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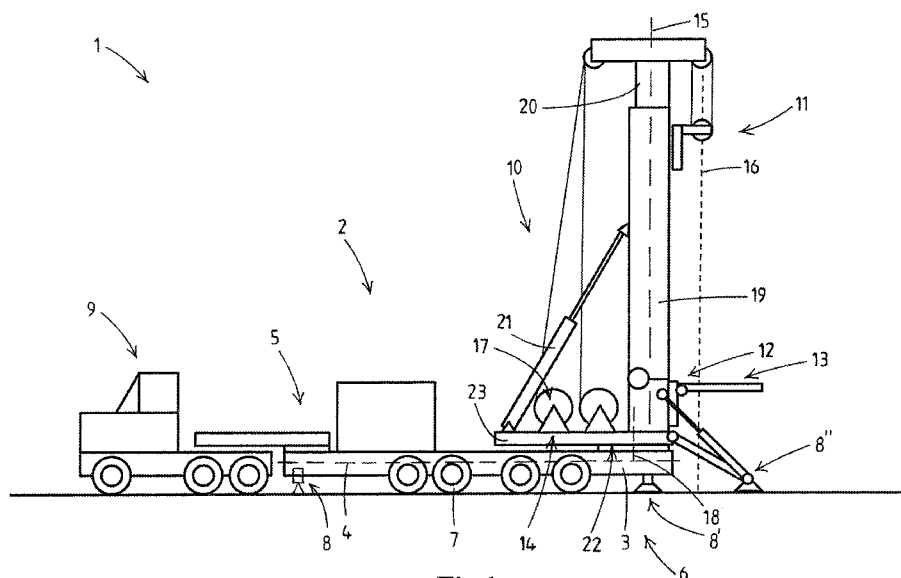


Fig.1

(57) **Abstract:** The invention relates to a mobile land rig for drilling and/or servicing a well comprising a road vehicle having an elongated chassis supporting a derrick unit, the derrick unit comprising an erectable derrick mast, a drill floor mount for supporting a drill floor, and a drawworks platform. The derrick unit is rotatable supported on the elongate chassis, such that the derrick unit, i.e. the erectable derrick mast, the drill floor mount, and the drawworks platform, can be rotated about upright vertical rotation axis. The vertical rotation axis is substantially parallel to a firing line when the derrick mast is in an upright working position, and is spaced relative to the firing line, such that by rotating the derrick unit about the vertical rotation axis, the firing line can be moved along a curved trajectory having the vertical rotation axis as its centre.



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Title: Mobile land rig for drilling and/or servicing a well

This invention relates to an apparatus and a method for drilling and/or servicing a well, more in particular to a mobile land rig for drilling and/or servicing a well.

- 5 The invention relates to mobile land rigs, i.e. rigs mounted on a mobile truck or trailer, such that they can be moved easily between oil fields, and between the wells of an oil field. Typically, the rig is configured to be operated from the truck or trailer and thus requires a minimum of set up time, which further reduces down time due to transportation of the rig between wells.

- 10 Semi mobile rigs are rigs which, to be transported, are to be completely dismantled such that the different components, parts of the mast, the drawworks, etc. can be transported separately by a caravan of trucks. Once arrived at the destination, elaborate construction is required prior to the rig being operable.

- 15 The difference between the mobile rigs and semi mobile rigs is mainly the size and capacity of the mast and drawworks. Mobile rigs are typically deployed for a short period of time, i.e. a few days to a few weeks, and for work on many wells in an oil field. Large ones will be on a site from a few weeks to many months. Thus, a short set up time is in particular a critical factor with mobile rigs.

- 20 Mobile land rigs are known in the prior art, for example, from US2015/0259984 and WO2009/040569. Mobile land rigs comprise a road vehicle, e.g. a mobile truck or trailer, an erectable derrick mast, a drill floor mount for supporting a drill floor, and drawworks.

The road vehicle comprises an elongate chassis, which chassis has a longitudinal axis extending between a front end of the chassis and a rear end of the chassis. The chassis is provided with wheels for supporting the chassis during road travel and with stabilizers for supporting the chassis in a lifted working position.

- 25 The derrick mast has a longitudinal axis and is pivotable mounted on the truck or trailer such that it can be pivoted between a transport position, in which the longitudinal axis of the derrick mast extends substantially horizontal and parallel to a longitudinal axis of the chassis, and a working position, in which the longitudinal axis of the derrick mast extends in a vertical direction, substantially perpendicular to the longitudinal axis of the chassis. The derrick mast, at

a front side thereof defines a firing line, which firing line extends parallel to the longitudinal axis of the mast.

The drill floor mount is located at the front side of the derrick mast for, when the derrick mast is in the working position, supporting a drill floor such that the firing line passes through an
5 opening in the drill floor.

The drawworks are mounted on the mobile truck or trailer, at the back of the derrick mast, such that the drawworks and the mounted drill floor extend in opposite directions relative to the longitudinal axis of the derrick mast when the derrick mast is in the working position.

For the road vehicle to be able travel roads, in particular the width of the road vehicle is limited.
10 This in combination with the need for transporting the derrick mast in a horizontal position makes that the road vehicles typically comprise an elongated chassis of considerable length. Since the rig is operated from the road vehicle, positioning the elongated chassis is an important factor when the land rig is to be set up at a well. In particular when the freedom of movement of the road vehicle relative to the well is limited, for example due to the proximity of
15 the well to other wells and/or the oil field infrastructure in the form of x-mas trees, above ground pipelines, etc., positioning the derrick mast with its firing line centered with the well is difficult and thus time consuming, or even impossible.

It is an object of the invention to provide a mobile land rig in which the above mentioned drawbacks are eliminated altogether or occur in a greatly reduced extent. In particular it is an
20 object of the invention to provide an improved mobile land rig, more in particular a land rig configured to facilitate positioning the firing line above a well, in particular in situations in which the movability of the road vehicle is restricted, for example by the wells located close to each other, oil field infra structure such as x-mas trees, above ground pipelines, etc.

According to the present invention, this object is achieved by designing a mobile land rig
25 according to claim 1.

The road vehicle of a mobile land rig according to the invention comprises a derrick unit, which derrick unit is located at the rear end of the chassis, and which derrick unit comprises the erectable derrick mast, the drill floor mount for supporting a drill floor, and a drawworks platform that supports the drawworks.

The derrick unit is rotatable supported on the elongate chassis, such that the derrick unit can, i.e. the erectable derrick mast, the drill floor mount, and the drawworks platform, can be rotated about a substantially vertical rotation axis, which vertical rotation axis is substantially parallel to the firing line when the derrick mast is in the working position, and which vertical rotation axis is spaced relative to the firing line, such that by pivoting the derrick unit about the vertical rotation axis, the firing line can be moved along a curved trajectory having the vertical rotation axis as its centre. Thus, the firing line can be aligned with any well centre located on the curved trajectory by rotating the derrick unit about the vertical rotation axis.

By combining the derrick mast, drawworks and drill floor mount in a derrick unit that is rotatable mounted on the elongated chassis, the invention allows for moving the firing line of the derrick mast relative to the elongate chassis of the road vehicle, which allows for positioning the firing line relative to the well without moving the road vehicle. Thus, positioning the road vehicle relative to the well is less critical, which reduces the time needed to set up the rig. In particular, the elongated chassis can be set up at different angles relative to the well, and still allow for the firing line to be positioned above the well. Furthermore, the rotatable mounted derrick unit increase the reach of the rig, such that the elongated chassis can be set up at more extreme angles relative to a well, in some embodiments even allows for a set up in which the longitudinal axis of the elongate chassis extends parallel to a row of wells. Thus, the mobile land rig according to the invention can be used in oil fields having a limited space for movement of the road vehicle, i.e. oil fields with multiple wells located close to each other and/or oil field infra-structure such as above ground piping etc. that limits freedom of movement of the road vehicle.

Preferably the mobile land rig further comprises a top drive, a mechanical device for providing torque to a drill string supported in the firing line, and/or for tripping tubulars, i.e. combining and separating tubulars. A top drive is typically moveable supported at the front side of the derrick mast, and can be moved along the mast, and thus along the firing line, using the draw works.

In most cases, a mobile land rig for drilling and/or servicing a well will be deployed in combination with a mobile tubular handling device. These mobile tubular handling devices are known in the state of the art and comprise a road vehicle that is provided with a tubular storage, for example a drilling pipe storage, in combination with a tubular delivery device, for example a lift arm, configured for positioning tubulars in a firing line.

The invention furthermore provides a well drilling and/or servicing set, the set comprising a mobile land drilling and/or servicing rig and a mobile tubular handling device. In a preferred embodiment, the mobile rig and the mobile tubular handling device are configured to be set up on opposite sides of a well. In a further preferred embodiment, both are configured to be
5 connected, i.e. temporarily fixed, to each other to provide a superstructure with increased rigidity for supporting torque loads during operation.

It is submitted that a trailer mounted mobile land rig and a mobile tubular handling device typically both have a longitudinal axis. In the prior art, the mobile tubular handling device has to be set up in line, i.e. both longitudinal axis coinciding, with the mobile land rig, such that the
10 derrick mast and the tubular handling device are positioned on opposite sides of the firing line. This to enable the tubular handling device to move tubulars correctly into and out of the firing line. With a mobile land rig according to the claimed invention, this aligned set up is no longer required. The rotatable supported derrick unit allows for alternative set ups of the tubular
15 handling device relative to the elongated chassis of the road vehicle, the derrick mast and the tubular handling device still positioned on opposite sides of the firing line.

Typically, mobile land rigs are provided with derrick unit stabilisers to provide a stable working platform, i.e. to support the vehicle in a substantially lifted working position. Such stabilisers are provided in many forms, for example in the form of outriggers in which the stabiliser leg is positioned away from the vehicle to provide additional stability.

20 In an embodiment of a mobile land rig according to the invention, the chassis has at its rear end a stabiliser, which rear end stabiliser is configured to support the rear end of the elongate chassis in a lifted support position, and which stabiliser is slideable connected to the chassis such that the chassis, while supported in the lifted support position, can be moved relative to the stabiliser, preferably in a direction substantially perpendicular to the longitudinal axis of the
25 chassis.

Thus, the chassis, and therefore the firing line, can be moved relative to the well

In a preferred embodiment, the rear end stabiliser is configured such that it can be moved relative to the elongate frame, more in particular such that the supported elongated frame can be moved relative to the stabiliser, in a direction perpendicular to the longitudinal axis of the
30 elongate chassis. Such a configuration is in particular advantageous when combined with a derrick unit that can be rotated such that the firing line is located at the side of the elongate

vehicle. The stabiliser allows for moving the elongate chassis sideways, and thus to move the firing line towards and away from the well. This, in combination with a rotatable mounted derrick unit according to the invention greatly improve the possibility to fine tune the position of the firing line relative to the well, while the chassis is in its supported working position. The initial set up of the road vehicle is less critical, because the firing line can be moved into alignment with the well after the road vehicle has been set up next to the well.

In an embodiment, when the rear end stabiliser is deployed to move the chassis relative to the stabiliser, preferably in a direction substantially perpendicular to the longitudinal axis of the chassis, the chassis is at the front end, and/or at a mid section, supported on wheels, which allows for pivoting of the elongated carriage about a vertical axis.

In an alternative embodiment, the elongated chassis is at its front end support on stabilisers that allow for pivoting of the elongate chassis about a vertical axis, the vertical pivot axis being located away from the rear end of the elongate chassis, the vertical pivot axis preferably being located at or near the front end of the elongate chassis.

In an alternative embodiment, the elongated chassis is at its front end support on stabilisers that allow for moving the chassis in a direction perpendicular to the longitudinal axis of the elongate chassis.

It is noted that positioning the firing line relative to the well while the chassis is in the lifted support position is more efficient than positioning the firing line only by moving the chassis back and forth since the subsequent lifting of the chassis into the lifted working position may move the firing line off centre. This effect should therefore be included during the set up with prior art vehicles.

In a preferred embodiment, a single stabiliser is provided, which is located at the centre of the elongated chassis, preferably on the longitudinal axis of the elongated chassis, and below the derrick unit. In an alternative embodiment, multiple stabilisers can be provided, for example in the form of outriggers, which are all configured to be moved relative to the chassis while supporting it in the lifted working position, to thus enable the firing line to be moved relative to the well in addition to the movement provided by the rotatable derrick unit.

In an embodiment of a mobile land rig according to the invention, the derrick unit is furthermore provided with two stabilisers, which stabilisers, when deployed, extend in a direction away from

the derrick mast, preferably such that, when seen in a top view, the firing line is located between the derrick mast and the derrick unit stabilisers, more in particular the firing line is located between the derrick mast and the points at which the stabilisers contact the surface, i.e. the ground.

- 5 Thus, in such an embodiment, when the derrick unit is rotated, the erectable derrick mast, the drill floor mount, the drawworks platform, and the two stabilisers are rotated in unison. By providing the derrick unit with derrick unit stabilisers, workloads generated during drilling and or servicing, for example torque generated by a top drive rotating a drill string in the well, can be transferred via the stabilisers instead of via the device that rotatable supports the derrick unit,
- 10 for example slew bearing. The latter can thus be made less robust and/or the risk of damage to the support device, e.g. slew bearing is reduced. This is in particular the case with a further preferred embodiment in which the stabilisers of the derrick unit are configured to be coupled with the stabilisers of a mobile tubular handling device, which is to be set up on the opposite side of the well.
- 15 In an embodiment, the rear end stabiliser and the two derrick unit stabilisers, when deployed, form a three point support for the derrick mast.

In a further embodiment, the rotatable derrick unit is provided additional stabilisers.

- As was set out above, preferably two stabilisers are mounted to the rotatable supported derrick unit such that when they are deployed, the firing line is located between them, i.e. in the area
- 20 enclosed between the stabilisers. In an embodiment in which these stabilisers are configured to also be coupled with the stabilisers of a mobile tubular handling device, which is to be set up on the opposite side of the well, the firing line is preferably located in the area defined between the connected stabilisers. In an embodiment, the mobile tubular handling device and the rotatable derrick unit are configured, i.e. instead of or in addition to stabilisers of the derrick unit and the
- 25 tubular handling device being coupled.

In an embodiment of a mobile land rig according to the invention, the derrick unit further comprises an erection apparatus, e.g. one or more cylinders, for example hydraulic cylinders or another type of drive for pivoting the derrick mast into the upright position.

- In a preferred embodiment, the erection apparatus is provided in the form of one or more
- 30 cylinders, preferably hydraulic cylinders, which cylinders are with one end pivotable mounted to

the drawworks platform and with an opposite end pivotable to the derrick mast. Thus, in such a configuration when the derrick mast is in the upright position, the draw works platform, part of the derrick mast and the cylinders form a sturdy frame, which provides the derrick unit with additional structural rigidity.

- 5 In an embodiment, the derrick unit has an elongate shape, for example has a frame connecting the drawworks platform with the base of the derrick mast and the drill floor mount, which frame, during transport, is positioned such that its longitudinal axis extends in a direction parallel to the longitudinal axis of the elongate vehicle.

10 In an embodiment of a mobile land rig according to the invention, the mobile land rig comprises a drive, preferably an electric drive, for rotating the derrick unit about the vertical rotation axis.

In a further embodiment of a mobile land rig according to the invention, the mobile land rig further comprises a centring device, which the centring device comprises a sensor, for example a camera, for determining the centre of the well, and comprises a control device for controlling the drive for rotating the derrick unit, wherein the control device is configured for rotating the
15 derrick unit about the upright vertical axis to align the firing line with the centre of the well. It is submitted that by enabling positioning of the firing line relative to the well by rotation of the derrick unit, the invention facilitates automation of the poisoning process of the firing line. Rotating the derrick unit by using an electric or hydraulic drive is easier to control than driving a truck or tractor relative to a well.

- 20 In a further embodiment of a mobile land rig according to the invention, the control device is connected with a drive for moving the chassis by rotating one or more wheels, i.e. driving the road vehicle, and/or by moving the chassis using a movably connected stabiliser at the end of the chassis, to automatically position the firing line in line with the centre of the well.

25 In an embodiment of a mobile land rig according to the invention, the chassis further comprises a support surface for supporting equipment, e.g. a tank with drilling fluid or equipment required for tripping of tubulars, etc, next to the derrick unit when the derrick unit is in a transport position.

In an embodiment of a mobile land rig according to the invention, the firing line can be moved along the curved trajectory over an angle of at least 90 degrees, preferably over an angle of at
30 least 120 degrees, more preferably over an angle of at least 180 degrees such that the firing

line can be positioned at the back of the elongate vehicle chassis and on opposite sides of the chassis, wherein the angles preferably are divided in equal halves by the longitudinal axis of the chassis.

Thus, the firing line can be positioned above a well located in these positions at the back and
5 the opposite sides of the elongated chassis, or along the curved trajectory, defined by rotating the derrick unit between those positions

Typically, the derrick mast when erected is positioned with its firing line at the back of the road vehicle. By enabling the derrick to be rotated over an angle of 90 degrees to the firing line can also be positioned at the side of the vehicle. Thus, the road vehicle can be parked alongside a
10 row of wells, i.e. with the longitudinal axis of the elongate frame parallel to the row of wells, and still be able to service and/or drill that well. Thus, a mobile land rig according to the invention can be set up between closely spaced rows of wells.

In an embodiment of a mobile land rig according to the invention, the derrick unit is rotatable supported by a slew bearing, which slew bearing is provided between the chassis and the
15 derrick unit. In a preferred embodiment, the derrick unit comprises a frame that extends from the drawworks platform up to the front of the derrick mast, preferably forms the drawworks platform, and this frame is mounted onto, e.g. is supported by a slew bearing provided on the elongate frame of the road vehicle.

In an alternative embodiment of a mobile land rig according to the invention, the derrick mast
20 has a hollow base, and the elongate chassis is provided with a rotation axle, concentric with the vertical rotation axis, which rotation axle is received inside the hollow base of the derrick mast, and wherein one or more slew bearings are provided between the rotation axle and the base of the derrick mast, such that the derrick unit is rotatable supported on the axle via the base of the derrick mast. Such an embodiment provides a stable support for the derrick unit, and the
25 rotation axle being received in the base of the derrick mast allows for an improved support of torque loads about a horizontal axis as well.

In such an embodiment, the rotation axis furthermore aligns with the mast axis, which is beneficial when it is desired to provide a support in the form of a stabiliser in line with the longitudinal axis of the derrick mast. Due to the longitudinal axis of the derrick mast being in
30 line with the rotation axis of the derrick unit, the derrick unit can be rotated without the derrick mast moving out of its position above the stabiliser.

In an embodiment of a mobile land rig according to the invention, the derrick mast, when in the erected position, the longitudinal axis of the mast does not coincide with vertical rotation axis of the derrick unit.

5 In an embodiment of a mobile land rig according to the invention, the derrick mast comprises a base and a top part, which base part and top part are pivotable or telescopically connected, such that the top part can be moved relative to the base part between a compact configuration, in which the top part is located adjacent the base part, and an extended configuration.

10 Providing a derrick mast in two or more components, which components can be folded and or telescopically inserted relative to each other to provide the derrick mast with a compact configuration and an extended configuration, facilitates road transport of a derrick mast having sufficient length for drilling operations and allows for quick and easy set-up of the derrick mast. Such an embodiment preferably allows for the derrick mast to be pivoted in the upright position prior to the derrick unit being rotated for positioning the firing line, but being extended to its full length only after the firing line has been correctly positioned. Thus, the derrick unit can be
15 rotated with the derrick mast still in a compact configuration, and thus with a low centre of gravity, which improves the stability of the derrick unit, more in particular of the entire mobile rig, during rotation of the derrick unit.

In an embodiment of a mobile land rig according to the invention, the drill floor mount is moveably supported, such that it allows for the drill floor to be moved in a direction parallel to
20 the longitudinal axis of the derrick mast. Thus, when the derrick mast is in the working position, the drill floor can be moved up and down along the firing line.

In an embodiment, the drill floor is pivotable connected to the drill floor mount, such that it can be pivoted between a transport position, preferably adjacent the derrick mast and/or extending parallel to the longitudinal axis of the derrick mast, and a working position, in which it extends
25 perpendicular to the longitudinal axis of the derrick mast. In an embodiment, the drill floor mount is configured to support a drill floor frame that is configured to support drilling equipment, for example slips, drill floor panels, a BOP or X-mas tree, etc.

In an embodiment of a mobile land rig according to the invention, the road vehicle is a trailer for combination with a truck.

The invention furthermore provides a method for drilling and/or servicing a well, using a mobile land rig according to one or more of the preceding claims, the method comprising:

- pivoting the derrick mast into its upright position;
- positioning the firing line of the derrick mast in line with the well by:
 - 5 - rotating the derrick unit about the vertical rotation axis and/or
 - driving the chassis supported by its wheels
- using the stabilisers to lift the chassis and support the chassis in a lifted working position;
- optionally: deploy stabilisers mounted to the derrick unit;
- extend the derrick mast and mount the drill floor at the front of the derrick mast such that the
- 10 firing line passes through an opening in the drill floor;
- optionally: set up a tubular handling device, preferably including connecting the tubular handling device with the mobile land rig at the well to provide a superstructure with increased rigidity for supporting torque loads during operation.

The invention furthermore provides a mobile land rig for servicing a well using coiled tubing.

- 15 Instead of a top drive, or in addition to a top drive, the derrick mast of such a land rig supports a coiled tubing injector head. Preferably, the road vehicle further comprises a coiled tubing storage device, for providing the coiled tubing to the coiled tubing injector head.

- 20 Mobile land rigs for servicing a well using coiled tubing are known in the prior art, for example form US4265304 and US10232393. These mobile coiled tubing rigs face similar problems as mobile rigs comprising a top drive, i.e. mobile rigs configured for tripping tubulars, in particular the difficulty in positioning the firing line of the derrick mast in line with the well, as was set out above.

In an embodiment, the mobile land rig for servicing a well using coiled tubing comprises:

- a road vehicle, wherein the road vehicle comprises:
 - 25 - an elongate chassis, which chassis has a longitudinal axis extending between a front end of the chassis and a rear end of the chassis, which chassis is provided with wheels for supporting

the chassis during road travel and with stabilizers for supporting the chassis in a lifted working position; and

- a derrick unit, which derrick unit is located at the rear end of the chassis, and which derrick unit comprises an coiled tubing erector head and a work floor mount for supporting a work floor,
5 wherein:

- the derrick mast has a longitudinal axis;

- the derrick mast is pivotable mounted such that it can be pivoted between a transport position, in which the longitudinal axis of the derrick mast extends substantially horizontal and parallel to a longitudinal axis of the chassis, and a working position, in which the longitudinal axis of the
10 derrick mast extends in a vertical direction, substantially perpendicular to the longitudinal axis of the chassis;

- the derrick mast, at a front side thereof defines a firing line, which firing line extends parallel to the longitudinal axis of the mast;

- the work floor mount is located at the front of the derrick mast for, when the derrick mast is in
15 the working position, supporting a work floor such that the firing line passes through an opening in the work floor;

- the coiled tubing injector head preferably is movable supported by the derrick mast, such that it can be moved, for example using draw works mounted on a draw works platform that is part of the derrick unit and is located at the back of the derrick mast, along the derrick mast when
20 the derrick mast is in the working position,

- the derrick unit is rotatable supported on the elongate chassis, such that the derrick unit, i.e. the erectable derrick mast and the work floor mount, can be rotated about upright vertical rotation axis, which vertical rotation axis is substantially parallel to the firing line when the derrick mast is in the working position, and which vertical rotation axis is spaced relative to the
25 firing line, such that by rotating the derrick unit about the vertical rotation axis, the firing line can be moved along a curved trajectory having the vertical rotation axis as its centre. Thus, the firing line can be aligned with any well centre located on the curved trajectory by rotating the derrick unit about the vertical rotation axis.

Such a mobile land rig preferably also comprises a coiled tubing storage device, preferably mounted on the elongated chassis, preferably at the front end thereof.

It is submitted that the invention thus provides an improved a mobile land rig for servicing a well. By combining the derrick mast, the derrick mast supporting the coiled tubing injector head, and work floor mount in a derrick unit that is rotatable mounted on the elongated chassis, the invention allows for moving the firing line of the derrick mast relative to the elongate chassis of the road vehicle, which allows for positioning the firing line relative to the well without moving the road vehicle. Thus, positioning the road vehicle relative to the well is less critical, which reduces the time needed to set up the rig. Furthermore, the rotatable mounted derrick unit increase the reach of the rig, such that the elongated chassis can be set up at more extreme angles relative to a well, in some embodiments even allows for a set up in which the longitudinal axis of the elongate chassis extends parallel to a row of wells. Thus, the mobile land rig according to the invention can be used in oil fields having a limited space for movement of the road vehicle, i.e. oil fields with multiple wells located close to each other and/or oil field infra-structure such as above ground piping etc. that limits freedom of movement of the road vehicle.

Advantageous embodiments of the mobile land rig according to the invention and the method according to the invention are disclosed in the subclaims and in the description, in which the invention is further illustrated and elucidated on the basis of a number of exemplary embodiments, of which some are shown in the schematic drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

- Fig. 1 shows a side view of a mobile land rig according to the invention;
- Fig. 2 shows a detailed side view of a mobile land rig according to the invention and a mobile tubular handling device set up on opposite sides of a well;
- Fig. 3 shows the mobile land rig and the mobile tubular handling device of fig. 2 in top view;
- Fig. 4 shows a top view of a mobile land rig according to the invention and a mobile tubular handling device set up on opposite sides of a well, wherein the derrick unit of the mobile land rig is rotated at an angle relative to the longitudinal axis of the road vehicle; and

Fig. 5 shows a top view of a mobile land rig according to the invention and a mobile tubular handling device set up on opposite sides of a well, wherein the derrick unit of the mobile land rig is rotated at an angle of 90 degrees relative to the longitudinal axis of the road vehicle.

Fig. 1 shows a side view of an exemplary embodiment of a mobile land rig 1 for drilling and/or servicing a well, according to the invention. The mobile land rig 1 comprises a road vehicle, in the exemplary embodiment shown a trailer 2 pulled by a tractor 9. In an alternative embodiment, the road vehicle is a truck.

The road vehicle 2 comprises an elongated chassis 3, in this embodiment the trailer frame. The elongate chassis has a longitudinal axis 4 extending between a front end 5 of the elongate chassis 3 and a rear end 6 of the elongate chassis 3. The chassis 3 is provided with wheels 7 for supporting the chassis during road travel and with stabilizers 8 for supporting the chassis in a lifted working position.

According to the invention, the mobile land rig 1 comprises a derrick unit 10. The derrick unit 10 is located at the rear end 6 of the elongate chassis 3. The derrick unit 10 comprises an erectable derrick mast 11, a drill floor mount 12 for supporting a drill floor 13, and a drawworks platform 14.

The derrick mast 11 has a longitudinal axis 15. The derrick mast 11, at a front side thereof defines a firing line 16, which firing line extends parallel to the longitudinal axis 15 of the derrick mast 11;

The derrick mast 11 is pivotable mounted such that it can be pivoted between a transport position and a working position, shown in fig. 1. In the transport position the longitudinal axis 15 of the derrick mast 11 extends substantially horizontal and parallel to a longitudinal axis 4 of the elongate chassis 3. In the working position the longitudinal axis 15 of the derrick mast 11 extends in a vertical direction, substantially perpendicular to the longitudinal axis 4 of the elongate chassis 3.

In the particular embodiment shown, the derrick mast 11 comprises a base part 19 and a top part 20, which base part and top part are telescopically connected. Thus, the top part 20 can be moved relative to the base part 19 between a compact configuration, depicted in the Figure 1, in which the top part is located adjacent, in the particular embodiment shown inside, the base part, and an extended configuration. Preferably, the derrick unit is rotated with the derrick mast

in the upright position but not yet fully extended. Thus, the centre of gravity of the derrick unit 10 is kept low to the ground, which improves the stability of the mobile land rig.

Furthermore, in the embodiment shown, the derrick unit 10 further comprises an erection apparatus in the form of two hydraulic cylinders 21, which cylinders are with one end pivotable
5 mounted to the drawworks platform 14 and with an opposite end is pivotable to the derrick mast 11, in the embodiment shown to the base part 19 of the derrick mast.

The drill floor mount 12 is located at the front of the derrick mast 11 for, when the derrick mast is in the working position, i.e. the upright position, supporting the drill floor 13 such that the firing line 16 passes through an opening in the drill floor.

10 In the particular embodiment shown, the drill floor 13 is pivotable connected to the drill floor mount 12, such that it can be pivoted between a transport position, adjacent the derrick mast and/or extending parallel to the longitudinal axis of the derrick mast, and a working position, shown in Fig. 1, in which it extends perpendicular to the longitudinal axis of the derrick mast. In the embodiment shown, the drill floor comprise a drill floor frame configured to support drilling
15 equipment, for example slips, drill floor panels, a torque wrench, BOP or X-mas tree, etc and or well maintenance equipment.

Furthermore in the embodiment shown, the drill floor mount is moveably supported, such that it allows for the drill floor to be moved in a direction parallel to the longitudinal axis of the derrick mast. Thus the drill floor can be moved upwards to position it above a BOP mounted on the
20 well head. In the preferred embodiment shown, the drill floor is configured to support the BOP and can thus also be used to lift the BOP. Preferably, the supports provided for the supporting the BOP are moveable supports, for example a frame that can be moved along a track, to allow for supported equipment to me moved into and out of the firing line.

In the embodiment shown in Fig. 1, the drawworks platform 14 supports the drawworks 17. The
25 drawworks platform 14 is mounted at the back of the derrick mast 11, such that the drawworks platform 14 and the mounted drill floor 13 extend in opposite directions relative to the longitudinal axis 15 of the derrick mast 11 when the derrick mast is in the working position.

The derrick unit 10 is rotatable supported on the elongate chassis 3, such that the derrick unit, more in particular the erectable derrick mast, the drill floor mount, and the drawworks platform
30 can in unison rotate about a vertical rotation axis 18. The vertical rotation axis 18 is

substantially parallel to the firing line 16 when the derrick mast 11 is in the working position, which condition is depicted in Figure 1. The vertical rotation axis 18 is spaced relative to the firing line 16, such that by rotating the derrick unit 10 about the vertical rotation axis 18, the firing line 16 can be moved along a curved trajectory 17 having the vertical rotation axis 18 as its centre.

In the particular embodiment shown in Fig. 1, the derrick unit 10 is rotatable supported by a slew bearing 22, which slew bearing is provided between the elongate chassis 3 and the derrick unit 10. In the preferred embodiment shown, the derrick unit 10 comprises a frame 23 that extends from the drawworks platform 14 up to the front of the derrick mast. The frame is a part of the drawworks platform, and is mounted onto, e.g. is supported by the slew bearing provided on the elongate frame of the road vehicle.

The mobile land rig is provided with stabilisers 8 to provide a stable working platform, i.e. to support the vehicle in a lifted working position. The use of stabilisers as such is generally known. However, in the preferred embodiment shown, the elongate chassis 3 has at its rear end a stabiliser 8' that is configured to support the rear end 6 of the chassis 3 in a lifted support position. The stabiliser 8' is slideable connected to the chassis such that the chassis, while supported in the lifted support position, can be moved relative to the stabiliser in a direction substantially perpendicular to the longitudinal axis of the chassis. Thus, the chassis, and therefore the firing line, can be moved relative to the well.

This is particular beneficial when the derrick unit is rotated over an angle of 90 degrees, and the firing line is posited at the side of the road vehicle, which set u is depicted in Fig. 5. In this configuration, the stabiliser 8' allows for moving the elongate chassis 3 sideways, and thus to move the firing line 16 towards and away from the well 24. In addition to the rotatable mounted derrick unit 10 this further improves the possibility to fine tune the position of the firing line relative to the well, while the chassis is in its supported working position.

In the embodiment shown, the derrick unit 10 is furthermore provided with two stabilisers 8'', which are pivotable mounted to the derrick unit 10. In the embodiment shown, the stabiliser comprise a stabilising leg and an actuator for pivoting the pivotable stabilising leg between an active position, shown in Fig. 1, and a transport position.

The stabilisers 8'', when deployed, extend in a direction away from the derrick mast 11, such that, when seen in a top view, the firing line 16 is located between the derrick mast 11 and the

stabilisers 8'', more in particular the firing line is located between the derrick mast and the points at which the stabilisers contact the surface. In the embodiment shown, the rear end stabiliser 8' and the two derrick unit stabilisers 8'', when deployed, form a three point support for the derrick mast.

- 5 By providing the derrick unit with stabilisers, workloads generated during drilling and or servicing, for example torque generated by a top drive rotating a drill string in the well, can be transferred via the stabilisers instead of via the device that rotatable supports the derrick unit, for example slew bearing. The latter can thus be made less robust and/or the risk of damage to the support device, e.g. slew bearing is reduced.
- 10 Fig. 2 shows a detailed side view of a mobile land rig 1 of fig. 1 and a mobile tubular handling device 25 set up on opposite sides of a well, and on opposite sides of the firing line. Fig. 3 shows the mobile land rig and the mobile tubular handling device of Fig. 2 in top view. In Figs. 2 and 3, the derrick unit 10 of the mobile land rig 1 is positioned in line with the longitudinal axis of the elongate frame, and the firing line is thus located on the longitudinal axis of the elongate frame of the road vehicle.
- 15

Fig. 4 shows a top view of the mobile land rig 1 and the mobile tubular handling device 25 set up on opposite sides of a well, wherein the derrick unit 10 of the mobile land rig 1 is rotated at an angle relative to the longitudinal axis of the road vehicle.

- Fig. 5 shows a top view of a mobile land rig according to the invention and a mobile tubular handling device set up on opposite sides of a well, wherein the derrick unit of the mobile land rig is rotated at an angle of 90 degrees relative to the longitudinal axis of the road vehicle.
- 20

The mobile land rigs shown in figs 1-5 can thus be used in a method for drilling and/or servicing a well, the method comprising the steps

- 25 - Pivoting the derrick mast into its upright position. Typically, the road vehicle has already been set up near to the well, preferably such that there is no need to move the vehicle after the derrick mast has been erected.
- Positioning the firing line of the derrick mast in line with the well by:
- rotating the derrick unit about the vertical rotation axis 15 and/or
 - driving the chassis supported by its wheels.

- Using the stabilisers to lift the chassis and support the chassis in a lifted working position.
 - Optionally: deploy stabilisers mounted to the derrick unit, to thus bring the elongated chassis in the lifted working position.
 - Extend the derrick mast and mount the drill floor at the front of the derrick mast such that the
- 5 firing line passes through an opening in the drill floor.
- Optionally: set up a tubular handling device, preferably including connecting the tubular handling device with the mobile land rig at the well to provide a superstructure with increased rigidity for supporting torque loads during operation.

After the set up has been completed, the well can be serviced, and or drilling can commence.

C L A I M S

1. Mobile land rig (1) for drilling and/or servicing a well (24), the mobile land rig comprising:

- a road vehicle (2), wherein the road vehicle comprises:

- an elongate chassis (3), which chassis has a longitudinal axis (4) extending between a front end (5) of the chassis and a rear end (6) of the chassis, which chassis (3) is provided with wheels (7) for supporting the chassis during road travel and with stabilizers (8, 8') for supporting the chassis in a lifted working position; and

- a derrick unit (10), which derrick unit is located at the rear end (6) of the chassis, and which derrick unit (10) comprises an erectable derrick mast (11), a drill floor mount (12) for supporting a drill floor (13), and a drawworks platform (14), wherein:

- the derrick mast (11) has a longitudinal axis;

- the derrick mast (11) is pivotable mounted such that it can be pivoted between a transport position, in which the longitudinal axis (15) of the derrick mast (11) extends substantially horizontal and parallel to a longitudinal axis (4) of the chassis (3), and a working position, in which the longitudinal axis (15) of the derrick mast (11) extends in a vertical direction, substantially perpendicular to the longitudinal axis (4) of the chassis (3);

- the derrick mast (11), at a front side thereof defines a firing line (16), which firing line extends parallel to the longitudinal axis (15) of the mast (11);

- the drill floor mount (12) is located at the front of the derrick mast (11) for, when the derrick mast is in the working position, supporting a drill floor (13) such that the firing line (16) passes through an opening in the drill floor;

- the drawworks platform (14) supports the drawworks (17), and is mounted at the back of the derrick mast (11), such that the drawworks platform and the mounted drill floor extend in opposite directions relative to the longitudinal axis (15) of the derrick mast (11) when the derrick mast is in the working position;

- the derrick unit (10) is rotatable supported on the elongate chassis (3), such that the derrick unit, i.e. the erectable derrick mast (11), the drill floor mount (12), and the drawworks platform (14), gets rotated about an upright vertical rotation axis (18), which vertical rotation axis is

substantially parallel to the firing line (16) when the derrick mast (11) is in the working position, and which vertical rotation axis (18) is spaced relative to the firing line (16), such that by rotating the derrick unit (10) about the vertical rotation axis, the firing line can be moved along a curved trajectory having the vertical rotation axis (18) as its centre.

- 5 2. Mobile land rig according to claim 1, wherein the elongate chassis has at its rear end a stabiliser, preferably a stabiliser mounted at the centre of the chassis, which stabiliser is configured to support the rear end of the elongate chassis in a lifted support position, and which stabiliser is slideable connected to the chassis such that the chassis, while supported in the
- 10 substantially perpendicular to the longitudinal axis of the chassis.
3. Mobile land rig according to claim 1 or claim 2, wherein the derrick unit is provided with two stabilisers, which stabilisers, when deployed, extend in a direction away from the derrick mast, preferably such that, when seen in a top view, the firing line is located between the derrick mast and the stabilisers, more in particular between the derrick mast and the points at which the
- 15 stabilisers contact the surface.
4. Mobile land rig according to claims 2 and 3, wherein the rear end stabiliser and the two derrick unit stabiliser, when deployed, form a three point support for the derrick mast.
5. Mobile land rig according to one or more of the preceding claims, wherein the derrick unit further comprises an erection apparatus, preferably in the form of a cylinder, preferably a
- 20 hydraulic cylinder, which cylinder is with one end pivotable mounted to the drawworks platform and with an opposite end is pivotable to the derrick mast.
6. Mobile land rig according to one or more of the preceding claims, wherein the mobile land rig comprises a drive, preferably an electric drive, for rotating the derrick unit about the vertical rotation axis.
- 25 7. Mobile land rig according to claim 6, wherein the mobile land rig further comprises a centring device, which the centring device comprises a sensor, for example a camera, for determining the centre of the well, and comprises a control device for controlling the drive for rotating the derrick unit, wherein the control device is configured for rotating the derrick unit about the upright vertical axis to align the firing line with the centre of the well.

8. Mobile land rig according to claim 7, wherein the control device is connected with a drive for moving the elongate chassis by rotating one or more wheels and/or by moving the elongate chassis using a movably connected stabiliser at the end of the elongate chassis, to automatically position the firing line in line with the centre of the well.

5 9. Mobile land rig according to one or more of the preceding claims, wherein the elongate chassis further comprises a support surface for supporting equipment next to the derrick unit when the derrick unit is in a transport position.

10 10. Mobile land rig according to one or more of the preceding claims, wherein the firing line can be moved along the curved trajectory over an angle of at least 90 degrees, preferably over an angle of at least 120 degrees, more preferably over an angle of at least 180 degrees such that the firing line can be positioned at the back of the elongate chassis and on opposite sides of the chassis, wherein the angles preferably are divided in equal halves by the longitudinal axis of the chassis.

15 11. Mobile land rig according to one or more of the preceding claims, wherein the derrick unit is rotatable supported by a slew bearing, which slew bearing is provided between the elongate chassis and the derrick unit.

20 12. Mobile land rig according to one or more of the claims 1-10, wherein the derrick mast has a hollow base, and the elongate chassis is provided with a rotation axle, concentric with the vertical rotation axis, which rotation axle is received inside the hollow base of the derrick mast, and wherein one or more slew bearings are provided between the rotation axle and the base of the derrick mast, such that the derrick unit is rotatable supported on the rotation axle via the base of the derrick mast.

25 13. Mobile land rig according to one or more of the preceding claims, wherein the derrick mast comprises a base part and a top part, which base part and top part are pivotable or telescopically connected, such that the top part can be moved relative to the base part between a compact configuration, in which the top part is located adjacent the base part, and an extended configuration.

30 14. Mobile land rig according to one or more of the preceding claims, wherein the drill floor mount is moveably supported, such that it allows for the drill floor to be moved in a direction parallel to the longitudinal axis of the derrick mast.

15. Mobile land rig according to one or more of the preceding claims, wherein the road vehicle is a trailer for combination with a truck.

16. Method for drilling and/or servicing a well, using a mobile land rig according to one or more of the preceding claims, the method comprising:

- 5 - pivoting the derrick mast into its upright position;
- positioning the firing line of the derrick mast in line with the well by:
 - rotate the derrick unit about the vertical rotation axis and/or
 - driving the elongate chassis supported by its wheels
- using the stabilisers to lift the elongate chassis and support the elongate chassis in a lifted
- 10 working position;
- optionally: deploy stabilisers mounted to the derrick unit;
- extend the derrick mast and mount the drill floor at the front of the derrick mast such that the firing line passes through an opening in the drill floor;
- optionally: set up a tubular handling device, preferably including connecting the tubular
- 15 handling device with the mobile land rig at the well to provide a superstructure with increased rigidity for supporting torque loads during operation.

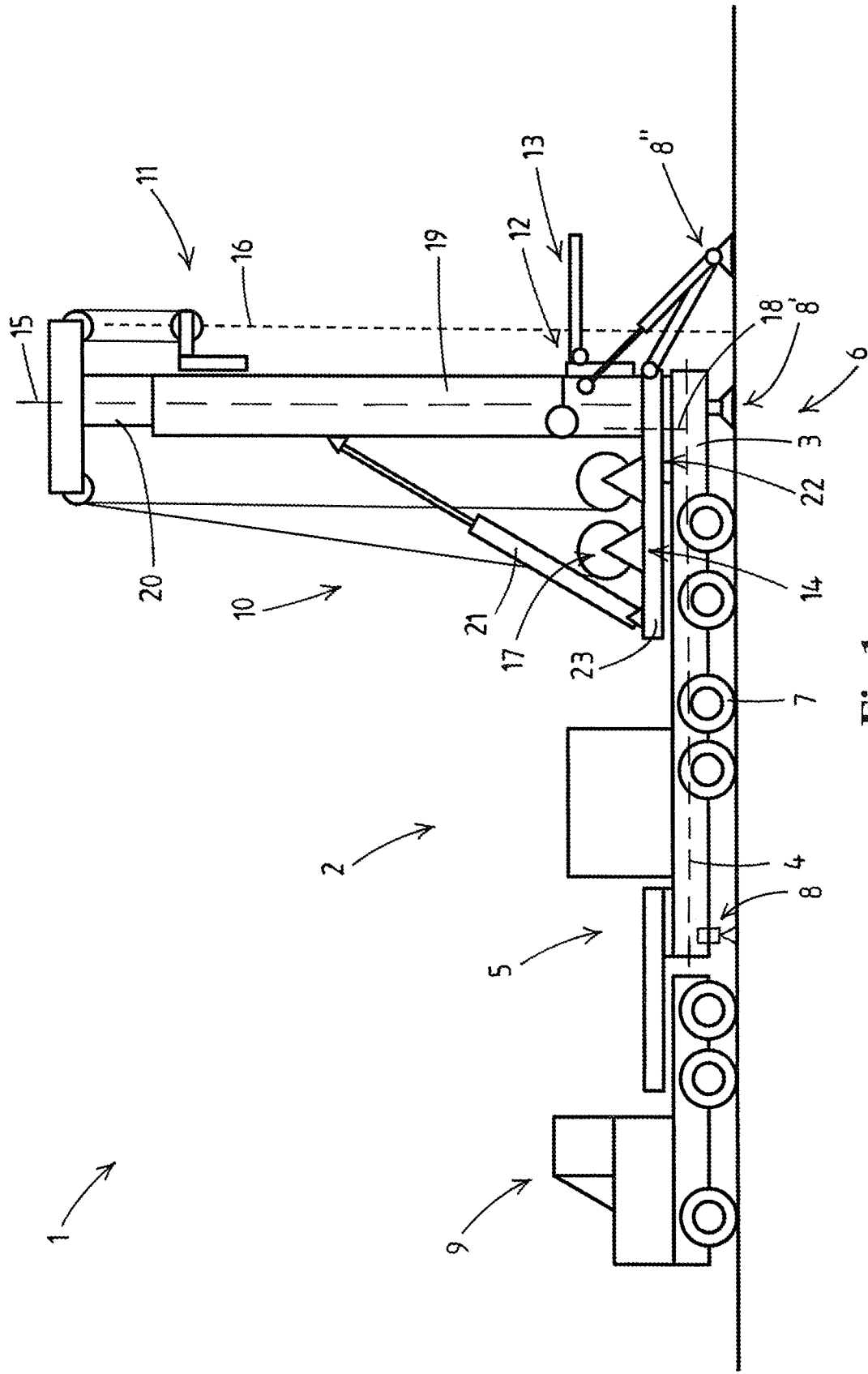
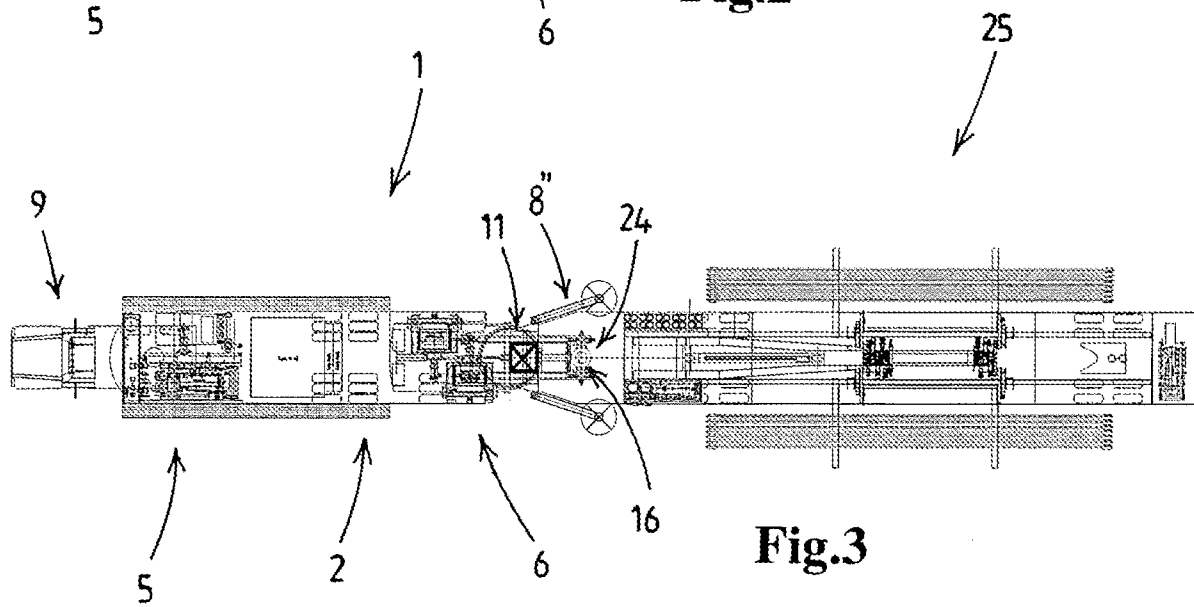
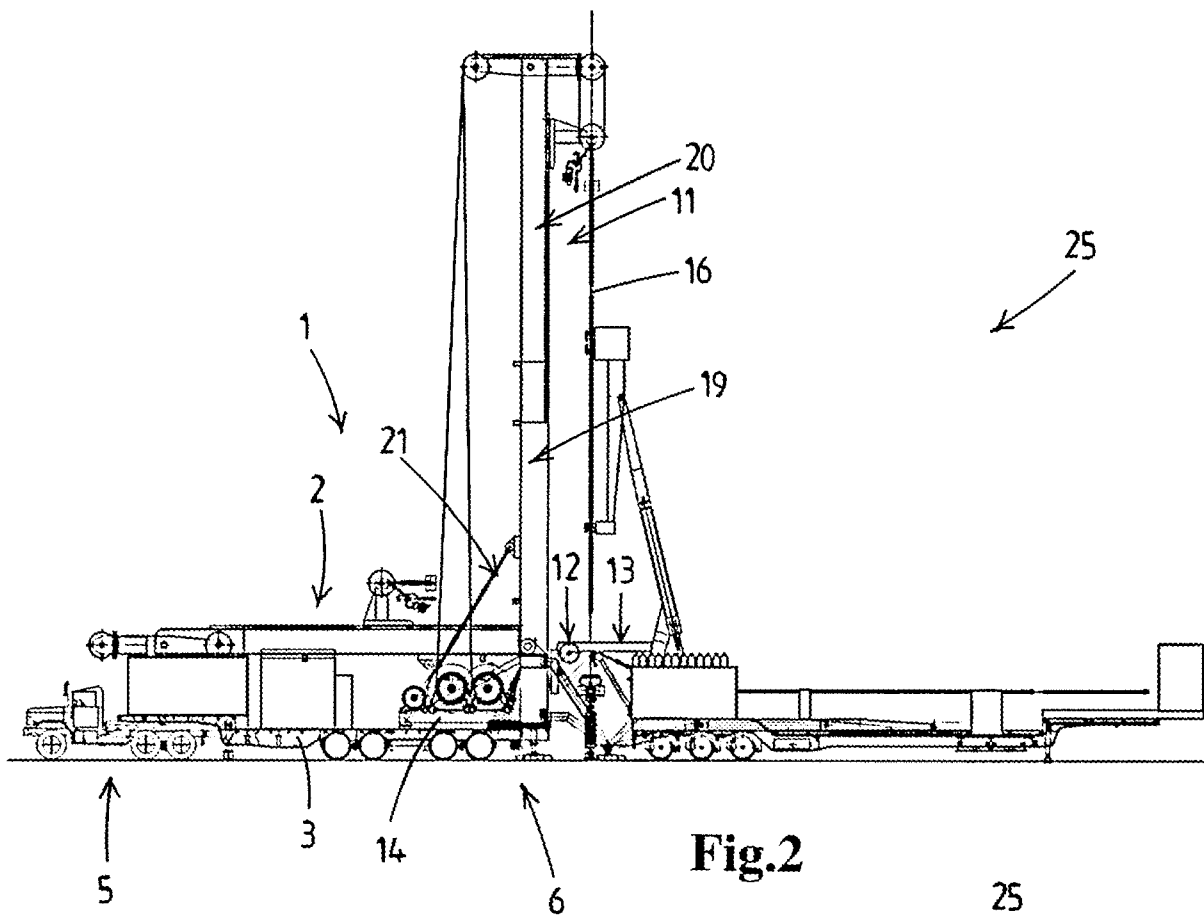


Fig.1



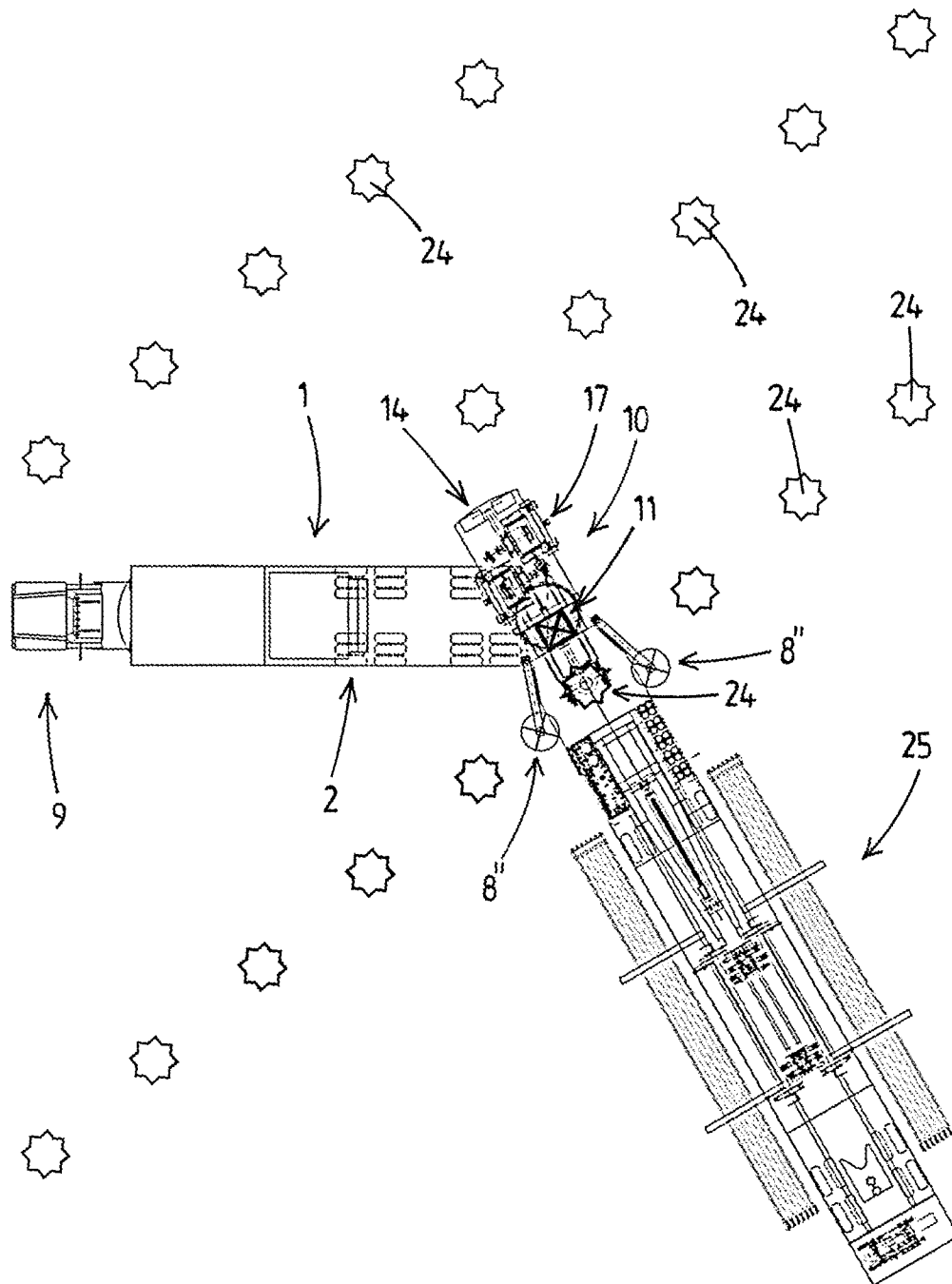


Fig.4

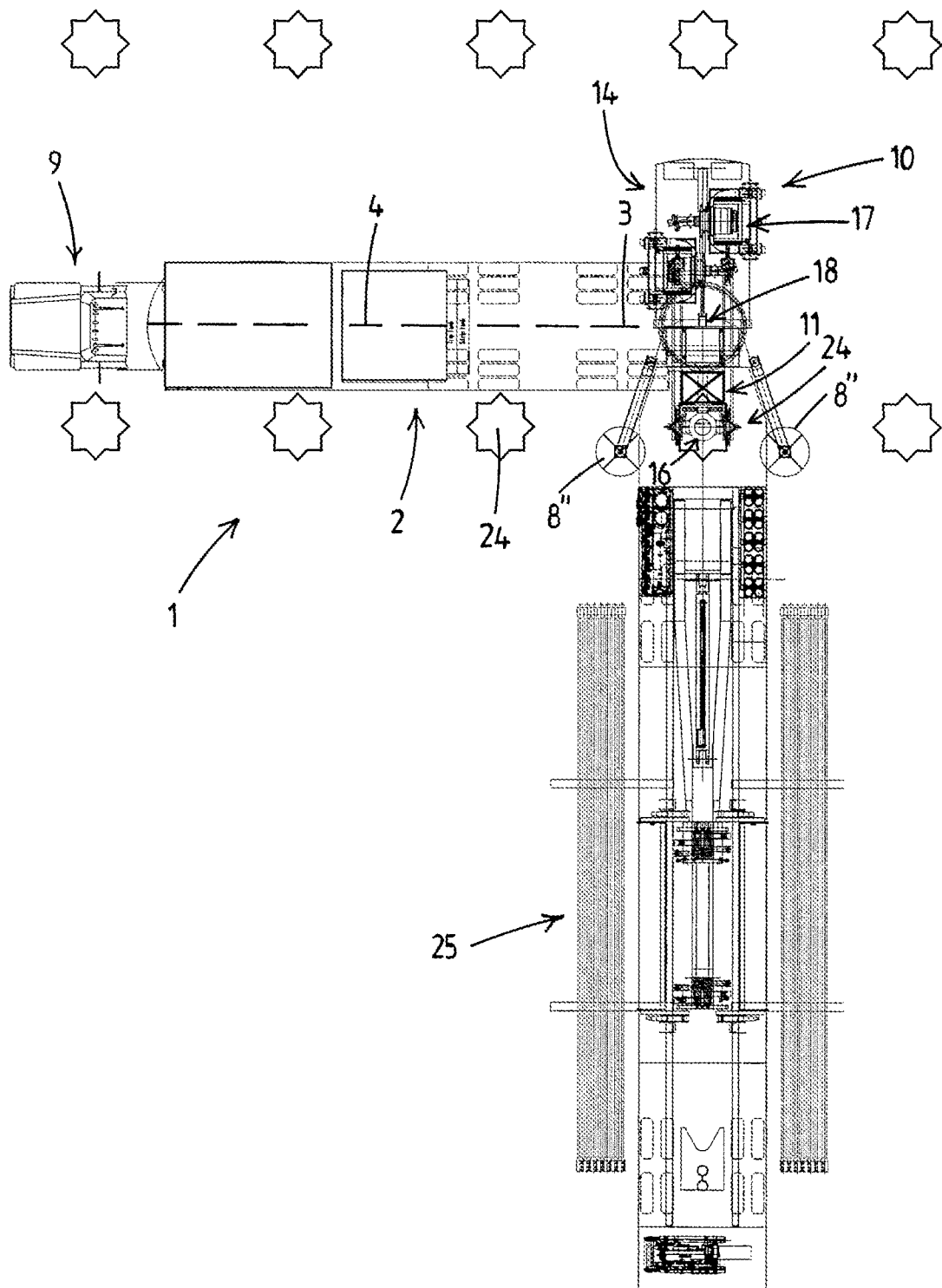


Fig.5

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2017/050745

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B7/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

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	-/--	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search

7 February 2018

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INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2017/050745

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Information on patent family members

International application No

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