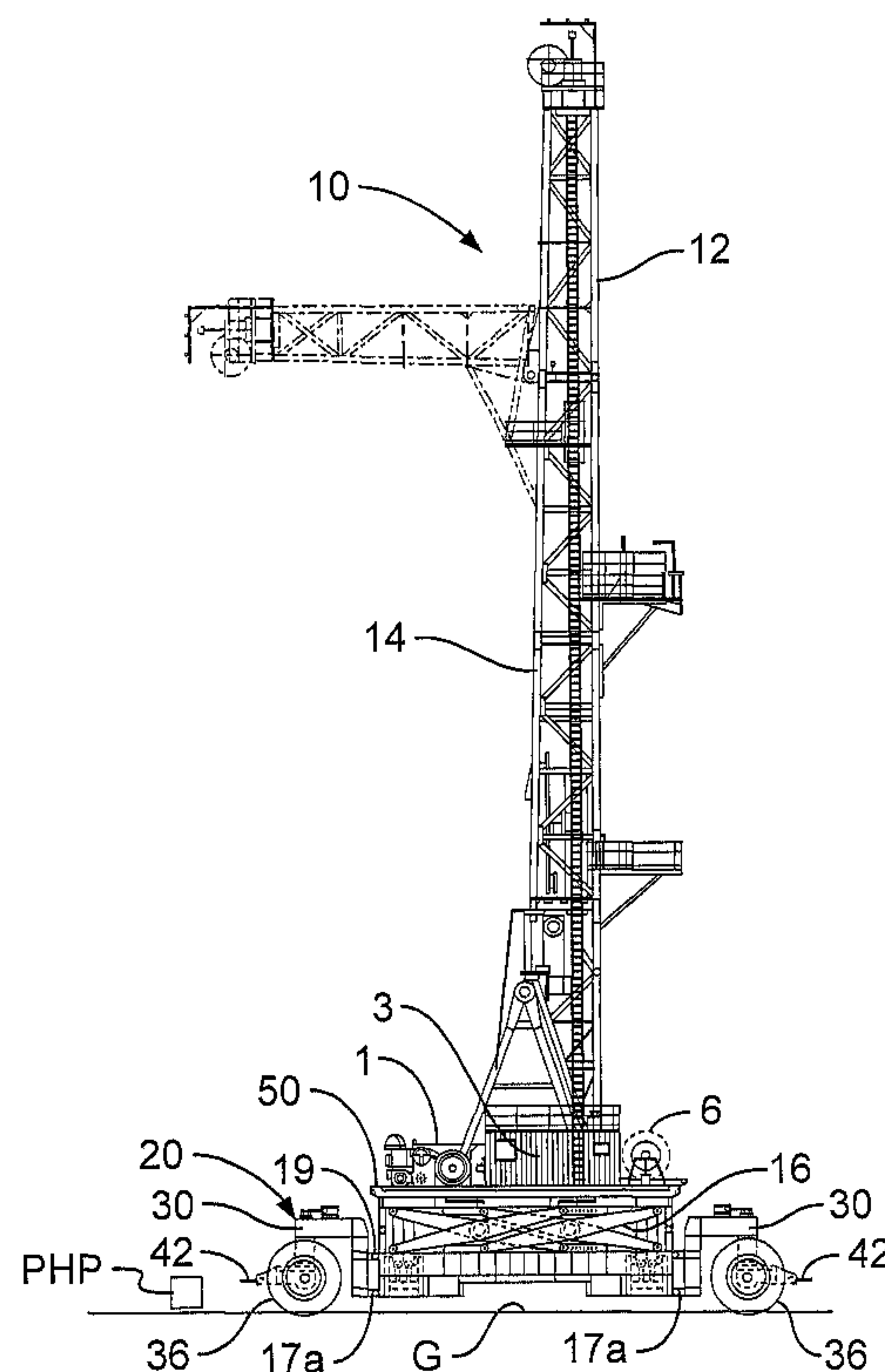
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(54) **Titre : INSTALLATION DE FORAGE ET PROCEDE PERMETTANT DE DEPLACER UNE INSTALLATION DE FORAGE**

(54) **Title:** A DRILLING RIG AND A METHOD FOR MOVING A DRILLING RIG



(57) Abrégé/Abstract:

A drilling rig is disclosed which comprises a base box, a substructure and a plurality of powered cylinder apparatuses. The substructure is raisable above the base box using the plurality of powered cylinder apparatuses. The drilling rig further comprises a plurality of scissors apparatuses for bracing the substructure with respect to the base box.

ABSTRACT

A drilling rig is disclosed which comprises a base box, a substructure and a plurality of powered cylinder apparatuses. The substructure is raisable above the base box using the plurality of powered cylinder apparatuses. The drilling rig further comprises a plurality of scissors apparatuses for bracing the substructure with respect to the base box.

A DRILLING RIG AND A METHOD FOR MOVING A DRILLING RIG

This application is a division of Canadian application 2,724,442 filed May 15, 2009.

The present invention relates to a drilling rig and a method for moving a drilling rig. The drilling rig is particularly, but not exclusively, for the workover and
5 drilling of oil and gas wells.

The prior art discloses a variety of rigs used in drilling and various wellbore operations, including rigs that are mobile; for example, and not by way of limitation, U.S. Patents 3,340,938; 3,807,109; 3,922,825;
10 3,942,593; 4,269,395; 4,290,495; 4,368,602; 4,489,526; 4,569,168; 4,837,992; 6,634,436; 6,523,319 and the references cited in these patents.

In the drilling of a well or in an operation working over or servicing a well, such an oil or gas well, on
15 land, land rigs are delivered to a site, assembled and then disassembled; including, in many cases, raising a rig mast to a vertical operational position. Often as an oilfield becomes mature, wells are drilled deeper into the earth to obtain production. Oil rigs are getting
20 progressively larger to meet these needs. In the past, a 1.1 megawatts (1500hp) rig was sufficient to handle most drilling. These rigs more recently have been supplanted by larger 1.5 megawatts (2000hp) rigs. Currently, 2.2 megawatts (3000hp) rigs are being made, but are not yet
25 widely used. A 2.2 megawatts (3000hp) rig typically has an 11m to 11.3m (36 to 37) foot high drillfloor, a 47.5m (156 feet) clear height mast, a 6,670,000N (1,500,000 pound) hookload, a 5,780,000N (1,300,000 pound) rotary load, and a 4,450,000N (1,000,000 pound) setback load.
30 Often large drilling rigs, for example in the Middle East, are transported between well sites by dismantling the rig into pieces that can be trucked between two well sites which can produce many time-consuming truckloads of

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rig components resulting in up to four additional weeks of rig downtime (the larger the capacity of the rig, the heavier the loads, and the number of loads also increases); and mounting the drilling module complete
5 with mast on tires. One drawback of a tire-mounted drilling module is tire load capacity and overall rig height. Often, the largest tires that are used are 40x57 earthmover tires.

With certain current rig designs, the largest rigs
10 that can be easily moved are 1.5 megawatts (2000hp) rigs of a box style substructure. This style of design is conducive to even tire loading. A typical 2.2 megawatts (3000hp) rig that has an evenly loaded box style substructure will be too tall to move with a 47.5m (156
15 feet) mast and a 11.3m (37 feet) drillfloor to get under power line height restriction with current moving systems (for example in countries such as Kuwait where a typical maximum clearance for power lines is 49.1m (161 feet) from the ground to the top of the rig being transported).
20 Anything taller than this will produce the potential for electrical arcing between the mast and the power lines if the rig is being towed on its tires.

Another common style of substructure is the slingshot substructure which is often used in large
25 hookload application. The substructure folds down in order to easily access the drillfloor from the ground level, which aids in rig assembly. Often a substructure of this size is broken down into truck sized loads. Placing a wheeled moving system on certain rigs of this
30 style may not be practical because it is not feasible to easily balance the wheel loads.

U.S. Patent 3,922,825 discloses a rig with a stationary substructure base and a movable substructure base mounted thereon which is coupled to the stationary

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base and swings upright into an elevated position on a series of struts that are connected to the stationary base with swivel connections at each end. The movable base is otherwise stationary since neither the stationary
5 base nor the movable base are mobile or repositionable without the use of an auxiliary crane or the like. The movable substructure base and the drill mast are raised with a winch mounted on an auxiliary winch truck.

U.S. Patent 3,942,593 discloses a mobile well
10 drilling rig apparatus which has a trailerable telescoping mast and a separate sectionable substructure assembly with a rig base, a working floor, and a rail structure. The mast is conveyed to the top of the substructure by rollers and is raised by hydraulic
15 raising apparatus to an upright position. With such a system the the mast assembly can be relatively long when transporting it and the mast can be unstable during raising. This system uses drawlines and winch apparatus to raise the mast onto the working floor.

20 U.S. Patent 6,523,319 discloses a drilling rig base and a lower mast section that are collapsible into a compact transportable position. The base is expandable in the field to support a drilling platform and equipment, and the telescoping mast is also expandable for
25 supporting the crown block and cables of the drawworks. The rig may have a plurality of beams, the outer beams being collapsible to a transportable position for placing on a single truck or trailer, and the A-frame lower mast section which is collapsible to a transportable position
30 for placing on a single truck or trailer. In one aspect, a mobile, collapsible drilling rig base and drilling platform are disclosed which have: a base having a plurality of parallel beams; the beams being in a horizontal plane and including inner beams and outer

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beams: the outer beams being collapsible in said horizontal plane to a transportable position; and a drilling platform attached to the base that is elevatable above the base.

5 U.S. Patent 6,634,436 discloses a mobile land drilling apparatus and method. The rig has a mobile telescoping substructure box. A lifting apparatus selectively supports the mobile telescoping substructure box unit in a raised position and lowered position. An
10 extension cylinder further extends the mobile telescoping substructure box unit in telescopic extension. A stationary frame member and a telescoping frame member have a plurality of cables attached thereto for supporting the telescoping frame member when extended. A
15 trolley winch allows completion of the rig assembly without an external crane.

U.S. Patent 7,357,616 discloses oil rig capable of being at least partially disassembled to form at least two portions, such as a top half and bottom half, and an
20 associated structure for transport. An oil rig top portion may be loaded onto a trailer for transport separate from a bottom portion. The trailer includes a bottom frame, a top frame, a structure operably associated with said bottom and top frames for moving the
25 top and bottom frames away from and towards one another, and a moving means attached to the at least bottom frame to allow the trailer to be moved along the support surface. The trailer may be towed by a truck or other vehicle. In one aspect a method is disclosed for
30 transporting an oil rig, including: disassembling the oil rig to form a top portion with a rig floor and a mast and bottom portion with a substructure; transporting the top portion separately from the bottom portion; transporting the rig floor on a trailer; raising a top surface of the

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trailer to accept the rig floor; and prior to the step of transporting the rig floor on the trailer, lowering the top surface of the trailer. In one aspect, a trailer is disclosed for moving a part of an oil rig along a support surface, the trailer having: a bottom frame; a top frame; a structure operably associated with the bottom and top frames for moving the top and bottom frames away from and towards one another and further operative to temporarily fix the position of the top and bottom frames with respect to one another, the structure having at least one hydraulic piston; an alignment mechanism affixed to one of the top and bottom frame, the alignment mechanism operative to align the top frame with a top surface of the oil rig; an I-beam affixed to the top surface and operative to facilitate loading the part of the oil rig onto the trailer; and a moving means attached to at least the bottom frame to allow the trailer to be moved along the support surface.

In accordance with the present invention, there is provided a drilling rig comprising a base box and a plurality of wheel assemblies characterised in that at least one of the wheel assemblies is connected to the base box on a pivot and is pivotable from a first position for facilitating movement of the drilling rig from a first location to a second location, to a second position disabling movement of the drilling rig. Preferably, the position disabling movement of the drilling rig, is a position raised from feet or the point at which the base box meets the ground. The wheel assembly is preferably raised clear from the ground in the disabled position or the wheel assembly is left under substantially its own weight on the ground.

Advantageously, the drilling rig further comprises a substructure connected to the base box, the substructure

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raisable above the base box. Preferably, the substructure supports a drill floor. The drill floor and substructure may be in the form of a unitary floor skid.

Preferably, the drilling rig further comprises wing
5 floor portions. This enables the drill floor area to be reduced for transportation. The wing floor portions may be removed for movement on the wheel assemblies or may be kept in place during movement of the drilling rig on the wheel assemblies. The wing floor portions may be attached
10 to the drill floor, the substructure or unitary floor skid with hooks hooked over lugs.

Advantageously, the drilling rig further comprises a raising apparatus arranged between the substructure and the base box for raising the substructure above the base
15 box. Preferably, the raising apparatus comprises a plurality of scissors apparatuses for bracing the substructure with respect to the base box, the scissors apparatuses positionable in a collapsed configuration with the substructure lowered and in an extended
20 configuration with the substructure raised to a working height. Preferably, the scissors apparatuses are releasably securable in the collapsed configuration and in the extended configuration. Advantageously, the plurality of scissors apparatuses includes four spaced-
25 apart scissors apparatuses, each with two centrally connected scissors members. Preferably, the substructure has top roller tracks, the base box has bottom roller tracks, and each scissors apparatus has a first scissors member with a top roller movable in a top roller track
30 and a second scissors member with a bottom roller movable in a bottom roller track. Preferably, the raising apparatus comprises a plurality of powered cylinder apparatuses.

Preferably, the drilling rig further comprises at

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least one bearing pad, such as feet, raisable and lowerable with respect to the base box on which the base box sits. Advantageously, at least one of the plurality of powered cylinders is arranged to move the at least one bearing pad to provide a firm footing for the base box on the ground. Thus a reduced number of power cylinders are needed to raise the substructure and provide a footing for the drilling rig. Preferably, the at least one of the plurality of powered cylinders is arranged to move the at least one foot to lift the base box clear of the ground. Preferably, by a sufficient amount to allow the wheel assemblies to be pivoted about the pivot to a position and locked in place, preferably with a pin in a lug, to allow the drilling rig to be supported on the wheel assemblies when the feet are removed.

Preferably, at least one of the plurality of wheel assembly including a steering apparatus for steering the wheel assembly. The steering apparatus may comprise an arm and a powered cylinder controlled from a controller base.

Preferably, the drilling rig further comprises a mast. Preferably, the mast is connected to the drill floor or the substructure. Advantageously, the mast is selectively erectable with respect to the drill floor. Preferably, the drilling rig has four corners, and the plurality of powered cylinder apparatuses includes four pairs of two powered cylinder apparatuses each, a pair of powered cylinder apparatuses at each corner of the rig. The drilling rig may also comprise such items as a driller's cabin, drawworks, rotary table, line spools, etc. which may be left on the drill floor whilst the drilling rig is moved from the first location to the second location.

Advantageously, each powered cylinder apparatus has

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a redundant power cylinder. Preferably, the powered cylinder and the redundant power cylinder are of the same size and type. Advantageously, the redundant power cylinder is activated with power fluid at the same time
5 as the power cylinder, such that if there is a failure of the power cylinder, the redundant power cylinder has sufficient power to continue lifting the substructure on the bearing pad.

Preferably, the drilling rig has a centre of gravity
10 maintainable in a horizontal plane during drilling and during rig movement.

The present invention also provides a method for moving a drilling rig, the method comprising the steps of pivoting wheel assemblies connected to a base box from a
15 passive position to an active position to facilitate moving the drilling rig from a first location to a second location, securing the wheel assemblies in the movement position, and moving the mobile drilling rig on the wheel assemblies.

Preferably, the method further comprises the steps
20 of lowering a substructure of the drilling rig with respect to the base box before moving the drilling rig from the first location to the second location. Advantageously, the substructure comprises a drill floor
25 having wing portions, the method comprising the step of removing the wing portions before moving the drilling rig from the first location to the second location.

Preferably, the substructure comprises a drill floor having wing portions, the method comprising the step of
30 leaving the wing portions attached to the drill floor before moving the drilling rig from the first location to the second location. Advantageously, the method further comprises the step of lowering the substructure with respect to the base box on scissor apparatus.

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Preferably, the method further comprises the step of lowering the substructure with respect to the base box by activating a plurality of powered cylinder apparatuses. Advantageously, the at least one bearing pad supports the base box the method further comprising the step of moving at least one bearing pad to transfer support to the plurality of wheel assemblies. Preferably, the method further comprises the step of activating the at least one of the plurality of powered cylinders to move the at least one bearing pad to transfer support to the plurality of wheel assemblies. Thus the powered cylinder is used to lower the bearing pad, raise the base box, allowing the bearing pads to provide a firm footing for the drilling rig and to raise the substructure and drill floor to a working height. The working height may be a height suitable to allow a blowout preventer tree to be arranged between the substructure and the ground at the well.

Advantageously, the method further comprises the step of steering the drilling rig by moving the wheel assemblies.

Preferably, the drilling rig comprises a mast, the method further comprising the step of leaving the mast erect whilst the drilling rig is moved from the first location to the second location. The mast is preferably lowered with the substructure, but maintained fitted and erected on the substructure. Alternatively, the mast may be lowered or removed or removed in part from the substructure before moving.

Preferably, each powered cylinder apparatus has a redundant power cylinder, the redundant power cylinder activated with power fluid at the same time as the power cylinder, such that if there is a failure of the power cylinder, the redundant power cylinder has sufficient

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power to continue lifting the substructure on the bearing pad.

Advantageously, the drilling rig has a centre of gravity, the method further comprising the step of
5 maintaining the centre of gravity in a horizontal plane during drilling whilst the drilling rig is moved from the first location to the second location.

The present invention also provides a drilling rig comprising a base box, a substructure and a plurality of
10 powered cylinder apparatuses, the substructure raisable above the base box using the plurality of powered cylinder apparatuses characterised in that the drilling rig further comprises a plurality of scissors apparatuses for bracing the substructure with respect to the base
15 box.

Preferably, the scissors apparatuses each have top ends connected to the substructure and bottom ends connected to the base box, the scissors apparatuses positionable in a collapsed configuration with the
20 substructure lowered and in an extended configuration with the substructure raised, and the scissors apparatuses releasably securable in the collapsed configuration and in the extended configuration. The scissor apparatuses provide bracing during raising and
25 lowering and may be used as bracing during drilling operations. The scissor apparatus may be removed once the drilling rig is erected. Additional support braces may be provided with fold with the scissor apparatus or fixed in place when the substructure is in the raised
30 configuration.

Preferably, the plurality of scissors apparatuses includes four spaced-apart scissors apparatuses, each with two centrally connected scissors members. Advantageously, the substructure has top roller tracks,

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the base box has bottom roller tracks, and each
scissors apparatus has a first scissors member with a top
roller movable in a top roller track and a second
scissors member with a bottom roller movable in a bottom
5 roller track.

The present invention, in certain aspects, discloses
a mobile drilling rig with integral wheel assemblies
selectively changeable from a drilling mode position to a
moving mode position. In the moving mode position, the
10 mobile drilling rig is movable on the wheel assemblies
from one location to another.

In certain aspects, the present invention discloses
a system that includes a land rig with an erectable
substructure; an erectable mast; and movement apparatus
15 on which the substructure is mounted for moving the rig
from one location to another. In one aspect, the present
invention discloses a mobile drilling rig with a base
box, a plurality of wheel assemblies pivotably connected
to the base box, each of the plurality of wheel
20 assemblies selectively pivotable from a first position to
a second position, the first position for moving the
mobile drilling rig from a first location to a second
location.

Accordingly, the present invention includes features
25 and advantages which are believed to enable it to advance
rig movement technology.

a drilling rig has a plurality of wheel assemblies
selectively movable into a moving mode to move the
drilling rig from one location to another.

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For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

5 Figure 1A is a front view of a drilling rig in accordance with the present invention positioned over a well;

Figure 1B is a side view of the drilling rig shown in Figure 1A;

10 Figure 1C is a top plan view of a rig floor of the drilling rig shown in Figure 1A;

Figure 1D is an enlarged side view of part of the drilling rig shown in Figure 1A;

15 Figure 1E is an enlarged top plan view of a wheel assemblies and interconnecting structure of the drilling rig shown in Figure 1A;

Figure 1F is an enlarged rear view of part of the drilling rig shown in Figure 1A in a raised position;

20 Figure 2A is a side view of a part of the drilling rig shown in Figure 1A in a collapsed position, showing a step in a method in accordance with the present invention;

Figure 2B is a side view of part of the drilling rig shown in Figure 1A in a collapsed position, showing a step after the step shown in Figure 2A;

25 Figure 2C is a side view of part of the drilling rig of Figure 1A showing a step after the step shown in Figure 2B;

30 Figure 2D is a side view of part of the drilling rig shown in Figure 1A in a collapsed position, showing a step after the step shown in Figure 2C;

Figure 2E is a side view of part of the drilling rig shown in Figure 1A in a collapsed position, showing a step after the step shown in Figure 2D;

Figure 2F is a side view of part of the drilling rig

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shown in Figure 1A in a part collapsed position, showing a step after the step shown in Figure 2E;

Figure 2G is a side view of part of the drilling rig shown in Figure 1A showing the drilling floor in a position;

Figure 3A is a top view of a wheel assembly of the drilling rig shown in Figure 1A;

Figure 3B is a side view of the wheel assembly shown in Figure 3A;

Figure 3C is a front view of the wheel assembly shown in Figure 3A;

Figure 4A is a front view of part of the rig shown in Figure 1A;

Figure 4B is a front view of a bearing pad of the rig shown in Figure 1A; and

Figure 4C is a front view of the bearing pad shown in Figure 4B.

Figures 1A and 1B show an apparatus 10 in accordance with the present invention which includes a drilling rig 12 with a mast 14, a substructure 16, and movement apparatus 20 supporting the substructure 16, the mast 14, and related equipment and structure. The mast 14 may be, as shown, a tilt top mast, or it may be any suitable known mast. The substructure 16 is erectable from a lowered, collapsed position as shown in Figure 1B to a raised position as shown in Figures 1A and 1D. The system 10 includes typical rig equipment and, apparatuses, for example, but not limited to, a drawworks 1, a rotary table 2 (see Figure 1C), a driller cabin/doghouse 3, a setback floor 4, a BOP stack 5, a drill line spooler 6, and hydraulic catheads 8.

The movement apparatuses 20 (see, Figures 2G, 3A to 3C) include four wheel assemblies 30 which are pivotably mounted to a base box 18 at pivot points 19. Each wheel

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assembly 30 has two wheels 35 each with a tire 36 and has a lug 31 selectively secured with a removable pin 17a to a lug 17 projecting from the base box 18. Stop members 15 abut top beams 37 of the wheel assemblies 30 when the wheel assemblies 30 pivot at the pivot points 19 to prevent further movement of the top beams 37 toward the substructure 16.

Axles 33 which rotate in trunnions 32 of the wheel assemblies 30 have wheels 35 secured thereto. Each wheel 35 has a tire 36 (for example, but not limited to 40x57, 76 ply tires). Optionally there is only one wheel for each wheel assembly each with one tire thereon at each of the four corners of a rig. A trunnion support 34 of each wheel assembly is rotatably secured at a wheel pivot 34a to the trunnion load beam 37a which is secured to the base box 18.

Each wheel assembly 30 has a towbar linkage 42 and one steering cylinder 41 for steering each wheel assembly. The steering cylinders 41 are connected to steering links 38 connected to the wheel pivots 34a. The steering cylinders 41 are controlled by a portable hydraulic power unit system PHP (shown schematically, Figure 1B).

The base box 18 includes base box spreaders 18a (beams that interconnect boxes on each side of the rig) and roller tracks 18c for scissors rollers (described below). Frame connection braces 18b are secured between pairs of base box spreaders 18a. Removable trunnion beam spreaders 37a are connected between pairs of trunnion load beams 37.

Four bearing pad apparatuses 40 are secured to the base box 18 in a raised position by pins 40a. When the rig 12 is in a drilling mode (for example see Figure 1A and 2G), the bearing pads 40 rest on the ground G. The

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bearing pads 40 have a limited travel length (for example, see Figures 2B, 2C). The bearing pads 40 are movable by cylinder apparatuses 70 (described below).

5 The substructure 16 supports a drillfloor 50 which includes a drillfloor skid 51 with ends 51a and 51b supported by drill floor skid supports 56;; a driller's side floor box 52; a central drill floor 53; and an off driller's side floor box 54. The drillfloor boxes 52, 54 include roller tracks 55 for scissors rollers (described
10 below). Drawworks support spreaders 57 extend between the drill floor boxes 52, 54.

The substructure 16 has four scissors apparatuses 60, two front and two rear. Each front scissors apparatus has a two outer scissors 61 and two inner
15 scissors 62. Each rear scissors has two outer scissors 63 and two inner scissors 64. The front and rear scissors parts are secured together with center pipe connections 65. Rollers 66 are rotatably mounted at certain ends of the beams of the scissors 61-64 for
20 movement in the tracks 55 (top rollers) or the tracks 18c (bottom rollers). Top ends of the beams of the scissors 61-64 without rollers are pivotably secured to the drill floor boxes 52 and 54 at pivot points 59 and bottom ends of the beams of the scissors 61-64 without rollers are
25 pivotably secured to the base box 18 at pivot points 18p.

The substructure 16 is raised and lowered by hydraulic cylinder apparatuses 70 (one, two, three, four or more at each end; eight shown, two pairs at each corner) which are connected at their tops to lugs 58 on
30 the drill floor boxes 52, 54 and at their bottoms to connections 48 of the bearing pads 40.

Figures 2A - 2G illustrate a method in accordance with the present invention for raising a drilling rig in accordance with the present invention from a transport

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position to a drilling position.

As shown in Figure 2A, the system 10a, like the system 10 described above and like numerals indicate like parts, has been moved on its wheel assemblies 30 from an original location to the new location shown in Figure 2A (for example towed by a truck or trucks with tow bars attached to the tow bar linkages 42). The substructure 16 (system 10a shown partially; may include some or all of the structures and apparatuses shown in Figures 1A, 1C and/or 1D) is located over a proposed well site W. As shown, the substructure 16 has not yet been raised.

As shown in Figure 2B, following removal of the pins 40a, the bearing pads 40 are lowered using the hydraulic cylinders 70. As shown in Figure 2C the hydraulic cylinders 70 are extended to lift the substructure 16, supported on the bearing pads 40 on the ground D. The pins 17a are then removed to permit disconnecting the lugs 31 from the lugs 17 to free the wheel assemblies 30 for pivoting.

As shown in Figure 2D, the substructure 16 (and whatever, not shown, is on the substructure 16) is lowered using the hydraulic cylinders 70. The wheel assemblies pivot at wheel pivots 19. As shown in Figure 2E, the substructure 16 is lowered until it rests on the ground D (or rig mats if they are used), with the wheel assemblies pivoted sufficiently to permit the substructure 16 to rest on the ground D. At this point, if the mast is not already mounted on the drill floor boxes 52, 54, the mast may be placed in a horizontal position on the drill floor and raised to a vertical position. (i.e., the mast can be moved as a separate load). Pins 15a which selectively secure the drill floor 50 and the base box 18 are removed so that the substructure 16 can be raised.

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As shown in Figure 2F, the substructure 16 and the drillfloor 50 (and whatever is on the drillfloor 50) are raised using the cylinders 70. The scissors apparatuses 60 are moving with their rollers in tracks from the collapsed positions of Figure 2E to the contracting positions of Figure 2F.

Figure 2G illustrates the substructure 16 raised to a desired height. The top roller ends of the beams of the scissors 61-64 are pinned with pins 67 to the drill floor boxes 52, 54 and the base box 18 with pins 67 (for example hydraulic pins may be used).

It is within the scope of the present invention for the scissors apparatuses 60 to be folded up with the drillfloor pinned to the base box in the moving mode. Optionally the BOP stack or stacks can be removed for transport (for example at a 5mph speed) using a known skidding-type BOP handling system or traditional BOP hoists to remove the stacks. At a 2.5mph speed the BOP stack(s) may, optionally, stay onboard the rig in such a position to complement the tire loading at the four corners. The cylinders used to lift up the substructure may be the same cylinders used to raise the substructure base.

In one aspect four pairs of cylinders 70 are multistage power cylinder apparatus used with two cylinders located under each of four rig corners to raise the drillfloor and mast (if present) as one unit. The cylinders, optionally, are failsafe in that the safety factor of the hydraulics and cylinders is such that if one cylinder loses pressure, the system can still safely run with another cylinder holding the load in the same corner. If both cylinders in one corner lose pressure, then the structure, in one aspect, may still be safely lowered to the base box because the hydraulics and the

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cylinders have enough support ability built into them to prevent a catastrophic failure.

In one aspect the scissors apparatuses 60 are additional lifting apparatus for the BOP stacks in a cellar CR. The cellar CR can also, optionally, have spreaders with rails built in for the stack handler to roll onto from the truck bed.

The scissors apparatuses 60 are pinned at a drilling height (for example as in Figure 2G) using hydraulic latch pins 67 which secure the scissor apparatuses to the guide tracks 18c and 55. In one drilling position, the rig is typically raised to a maximum height, but, in one aspect, the inherent design of the scissors apparatuses 60 allow this substructure to operate over a much larger range of heights, for example from 28-29 feet to 36-37 feet, although a larger design in accordance with the present invention can provide a maximum height to over 40 feet. For example, a smaller design of the scissors apparatuses 60 may be used to create a range of 15 feet to 25 feet for an operating height.

In certain aspects, for any sized rig in accordance with the present invention, a mast can have its top section lay down to clear the power lines. This rig may include a top drive and torque track in place. Depending on the size of the rig selected, the transport height can be much lower for a smaller rig. For example, in one aspect, a shorter portable drilling rig provided in accordance with the present invention still has a complete drilling module. The mast may also be removed completely and shipped separately in order for the system 10a to achieve an even smaller minimum road height.

The scissors apparatuses 60 may be used in conjunction with any other sized drillfloor, large or small, tall or short, and other sized mast, in order to

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achieve a minimum road height and to help with clearance and stability for all families of scissor-type substructure drilling rigs. In cases where the BOP stack or other wellhead equipment is left on the well when the
5 drilling rig (for example a rig 10) is ready for transport, the rig can be towed clear of the stack and then lowered to the transport height.

Systems in accordance with the present invention, in certain aspects, aid in keeping the centre of gravity of
10 a rig in a horizontal plane at the same location in both drilling and transport modes (for example see Figures 1D and 1B; Figures 2G and 2A). This allows for quicker and easier rig moves with less down time for the operator, and a more evenly loaded and compact moving system
15 design. The system, in certain aspects, also incorporates a relatively shorter wheelbase providing a more maneuverable drilling rig with a tighter turning radius, allowing for much easier transportation and location on well sites than certain current designs
20 allow.

The present invention provides mobile drilling rigs, systems and methods for rig erection; and systems and methods for moving a drilling rig. This invention's teachings are applicable, inter alia, to any rig which
25 has an erectable substructure.

The present invention, therefore, provides in some, but not in necessarily all, embodiments a mobile drilling rig including: a base box, a plurality of wheel assemblies pivotably connected to the base box, each of
30 the plurality of wheel assemblies selectively pivotable from a first position to a second position, the first position for moving the mobile drilling rig from a first location to a second location. Such a system may include one or some, in any possible combination, of the

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following: a substructure connected to the base box; the substructure raisable above the base box; a raising system connected to the substructure and to the base box for raising the substructure above the base box; the

5 raising system includes a plurality of powered cylinder apparatuses for raising and lowering the substructure; wherein the raising system includes a plurality of scissors apparatuses for bracing the substructure, the scissors apparatuses each with top ends connected to the

10 substructure and bottom ends connected to the base box; the scissors apparatuses positionable in a collapsed configuration with the substructure lowered and in an extended configuration with the substructure raised; and the scissors apparatuses releasably securable in the

15 collapsed configuration and in the extended configuration; wherein the plurality of scissors apparatuses includes four spaced-apart scissors apparatuses, each with two centrally connected scissors members; wherein the substructure has top roller tracks;

20 the base box has bottom roller tracks; and each scissors apparatus has a first scissors member with a top roller movable in a top roller track and a second scissors member with a bottom roller movable in a bottom roller track; a plurality of bearing pads connected to the base

25 box, each bearing pad of the plurality of bearing pads selectively movable down from the base box to contact ground therebeneath; the bearing pads movable by the powered cylinder apparatuses; each wheel assembly including a steering apparatus for steering the wheel

30 assembly; a drill floor on the substructure; a mast on the drill floor; wherein the mast is selectively erectable with respect to the drill floor; wherein the mobile drilling rig has four corners; and the plurality of powered cylinder apparatuses includes four pairs of

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two powered cylinder apparatuses each; a pair of powered cylinder apparatuses at each corner of the rig; wherein a substructure is connected to the base box, the substructure raisable above the base box and wherein one
5 powered cylinder apparatus alone of each pair can be used to raise and lower the substructure; and/or wherein the mobile drilling rig has a center of gravity maintainable in a horizontal plane during drilling and during rig movement.

10 The present invention, therefore, provides in some, but not in necessarily all, embodiments a mobile drilling rig including a base box, a plurality of wheel assemblies pivotably connected to the base box, each of the plurality of wheel assemblies selectively pivotable from
15 a first position to a second position, the first position for moving the mobile drilling rig from a first location to a second location, a substructure connected to the base box, the substructure raisable above the base box, a raising system connected to the substructure and to the
20 base box for raising the substructure above the base box, the raising system includes a plurality of powered cylinder apparatuses for raising and lowering the substructure, and a plurality of scissors apparatuses for bracing the substructure, the scissors apparatuses each
25 with top ends connected to the substructure and bottom ends connected to the base box, the scissors apparatuses positionable in a collapsed configuration with the substructure lowered and in an extended configuration with the substructure raised, the scissors apparatuses
30 releasably securable in the collapsed configuration and in the extended configuration, the plurality of scissors apparatuses including four spaced-apart scissors apparatuses, each with two centrally connected scissors members, a plurality of bearing pads connected to the

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base box, each bearing pad of the plurality of bearing pads selectively movable down from the base box to contact ground therebeneath, the bearing pads movable by the powered cylinder apparatuses, each wheel assembly
5 movably connected to the base box and including a steering apparatus for steering the wheel assembly, a drill floor on the substructure, a mast on the drill floor, and wherein the mast is selectively erectable with respect to the drill floor.

10 The present invention provides, therefore, in at least certain, but not necessarily all, embodiments a mobile drilling rig with a base box, a substructure connected to the base box, the substructure raisable above the base box, a raising system connected to the
15 substructure and to the base box for raising the substructure above the base box, the raising system includes a plurality of powered cylinder apparatuses for raising and lowering the substructure, the raising system includes a plurality of scissors apparatuses for bracing
20 the substructure, the scissors apparatuses each with top ends connected to the substructure and bottom ends connected to the base box, the scissors apparatuses positionable in a collapsed configuration with the substructure lowered and in an extended configuration
25 with the substructure raised, and the scissors apparatuses releasably securable in the collapsed configuration and in the extended configuration. Such a rig may have one or some, in any possible combination, of the following: wherein the plurality of scissors
30 apparatuses includes four spaced-apart scissors apparatuses, each with two centrally connected scissors members; wherein the substructure has top roller tracks, the base box has bottom roller tracks, and each scissors apparatus has a first scissors member with a top roller

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movable in a top roller track and a second scissors member with a bottom roller movable in a bottom roller track; a drill floor on the substructure, a mast on the drill floor, and wherein the mast is selectively
5 erectable with respect to the drill floor.

The present invention, therefore, provides in some, but not in necessarily all, embodiments a method for moving a mobile drilling rig, the method including: pivoting wheel assemblies pivotably connected to a base
10 box of a rig from a drilling position to a movement position, the rig comprising a base box, a plurality of wheel assemblies pivotably connected to the base box, each of the plurality of wheel assemblies selectively pivotable from a first position to a second position, the
15 first position for moving the mobile drilling rig from a first location to a second location; securing the wheel assemblies in the movement position, and moving the mobile drilling rig on the wheel assemblies. Such a method may include one or some, in any possible
20 combination, of the following: a substructure connected to the base box, the substructure raisable above the base box, a raising system connected to the substructure and to the base box for raising the substructure above the base box, the method including raising with the raising
25 system the substructure above the base box; wherein the raising system includes a plurality of powered cylinder apparatuses for raising and lowering the substructure; wherein the raising system includes a plurality of scissors apparatuses for bracing the substructure, the
30 scissors apparatuses each with top ends connected to the substructure and bottom ends connected to the base box, the scissors apparatuses positionable in a collapsed configuration with the substructure lowered and in an extended configuration with the substructure raised, and

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the scissors apparatuses releasably securable in the collapsed configuration and in the extended configuration, the method including moving the scissors apparatuses from the collapsed configuration to the
5 extended configuration as the substructure is raised; wherein the substructure has top roller tracks, the base box has bottom roller tracks, and each scissors apparatus has a first scissors member with a top roller movable in a top roller track and a second scissors member with a
10 bottom roller movable in a bottom roller track, the method including moving the top rollers in the top roller tracks, and moving the bottom rollers in the bottom roller tracks; wherein a plurality of bearing pads are connected to the base box, each bearing pad of the
15 plurality of bearing pads selectively movable with respect to the base box, the bearing pads in contact with ground during drilling and movable by the powered cylinder apparatuses, the method including raising the bearing pads above the ground to facilitate movement of
20 the mobile drilling rig; wherein each wheel assembly including a steering apparatus for steering the wheel assembly, the method including steering each wheel assembly with its corresponding steering apparatus; wherein there is a drill floor on the substructure, a
25 mast on the drill floor, and wherein the mast is selectively erectable and lowerable with respect to the drill floor, the method including lowering the mast to facilitate movement of the mobile drilling rig; wherein the raising system includes a plurality of powered
30 cylinder apparatuses for raising and lowering the substructure, the mobile drilling rig has four corners, and the plurality of powered cylinder apparatuses includes four pairs of two powered cylinder apparatuses each, a pair of powered cylinder apparatuses at each

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corner of the rig, and wherein a substructure is connected to the base box, the substructure raisable above the base box and wherein one powered cylinder apparatus alone of each pair can be used to raise and
5 lower the substructure, the method including operating only one powered cylinder apparatus of one pair of powered cylinder apparatuses during raising or lowering of the substructure; and/or wherein the mobile drilling rig has a center of gravity maintainable in a horizontal
10 plane during drilling and during rig movement, the method including maintaining the center of gravity of the mobile drilling rig in a horizontal plane during drilling and during rig movement.

15

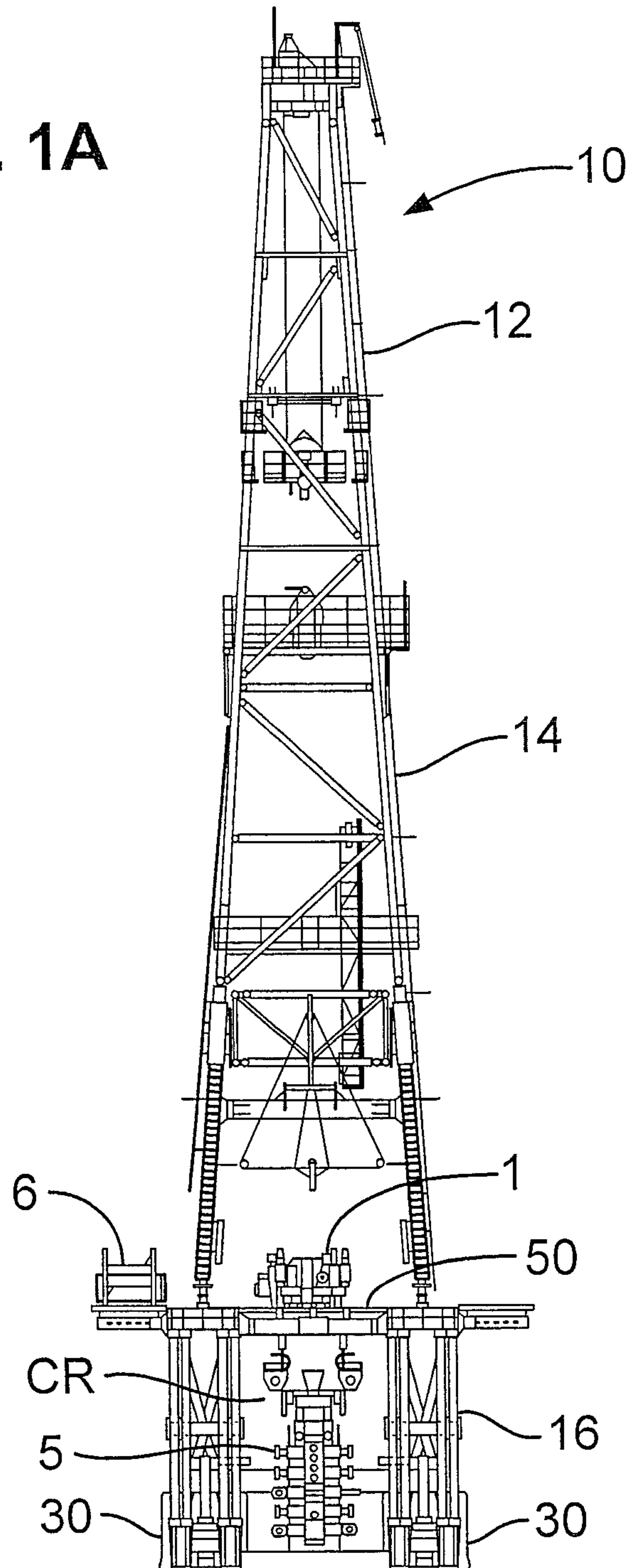
The embodiments of the present invention for which an exclusive property or privilege is claimed are defined as follows:

1. A drilling rig comprising a mast, a base box, a substructure supporting a drill floor and a plurality of powered cylinder apparatuses, the substructure raisable above the base box using the plurality of powered cylinder apparatuses characterised in that the drilling rig further comprises a plurality of scissors apparatuses for bracing the substructure with respect to the base box, such that the drilling rig is operational whilst the substructure remains raised at an operational height by said scissors apparatuses.
2. The drilling rig as claimed in Claim 1, wherein the scissors apparatuses each have top ends connected to the substructure and bottom ends connected to the base box, the scissors apparatuses positionable in a collapsed configuration with the substructure lowered and in an extended configuration with the substructure raised, and the scissors apparatuses releasably securable in the collapsed configuration and in the extended configuration.
3. The drilling rig as claimed in Claim 1 or 2, wherein the plurality of scissors apparatuses includes four spaced-apart scissors apparatuses, each with two centrally connected scissors members.

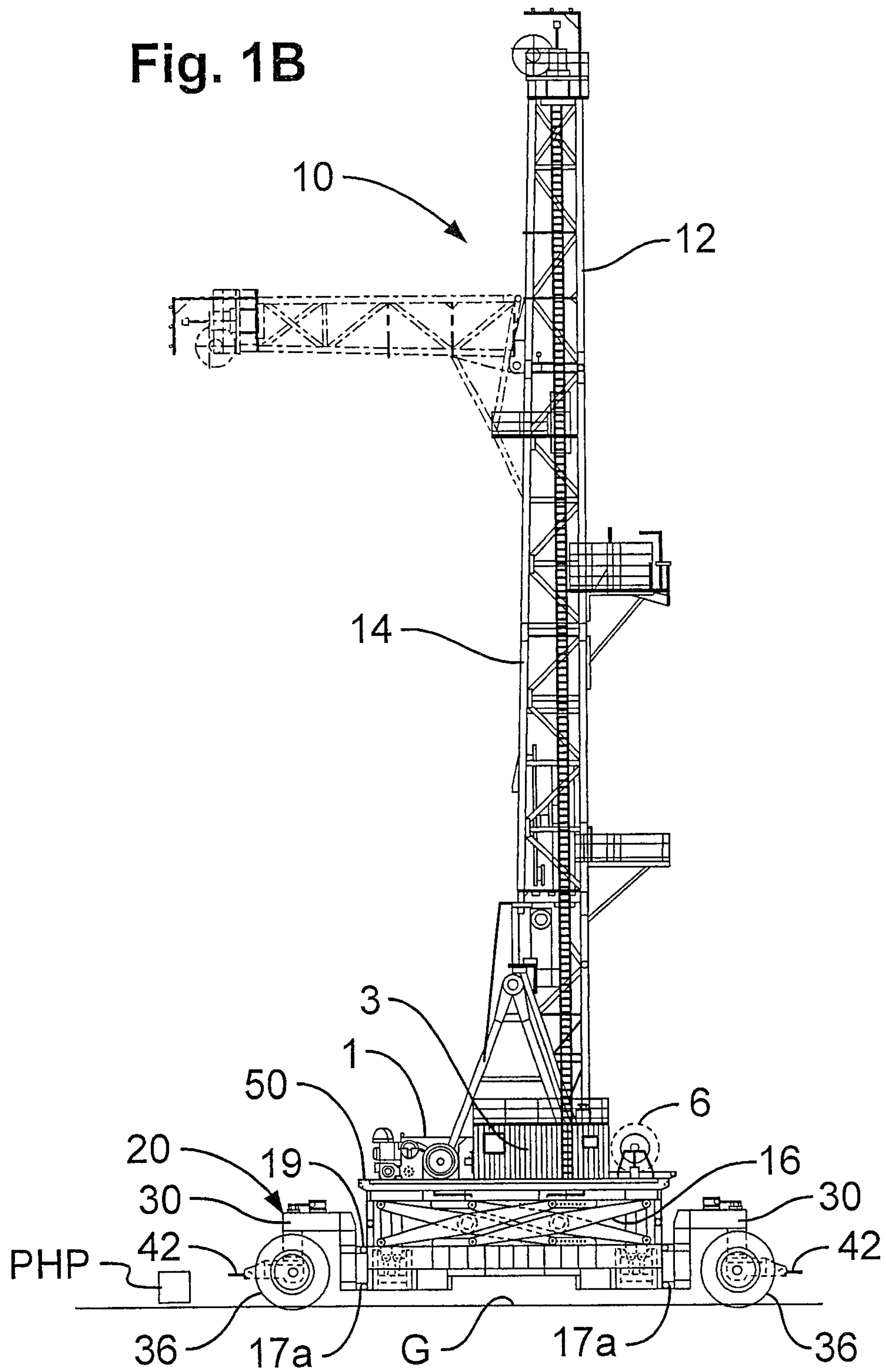
4. The drilling rig as claimed in Claim 1, 2 or 3, wherein the substructure has top roller tracks, the base box has bottom roller tracks, and each scissors apparatus has a first scissors member with a top roller movable in a top roller track and a second scissors member with a bottom roller movable in a bottom roller track.

5. A method for erecting a drilling rig, the drilling rig comprising a mast, a base box, a substructure supporting a drill floor and a plurality of powered cylinder apparatuses, the drilling rig further comprising a plurality of scissors apparatuses, the method comprising the steps of raising the substructure above the base box to an operational height using the plurality of powered cylinder apparatuses and bracing the substructure with respect to the base box with said plurality of scissors apparatuses, the method further comprising the step of operating said drilling rig whilst the substructure remains raised at the operational height by said scissors apparatuses.

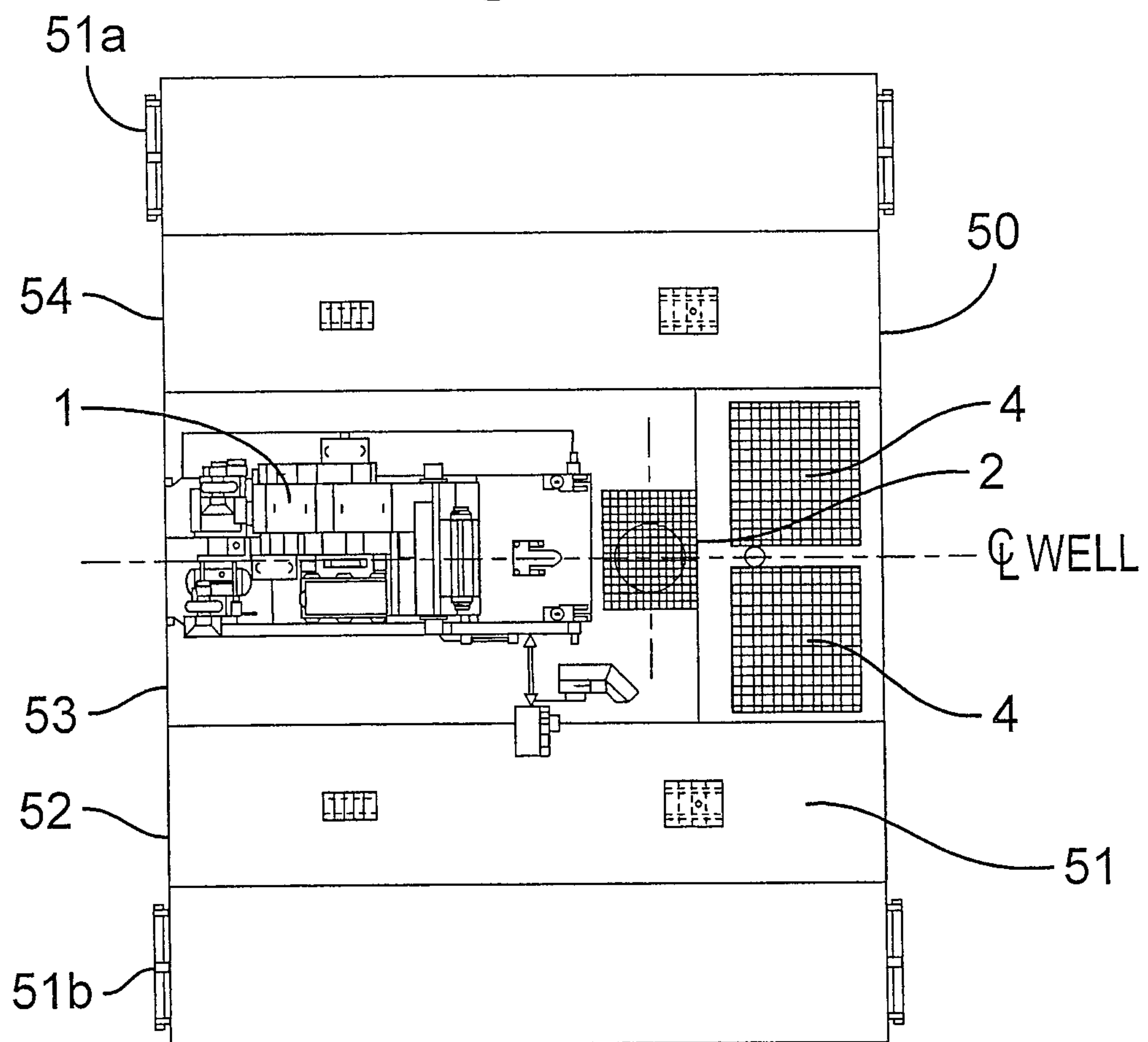
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Fig. 1A

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Fig. 1B

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Fig. 1C

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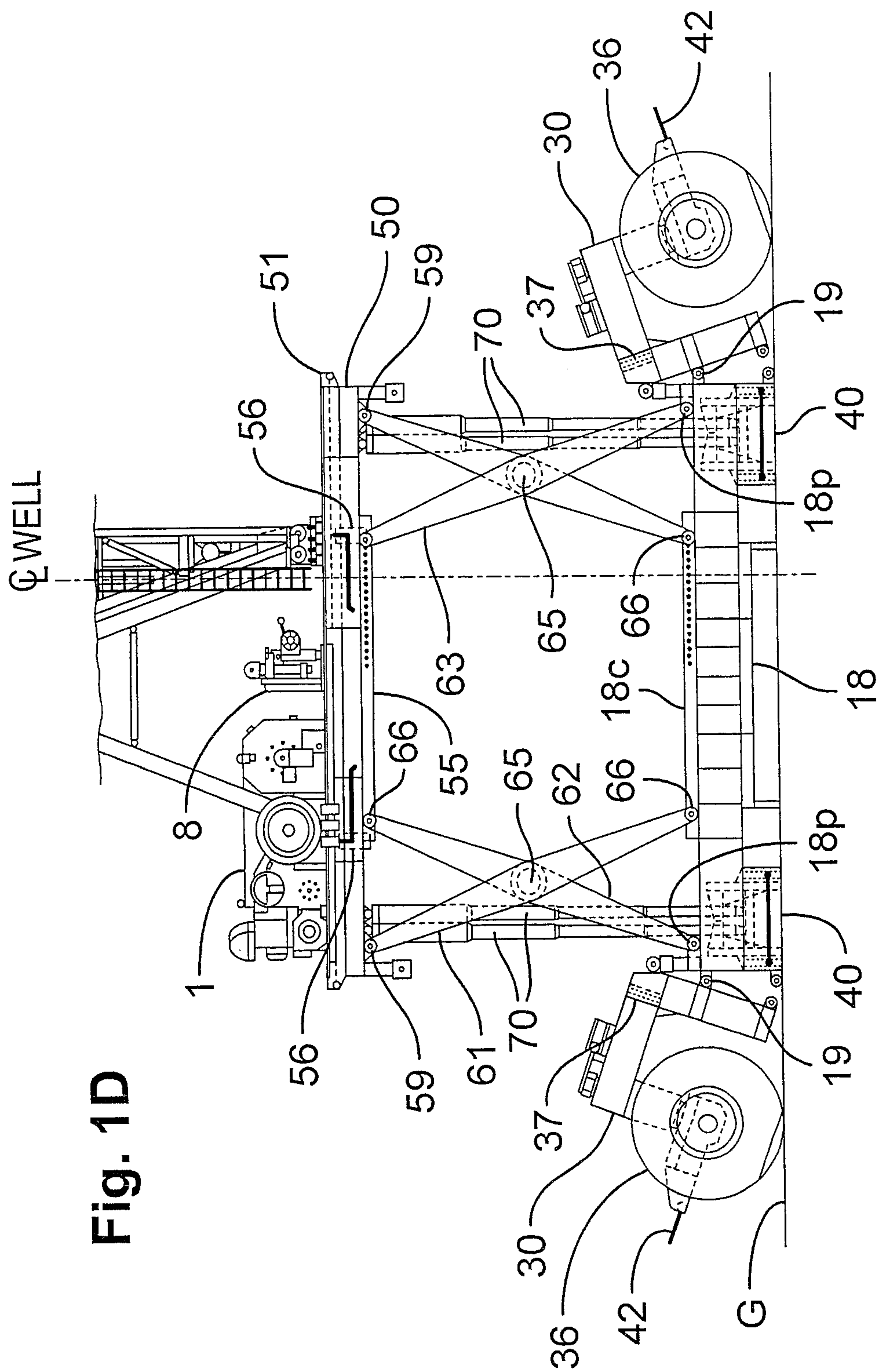


Fig. 1D

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Fig. 1E

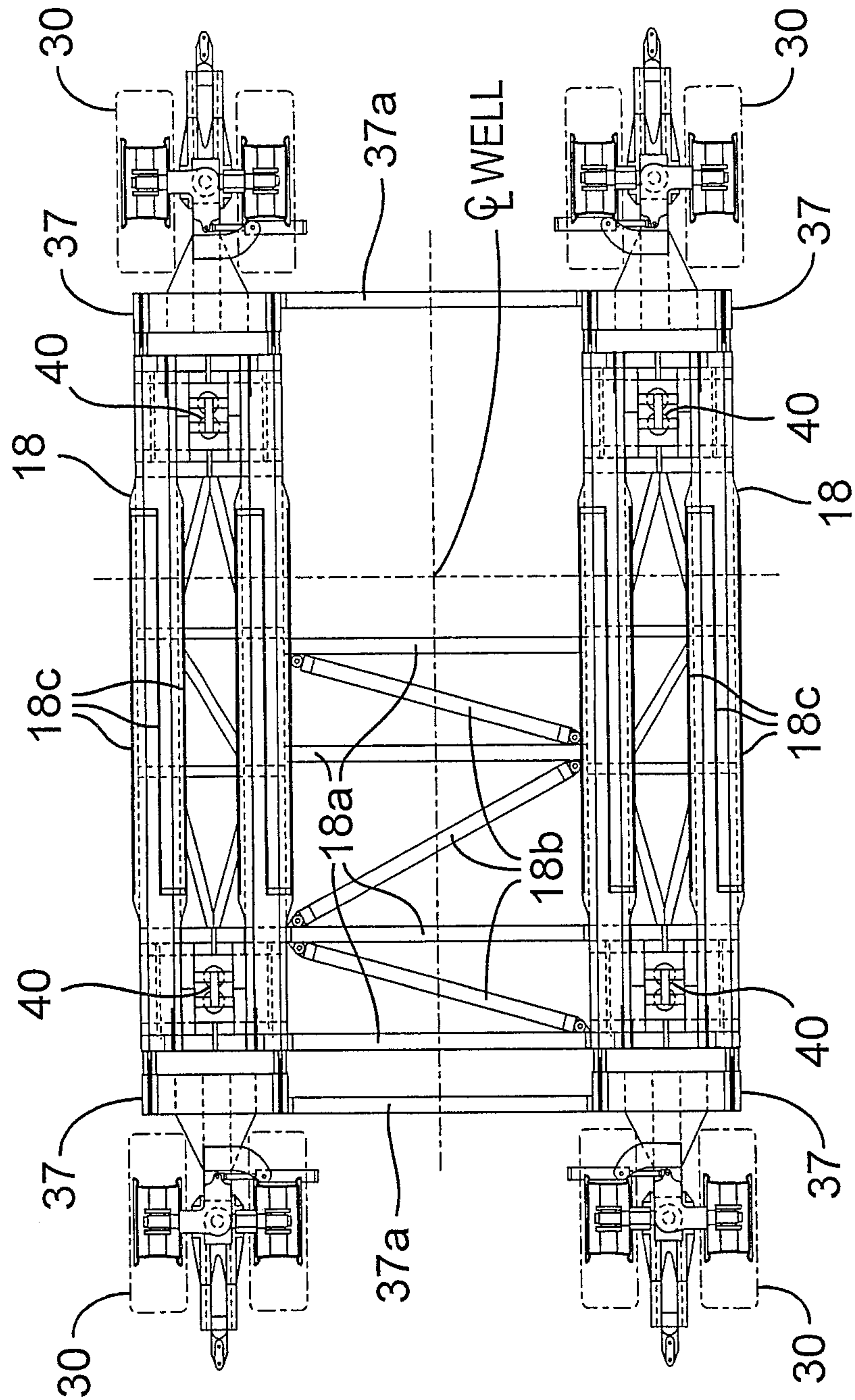


Fig. 2A

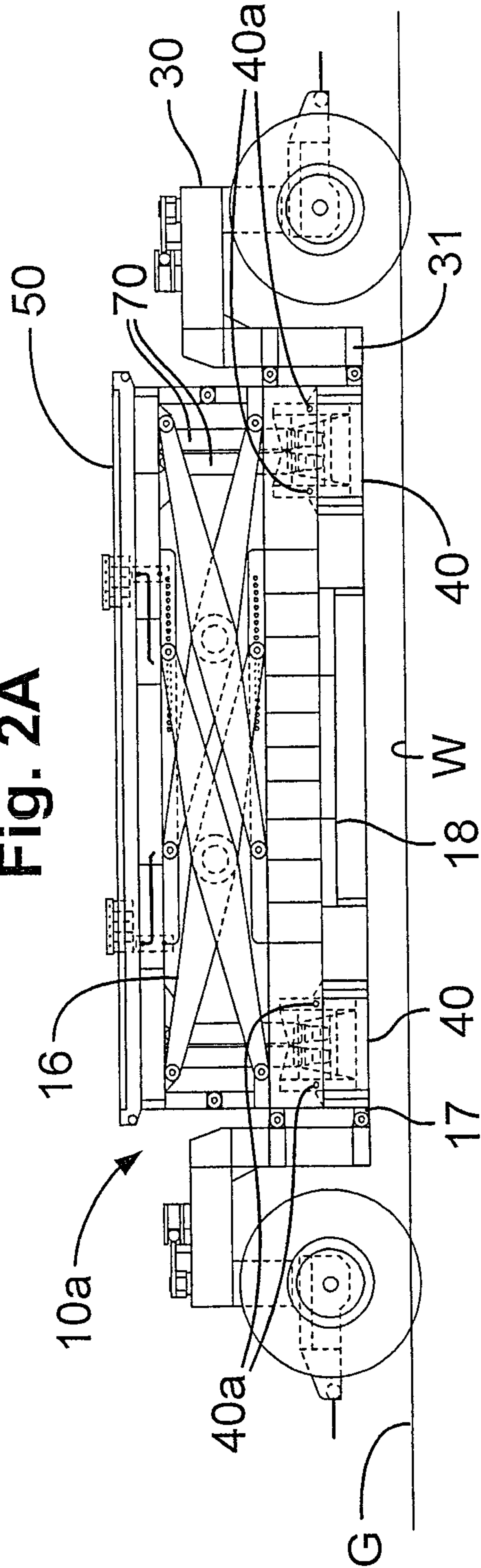


Fig. 2B

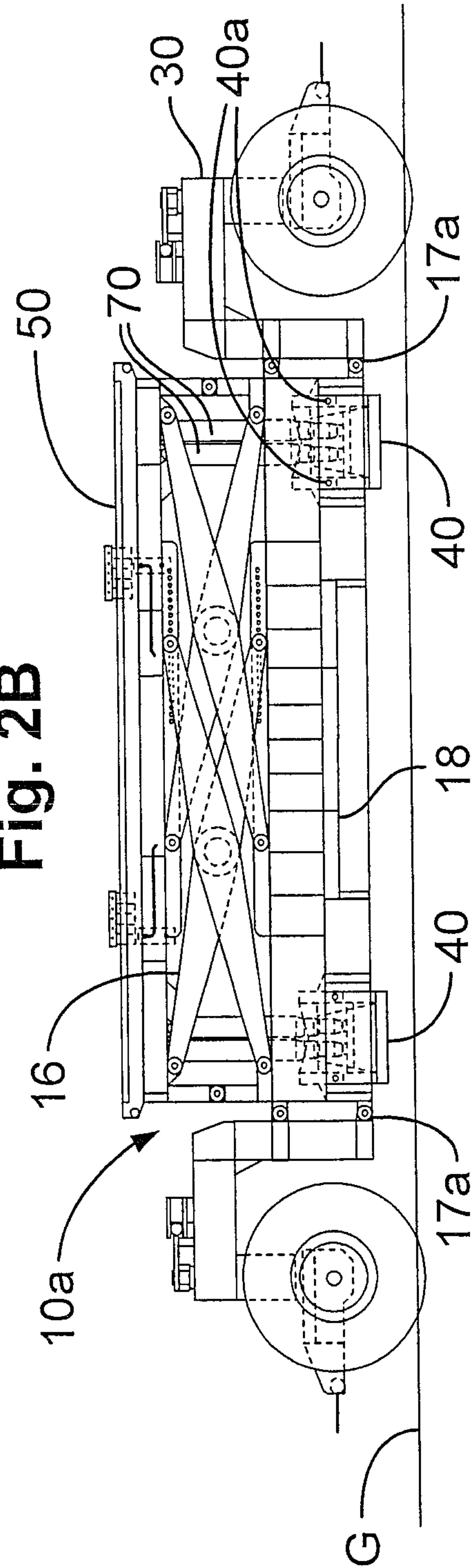


Fig. 2C

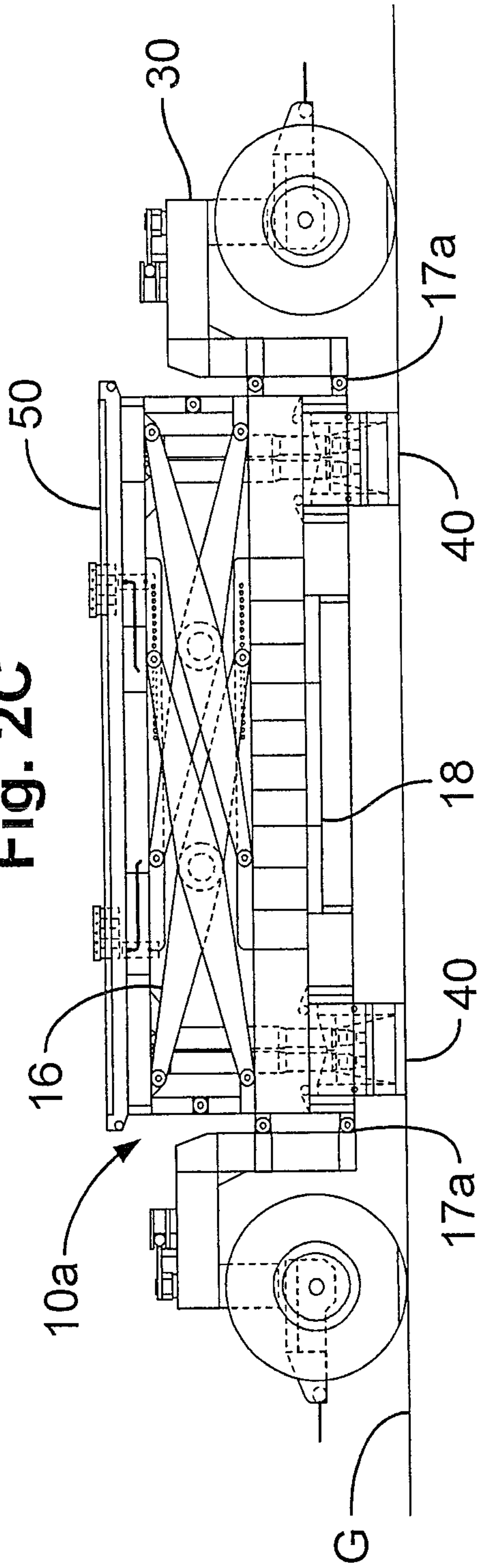
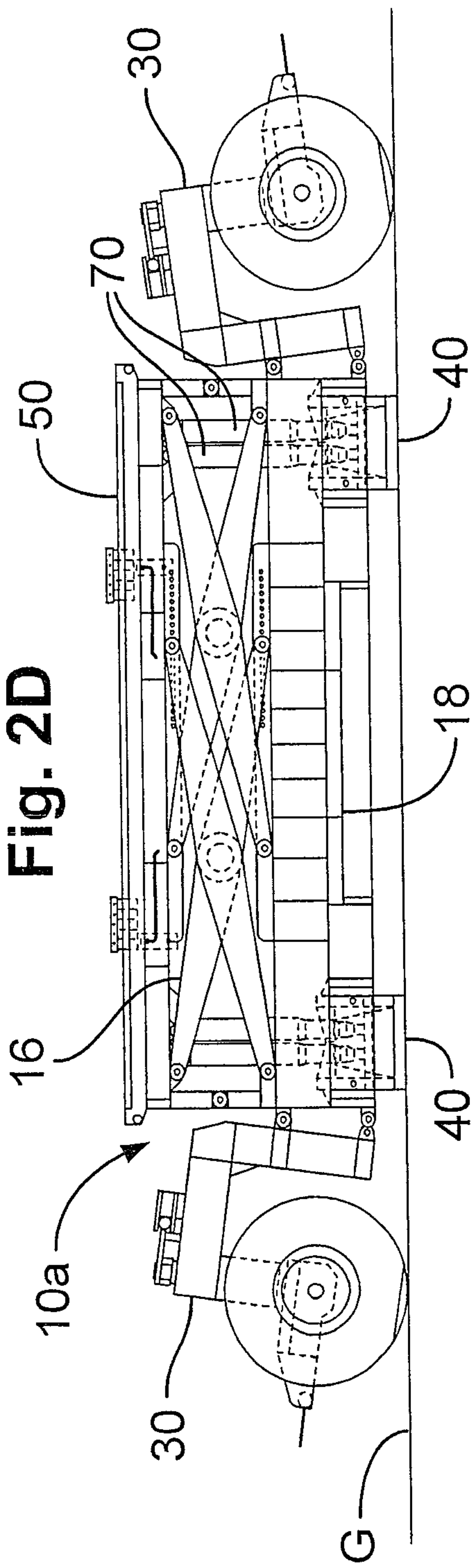
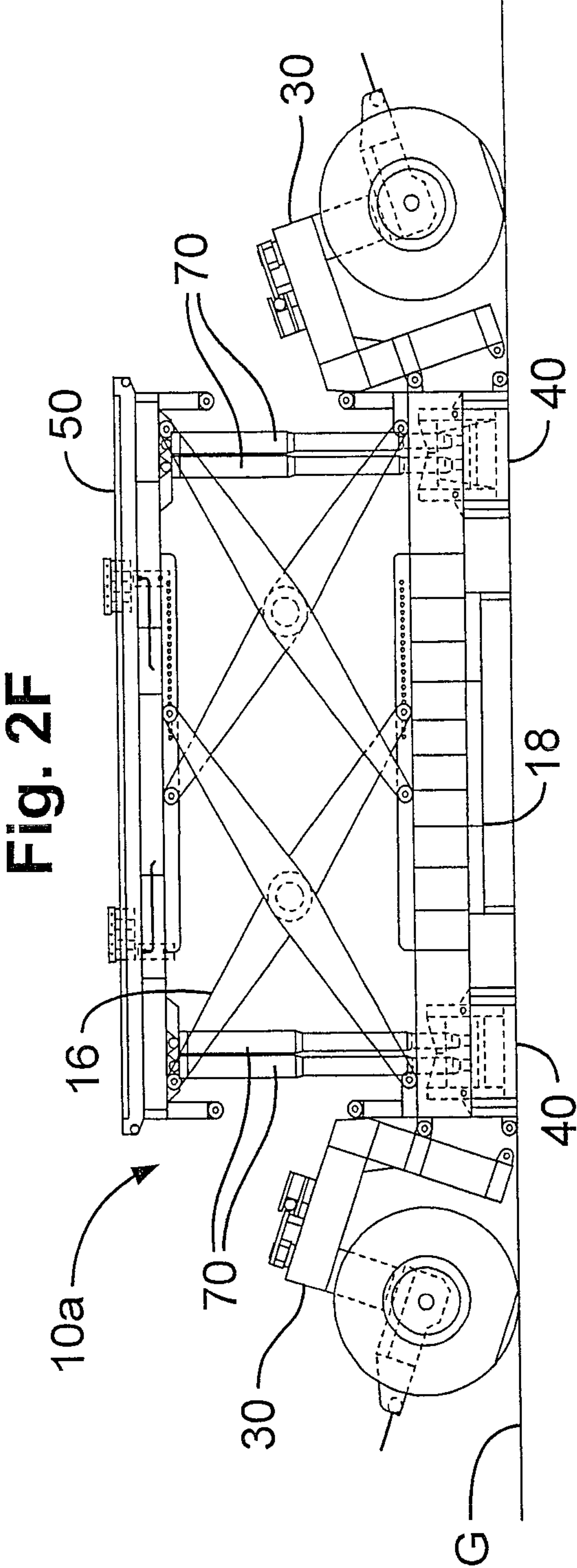
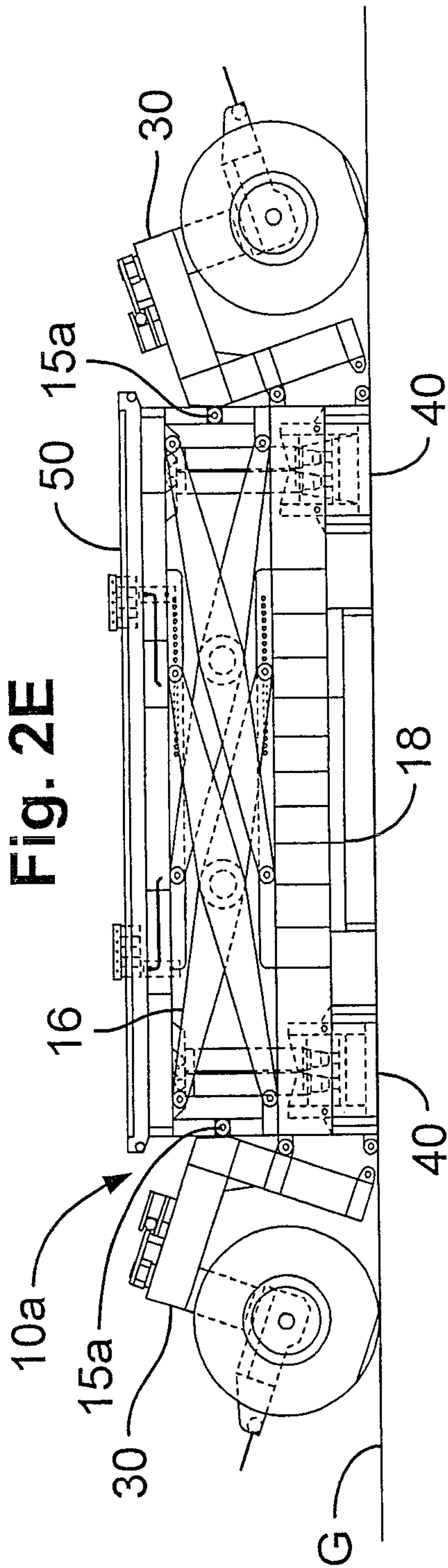
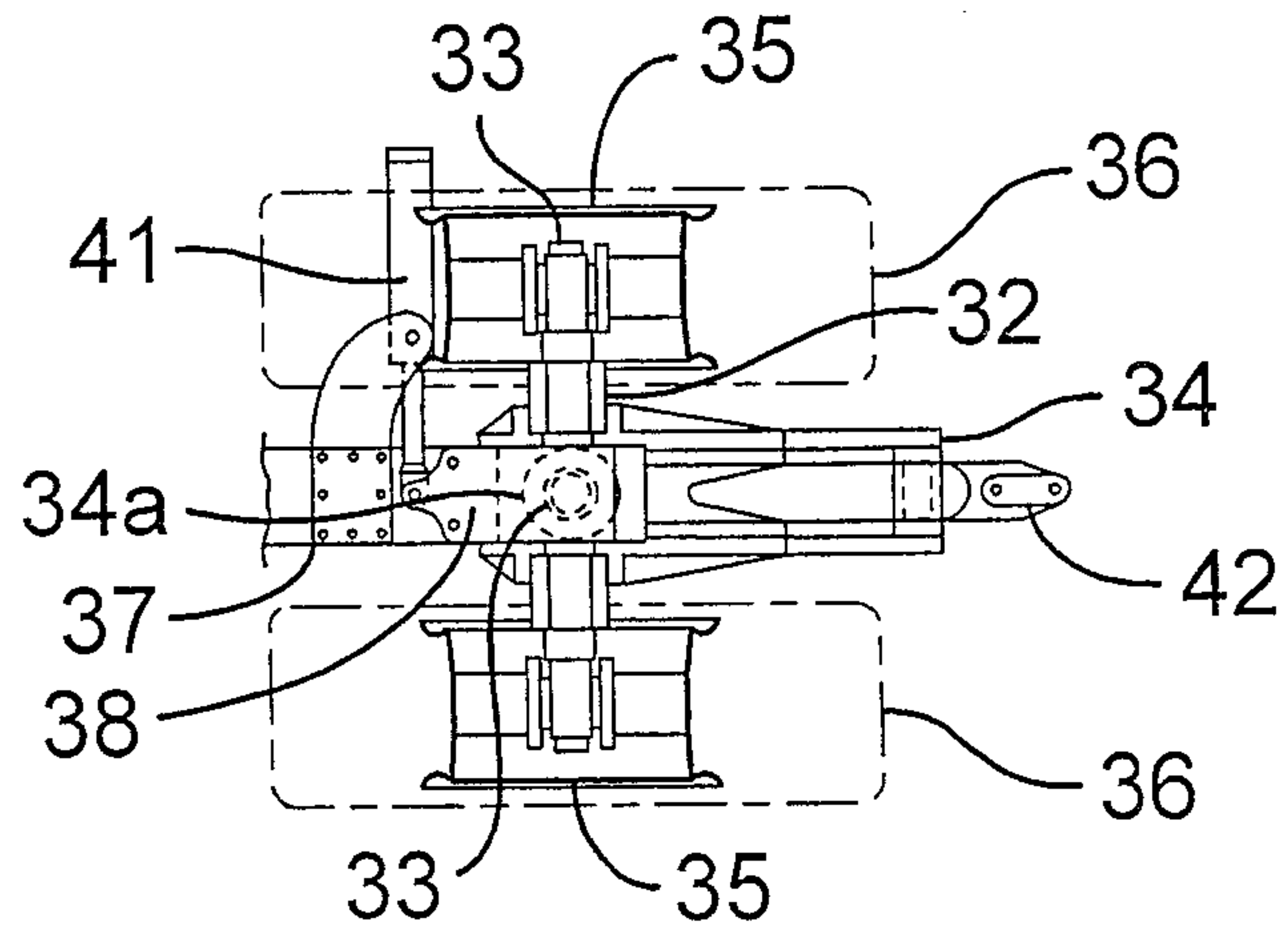
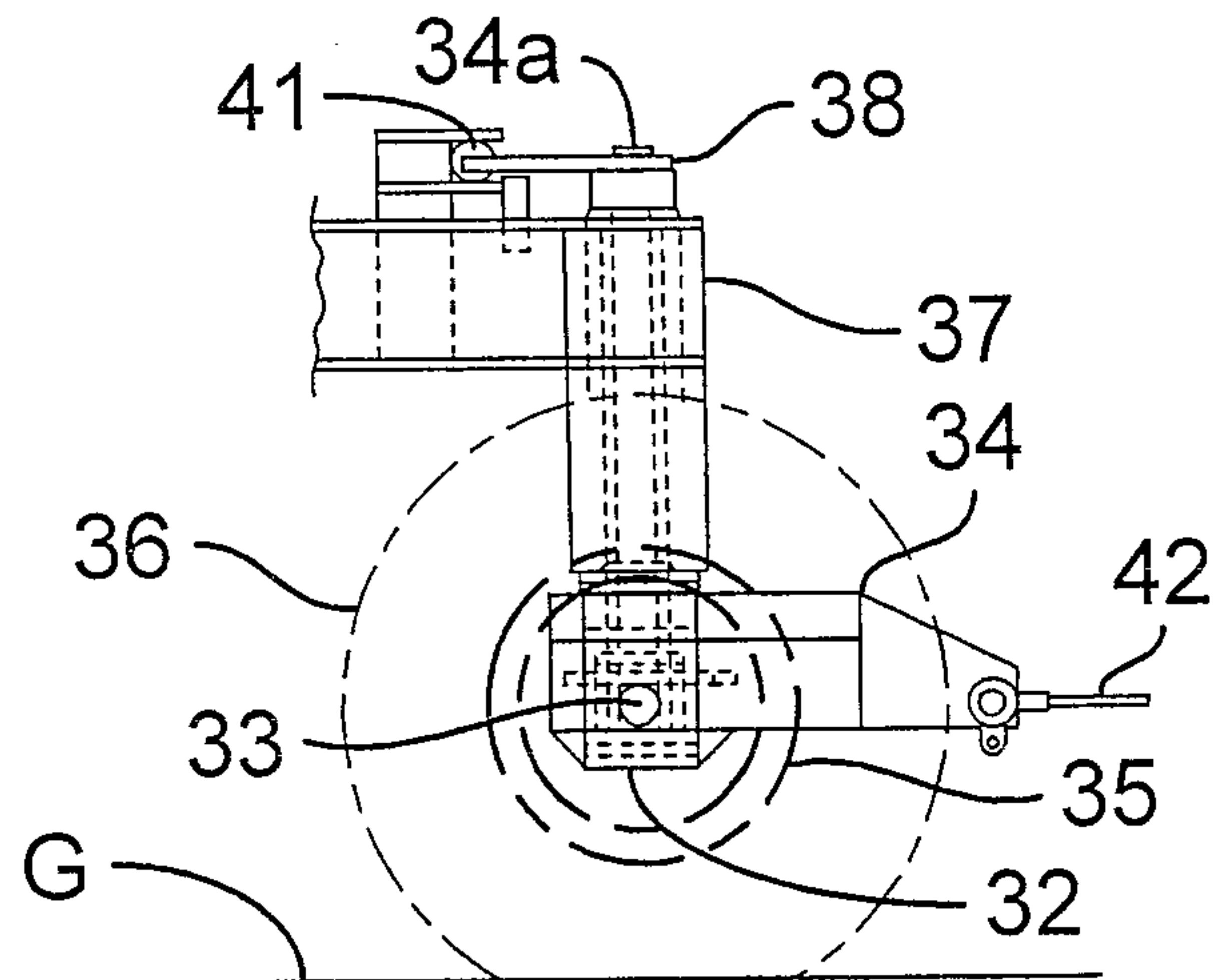
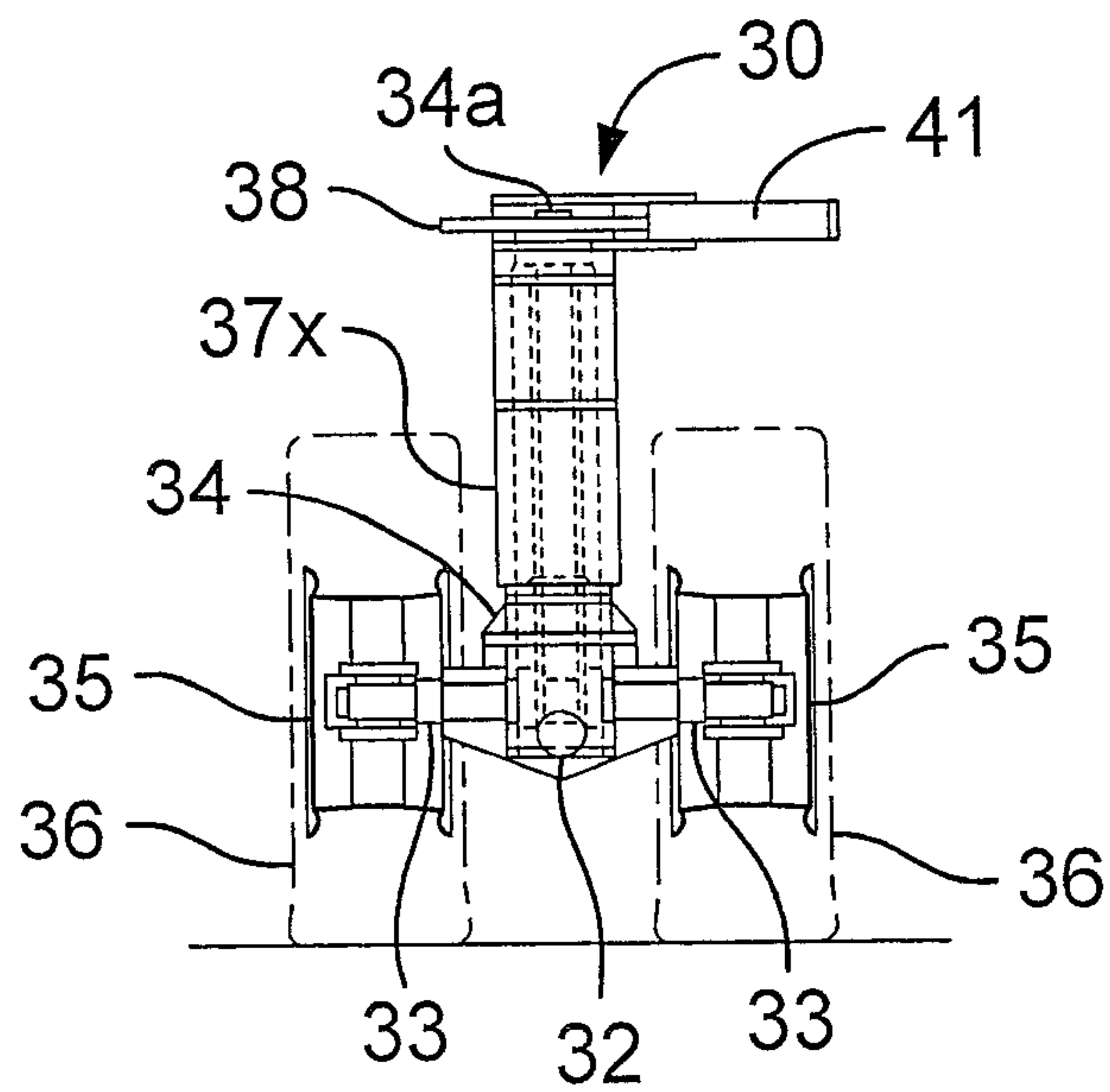


Fig. 2D





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Fig. 3A**Fig. 3B****Fig. 3C**

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Fig. 4A

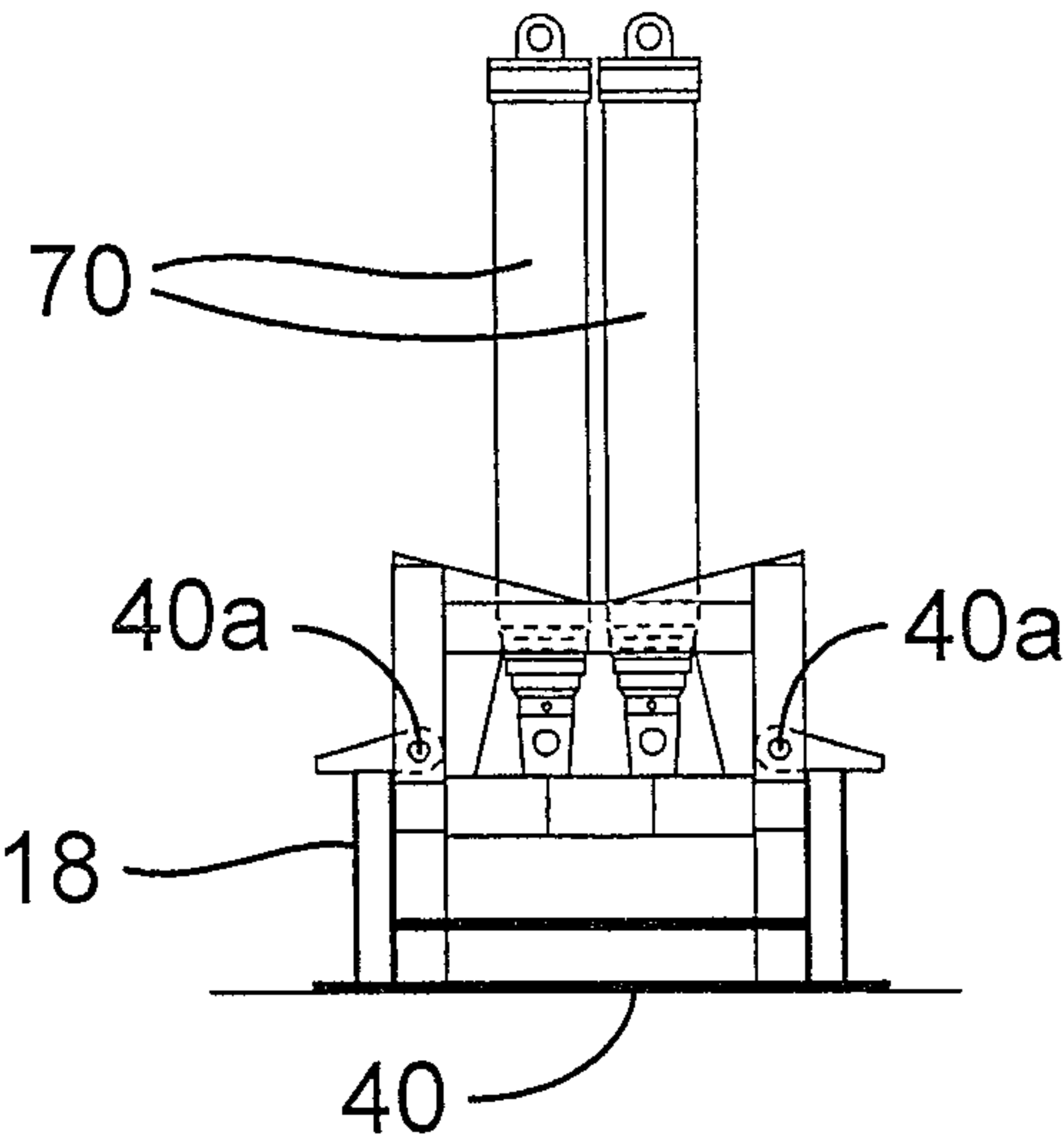


Fig. 4B

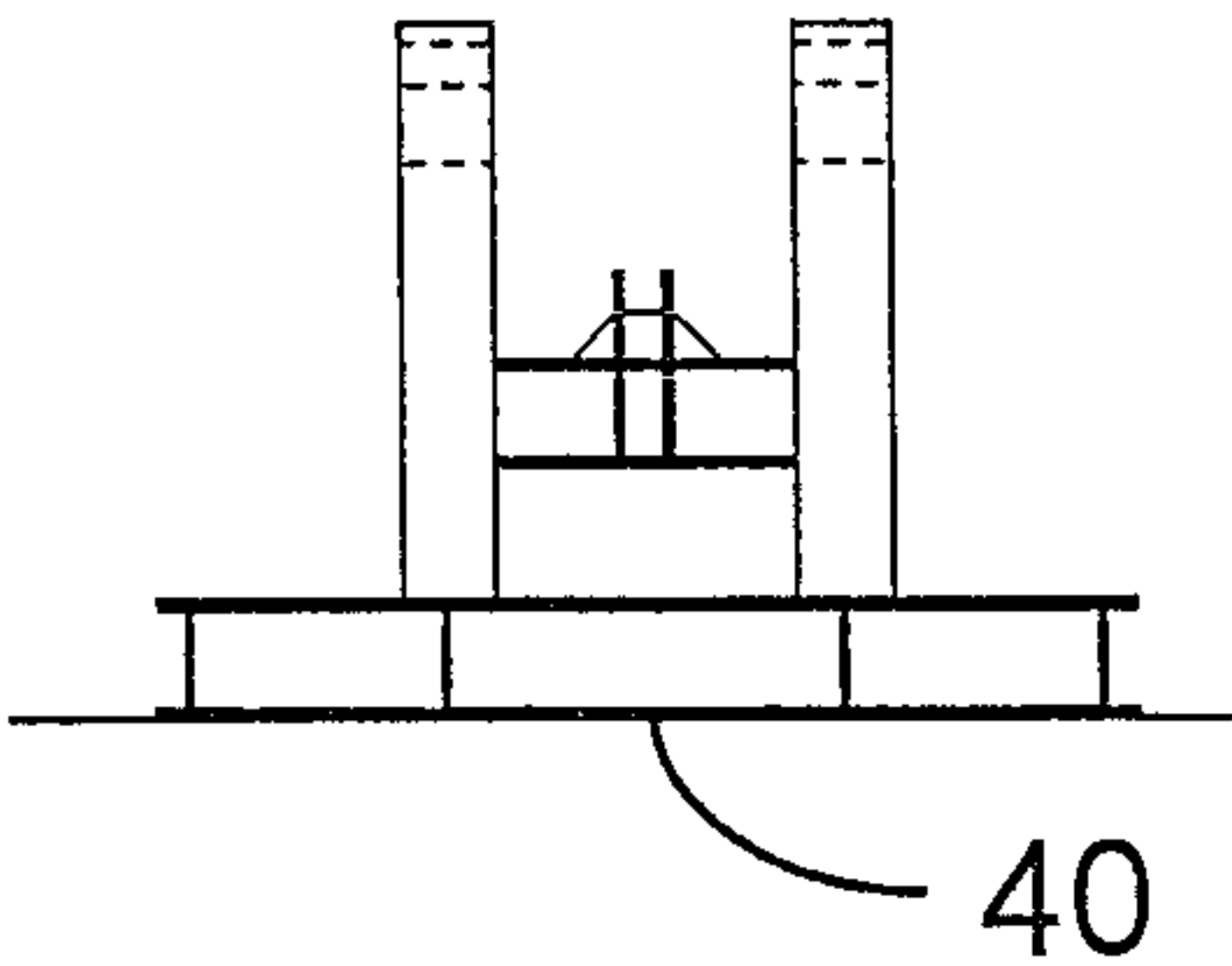


Fig. 4C

